Co-Designing M-Healer: Supporting Lay Practitioner Mental Health Workers in Ghana

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Abstract. Mental health is a vast problem around the globe and is one of the key population health issues in the world today. At any given time, up to 6.8% of the world's population suffers from a serious mental illness (SMI) such as schizophrenia or bipolar disorder. The impacts of SMI on a population are especially challenging in low and middle-income countries (LMIC). Mobile healthcare application research is a growing area of research aiming to ameliorate these challenging impacts. In Ghana, a LMIC in West Africa, mental healthcare systems are severely under-resourced and people with SMI often receive care from lay practitioners such as traditional and faith healers rather than trained mental health clinicians. These challenges exist alongside developed wireless infrastructure. In these contexts, mobile applications can substantially increase access to health information. This is the basis for our work developing a mobile health (mHealth) application to support mental health lay practitioners in Ghana. We describe the ways that our principled design research practice is intersecting with local faith-based practices, vernacular expertise and values, and the practicalities of technology adoption in Ghana.

Keywords: Mobile health · Mental health · Ghana

1 Introduction

By leveraging wireless infrastructure and available technologies, mobile applications can substantially increase access to health information, especially in under-resourced communities [7,19]. In particular, in many low- and middle-income countries (LMIC), challenges related to health care equity exist alongside strong

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wireless infrastructure. HCI work in the area of information and communication in developing contexts (ICT4D) advocates for (1) the critical importance of establishing strong collaborations with local stakeholders and (2) avoiding a "one size fits all" approach to technology design [26]. In describing our ongoing work designing and implementing a mobile app to support non-clinically trained spiritual healers in Ghana, we highlight ways that our principled design research practice intersected with local faith-based practices, vernacular expertise and values, and the practicalities of technology adoption in West Africa.

Mental illness is a significant global health problem. At any given time, up to 6.8% of the world's population suffers from a serious mental illness (SMI) such as schizophrenia or bipolar disorder [14]. These psychiatric conditions result in particularly devastating long-term impacts in LMIC [29]. In West Africa, hardships associated with SMI are compounded by pervasive societal stigma, scarce treatment options, and systematic neglect and abuse [20,21,23]. West African mental healthcare systems are severely under-resourced leading to substantial unmet mental health needs [10,12,13,25]. People with SMI often receive care from traditional and faith healers rather than trained mental health clinicians [11,18,22]. Previous research in Ghana found that stakeholders from all sectors (patients, providers, government officials, and faith healers) were open to exploring mobile health approaches to improve the clinical outcomes of those in need [3].

To address this gap, we are developing a smartphone intervention, M-Healer, to provide local healers with educational content and practical tutorials for techniques such as de-escalation, deep breathing, and re-framing anxious thoughts. Our goals are two-fold: (1) to reduce human rights violations commonly associated with the care of people with SMI in LMIC [8,28] by providing information about more humane alternatives and (2) to evaluate the impacts of a mobile app on treatment outcomes for individuals with SMI in West Africa.

2 Related Work

Health information and interventions delivered via mobile systems (mHealth) have the ability to improve mental health-care outcomes [5,9,15]. A systemic review and meta-analysis of randomized controlled trials that used smartphone applications to treat symptoms of anxiety found that the most successful programs combined mobile content with the delivery of face-to-face interventions [9]. A team of researchers responding to a large treatment gap in mental health in Zimbabwe (approximately 10 psychiatrists for a population of 13 million) investigated if lay health workers delivering psychological interventions using a form of cognitive-behavioral therapy (CBT) could improve symptoms of depression and anxiety. Participants were taught a structured approach to identifying problems and finding workable solutions through 4 individual sessions, first with lay health workers then in peer-led groups. The study concluded that primary care administered by lay health worker combined with education and support resulted in improved symptoms at 6 months [6].

Our approach involves local stakeholders in the app design process. Related work uses similar co-design methodology. Two case studies in Mozambique and in Romania [27] document procedures, successes, and hurdles of community-based participatory design. In Romania, hierarchy in social interaction and decision-making led to some participants not feeling empowered to engage fully in the design process [27]. In contrast to the intended impact, participatory and co-design methods highlighted lack of agency experienced by people the process was meant to empower. However, a co-design study in rural South Africa focused on a billing system for voice services provided by a community network shows that the co-design process can result in an intervention that is usable and integrated with local culture [24]. Another group of researchers used co-design methods to enhance communication between mothers and Neonatal Intensive Care Unit (NICU) staff in South Africa [16]. While researchers noted that co-design sessions seemed to make participants feel more comfortable about contributing substantively, they also observed that junior nurses did not feel free to critique ideas of more senior members of the healthcare system [16]. In response, researchers introduced a card-sorting method to encourage group cohesion.

3 Methodology

During fall 2019, members of our team traveled to Ghana to (1) learn more about the context in which our intervention would be implemented and (2) conduct co-design sessions with local stakeholders. As a result, we were able to compile a set of system, interface, and content requirements for a fully functional prototype. User feedback sessions with target users were conducted during summer 2020. User feedback sessions were conducted on-site by collaborators from the University of Ghana, in accordance with WHO recommended COVID-19 preventative practices. This work was approved by the Institutional Review Boards of the University of Washington and the University of Ghana.

3.1 Design Research and Requirements Gathering

Prior to field work, We conducted survey of digital infrastructure requirements, focusing on the likelihood of certain technologies being readily used, data and storage constraints, and other factors that would constrain the future application development. Our team also completed a series of design research activities aimed at better understanding Ghanaian culture, care and treatment of people with mental health issues in West Africa, common practices of faith healers that provide care to individuals with SMI, and the nature of relationships among clinicians, religious leaders, and policymakers. Interview protocols and elicitation materials drew on the team's previous work in Ghana [3], mHealth literature, and user-centered technology design best practices.

