Designing for Complex Needs of Vulnerable Populations: Considerations for Integrating Social Determinants of Health into Technology Design

OGHENEMARO ANUYAH, University of Notre Dame, USA
RONALD METOYER, University of Notre Dame, USA

Given vulnerable populations' growing reliance on technology and the complex nature of their social needs, it is critical that the research community develop solutions to address these needs, as these have an impact on their overall health outcomes. In this position paper, we discuss how the HCI community may integrate social determinants of health such as food security, education, and the physical environment into design solutions that address the complex needs of society's most vulnerable citizens.

CCS Concepts: • **Human-centered computing** → *Human computer interaction (HCI).*

Additional Key Words and Phrases: vulnerable populations, social determinants, social services, recommender systems, health, artificial intelligence

ACM Reference Format:
Oghenemaro Anuyah and Ronald Metoyer. 2018. Designing for Complex Needs of Vulnerable Populations: Considerations for Integrating Social Determinants of Health into Technology Design. In . CHI '22 Workshop on Designing Ecosystems for Complex Health Needs, 4 pages. https://doi.org/XXXXXXX.XXXXXXX

1 VULNERABLE POPULATIONS, TECHNOLOGY, AND COMPLEX NEEDS

Vulnerable populations (the economically disadvantaged, formerly incarcerated individuals, elderly, or homeless) are increasingly turning to digital technologies to gain access to social services–government-funded assistance that includes healthcare, housing, education, feeding, and employment [1]. When in need of these services, they rely on digital technology to contact service providers and to search for information online and on social media [2, 9]. Driven by the desire to improve their access to relevant resources within their community and the need for additional technology interventions in society today, several Human Computer Interaction (HCI) researchers have begun to focus on designing technology that can aid vulnerable citizens in their information seeking quest [6, 7, 16].

According to the literature, given the current structures in place for accessing social services, it is common for society's most vulnerable citizens to focus primarily on their most immediate needs [2]. This approach may miss important opportunities, however, given that vulnerable populations are known to have complex social needs many of which they don't even realize and have not been considered [2, 12, 15]. For example, vulnerable citizens with chronic health challenges (e.g., obesity) and needing health-related services are also likely to have other underlying social needs such as food security, employment, education, and housing, all of which can factor into their health outcomes [14]. In fact, there is evidence to show that social determinants of health (SDoH)–including income, education, employment status, food security, and home security–accounts for up to 40% of individual health outcomes and well-being, especially among vulnerable populations [3, 4]. Consequently, persons with unmet social needs are more likely to utilize the

Manuscript submitted to ACM

emergency room frequently, have no-show medical appointments repeatedly, and have lower glycemic and cholesterol management than those who get their needs met [15]. Hence, the research literature suggests that social needs and health outcomes are interrelated when it comes to vulnerable populations. This makes it essential to characterize complex health needs for vulnerable populations in terms of socio-economic factors. Further, it is important for the HCI community study ways to design technology that can improve their access to resources that address their social needs.

We focus our discussion in this position paper on three points in light of SDoH and for promoting access to relevant resources. First, designers can assist in addressing complex needs of vulnerable populations by designing solutions that enhance existing methods of interaction between community workers (e.g., health care providers) and their patients (vulnerable populations) [2]. This can give these experts the leverage to adequately gather and manage patient information and refer them to relevant resources based on their SDoH. Second, there are opportunities around addressing complex needs by fostering the sharing of information among vulnerable populations. This can serve as a way for them to learn about community resources from their trusted peers (e.g., availability of free food and jobs) [2, 10] and can potentially trigger healthy habits (e.g., through the sharing of health behavioral data) [14]. Third, there is potential for design to benefit from Artificial Intelligence (AI) for helping this complex needs population. Designers can leverage AI-based solutions to assist vulnerable populations to better articulate their social needs by providing them with search suggestions when they utilize referral systems. Designers can also use AI-based solutions to recommend other resources for patients based on SDoH, in addition to those that respond to their immediate needs. Based on these considerations, we anticipate that designing for this complex needs population will entail interdisciplinary efforts involving HCI, AI/ML, and Data Science researchers, as well as collaboration with both community workers (service providers) and vulnerable populations for design. We elaborate on these three points in the rest of this section. It is important to note that the majority of our discussion is based on a recent research study that we conducted.

1.1 Amplifying the practices of providers for managing information and interacting with clients during a referral

To capture information relating to their SDoH, providers must ask their patients relevant questions and record their information, before they are able to decide the types of resources that are best for them [15]. Prior research has demonstrated that service providers frequently use an ad hoc array of techniques to acquire information from their patients, which produces ineffective and unproductive results [2, 15]. In addition, it is common for community experts to rely on outdated, often inaccurate printouts from their websites or emails, or even the ubiquitous three-ring binder for gathering and storing information [2]. Unfortunately, these approaches make it challenging for them to effectively manage their patient information and have the most accurate information about available social services, which can be an hindrance to identifying social needs and referring patients to the right resources.

The HCI community can assist these experts by developing solutions to enhance and amplify their current practices, particularly in terms of managing client information and disseminating up-to-date social service information. One potentially fruitful avenue the HCI community could consider is to approach this problem from a knowledge management, knowledge transfer lens. Based on a recent research we conducted with service providers and vulnerable populations, our findings revealed that there is a strong need for tools oriented to local communities, and that community workers are in need of systems that can support them in creating organizational accounts, managing and transferring their institutional knowledge, creating communities of practice, and communicating and sharing expert knowledge directly with their patients [2]. Thus, there is an opportunity for HCI researchers to address this gap and study ways to build knowledge management and transfer practices into these distributed and informal communities of experts.

1.2 Assisting vulnerable populations with articulating their needs

To be referred to relevant resources that address their SDoH, patients have to articulate what they need. However, existing research has revealed that vulnerable populations often struggle to express what they need; with some of these struggles relating to their limited tech fluency and literacy skills [2, 5, 10]. When thinking of designing tools to help improve vulnerable populations' access to community resources, the research community must consider integrating functionality to help them initiate their search.

In search systems, it is typical for users to express their need in the form of a natural language search query. To capture vulnerable populations' search intent and help them in formulating searches, researchers can employ AI-based solutions such as query suggestion algorithms similar to those found in search engines like Google and Bing. For instance, as soon as they start typing a search query, the system will complete their search terms and present relevant query suggestions that likely captures what they intended to search for. Given that vulnerable populations struggle with tech fluency (are not perfect at typing on their computer or mobile phone) and have limited literacy skills (some may not have a higher education or have limited English proficiency), a known behavior they exhibit when searching for information is to misspell search keywords [2]. Hence, it is essential that query suggestions algorithms oriented to this population be trained to handle their misspellings, incomplete search terms, and vocabulary that they uniquely use to search for social services. Although researchers have explored search intent and suggestion of queries for users of search systems in general, to the best of our knowledge, they are yet to look into formulating searches on behalf of vulnerable populations in need of social services. Researchers must keep in mind that understanding the intent of vulnerable populations and generating relevant query suggestions for them is important, but may be challenging, because the same query should likely return different results for different patients (e.g., pregnant mothers and formerly incarcerated individuals). Thus, the algorithm should also consider the unique need of the person searching. Further, it will be important for the algorithm to be trained on social service search data to ensure that users are presented with relevant queries that capture their needs.

1.3 Promoting information sharing among vulnerable populations

One of the most prevalent ways by which vulnerable populations may learn about the availability of and location of community resources is through word-of-mouth [2, 10]. In fact, the authors in [2] found that social service information received from friends and family is preferred because they trust them. Beyond learning about community resources, research has also shown that sharing of information among vulnerable populations can also trigger healthy lifestyles. Saksono et al. [14], for example, created a fitness tracking app for low-income families and discovered that having the ability to share behavioral data about their fitness activities with the community encourages people to live healthier lives for reducing obesity and, as a result, improves health outcomes. These findings emphasize the importance of information sharing for vulnerable populations and the need for more technology interventions to support these behaviors. There is an opportunity to better understand how to use existing or create new social networking tools that meet the needs of these communities – protecting privacy, supporting specialized communication, and creating a digital community within their physical community.

To improve access to resources that can help vulnerable populations to fulfill their social needs, it is important that HCI researchers develop solutions that not only support these users in sharing information, but also ensure that the information they share is accurate. Sharing of correct information about community resources is especially important, because it can save these users from wasted trips to a no-longer-available service site [8] and can also prevent the spread of inaccurate information within the community [2].

1.4 Leveraging AI for recommending resources based on social determinants of health

According to a previous study conducted with vulnerable populations and community experts, people often search for the one service that meets their most immediate need, not thinking beyond that need to other associated needs. Most users, however, have multiple underlying social needs, some that they did not even realize that they need or are qualified to receive (e.g., disability support or formal clothing for a new job).

Designers can address this issue by suggesting resources to vulnerable citizens based on their current context of need and the SDoH [15]. When a patient requests a health-related service, for example, they may also receive suggestions to other relevant resources related to SDoH such as housing, employment, and food. Recommendation engines are the ideal technology that comes to mind when considering such a solution. Recommendation systems help people locate relevant information and make decisions where they may lack experience or not be able to consider all the data at hand [13]. For such a design, the algorithm must be trained with data from social services. Further, to ensure that the recommendations are personalized to each user need, designers must consider ways to obtain their contextual/personal information. For instance, a pregnant mother will have different needs from a homeless individual. Designers must also consider ways to protect user information, which is particularly important given the sensitive population [11].

REFERENCES

[1] Anneli Anttonen. 2017. Challenges and dilemmas in the provision of social services. In *Social Services Disrupted*. Edward Elgar Publishing.

[2] Oghenemaro Anuyah, Ann-Marie Conrado, Clinton Carlson, Jacob Rush, Madison McBride, Magaret Farrell, and Ronald Metoyer. 2022. Title anonymized for review. In *Under review*.

[3] Seth A Berkowitz, A Catherine Hulberg, Clemens Hong, Brian J Stowell, Karen J Tirozzi, Carine Y Traore, and Steven J Atlas. 2016. Addressing basic resource needs to improve primary care quality: a community collaboration programme. *BMJ quality & safety* 25, 3 (2016), 164–172.

[4] Bridget C Booske, Jessica K Athens, David A Kindig, Hyojun Park, and Patrick L Remington. 2010. Different perspectives for assigning weights to determinants of health. *University of Wisconsin: Population Health Institute* (2010).

[5] Tawanna R Dillahunt and Alex Lu. 2019. DreamGigs: Designing a Tool to Empower Low-Resource Job Seekers. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. 1–14.

[6] Sarah Fox and Christopher Le Dantec. 2014. Community historians: scaffolding community engagement through culture and heritage. In *Proceedings of the 2014 conference on Designing interactive systems*. 785–794.

[7] Christopher A Le Dantec. 2010. Exploring mobile technologies for the urban homeless. In *CHI'10 Extended Abstracts on Human Factors in Computing Systems*. 2883–2886.

[8] Nisha Mohan and Abhraneel Sarma. 2017. Elevate: Ensuring access to food for homeless populations. In *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems*. 80–85.

[9] Ihudiya Finda Ogbonnaya-Ogburu, Kentaro Toyama, and Tawanna Dillahunt. 2018. Returning Citizens' Job Search and Technology Use: Preliminary Findings. In *Companion of the 2018 ACM Conference on Computer Supported Cooperative Work and Social Computing*. 365–368.

[10] Ihudiya Finda Ogbonnaya-Ogburu, Kentaro Toyama, and Tawanna R Dillahunt. 2019. Towards an effective digital literacy intervention to assist returning citizens with job search. In *Proceedings of the 2019 CHI conference on Human factors in computing systems*. 1–12.

[11] Katheryn Margaret Pascoe. 2021. Considerations for integrating technology into social work practice: A content analysis of nine professional social work associations' Codes of Ethics. *International Social Work* (2021), 0020872820980833.

[12] Rubina Rizvi, Courtney VanHouten, Tiffani J Bright, Mollie M McKillop, Shira Alevy, David Brotman, Megan Sands-Lincoln, Jane Snowdon, Barbie J Robinson, Carolyn Staats, et al. 2021. The Perceived Impact and Usability of a Care Management and Coordination System in Delivering Services to Vulnerable Populations: Mixed Methods Study. *Journal of medical Internet research* 23, 3 (2021), e24122.

[13] Martin Robillard, Robert Walker, and Thomas Zimmermann. 2009. Recommendation systems for software engineering. *IEEE software* 27, 4 (2009), 80–86.

[14] Herman Saksono, Carmen Castaneda-Sceppa, Jessica A Hoffman, Magy Seif El-Nasr, and Andrea Parker. 2021. StoryMap: Using Social Modeling and Self-Modeling to Support Physical Activity Among Families of Low-SES Backgrounds. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. 1–14.

[15] Caitlin Thomas-Henkel and Meryl Schulman. 2017. Screening for social determinants of health in populations with complex needs: implementation considerations. *Center for Health Care Strategies* 10 (2017).

[16] Jill Palzkill Woelfer and David G Hendry. 2011. Designing ubiquitous information systems for a community of homeless young people: precaution and a way forward. *Personal and Ubiquitous Computing* 15, 6 (2011), 565–573.

,