In Ghana, interviews and verbal prototyping sessions with 18 faith healers took place at three prayer camps located just outside the capital of Accra. Field

work culminated with a half day co-design focus group with 12 healers representing each of the three camps. During these activities, the research team met daily to discuss findings and to reflect on qualitative and design methods as they unfolded. These discussions were documented in field notes and serve as the primary source of data for the emergent themes we highlight here.

3.2 System Design

In response to design research insights, emergent co-design concepts, and requirements gathered on site, we developed the M-Healer prototype to be a stable and self-contained Android platform. The android platform was chosen because it is estimated to have 84% of the mobile operating system market share in Ghana [17]. Due to low broadband support and costs associated with data plans in West Africa, the application was built to be self-contained with content delivered via optimized and light-weight animated videos downloaded with install files. This means that M-Healer has no backend functionality, API integration, or database connections. The user interface was also designed dark mode first as dark mode has shown to be more efficient in battery consumption [1]. See Fig. 1.

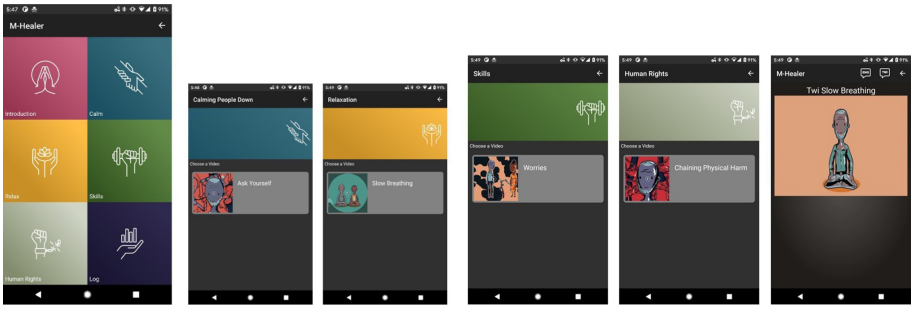


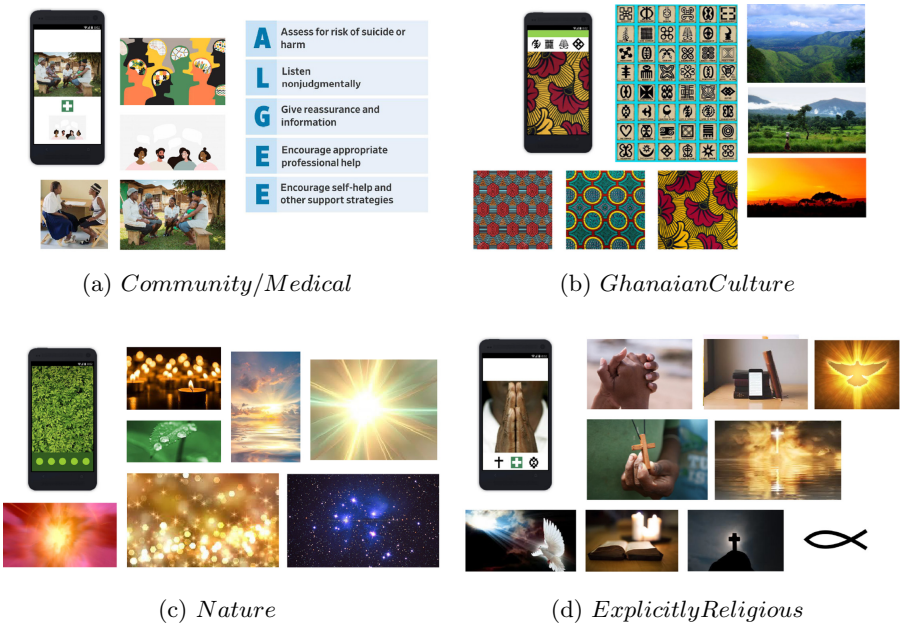
Fig. 1. Functional prototype

The application was written in Kotlin, the official android platform development language. A benefit of Kotlin, as opposed to Flutter or React Native, is that it is optimized for performance across all android phones. It scores better on performance metrics such as CPU usage, memory use, battery efficiency, all vital for an app operating in environments with limited access to power and data connectivity. Additionally, Kotlin typically leads to a codebase that is more compact and concise than traditional java android applications [2]. Kotlin has also shown the ability to reduce the frequency of Null Pointer Exceptions [2] which is often a hurdle in Java Android development. The application's user interface design was built using a modified version of Google's Material Design language. The app uses Material Design system icons and square buttons in a grid-like layout with flat lateral navigation flows. The main navigation buttons are also

relatively larger than the traditional Material Design button size with the six of them each evenly taking up 16.67% of the screen for ease of clicking.

The M-Healer application itself consists of a home screen where users have the option to click on six buttons that each correspond to a content bucket. Content areas, established in collaboration with stakeholders, include de-escalation and relaxation techniques, tutorials on alternatives to problematic practices such as physical restraints and forced fasting, and general education regarding human rights in the care of people with SMI. Original content was aligned with, but did not explicitly refer to, religious messaging and language discussed during interviews and co-design sessions. From content landing pages, users can choose from a list of videos, accessed through a video player integrated in the application. Users also have the option to switch video language between Twi (a common spoken language in the southern region of Ghana) and English.

Documentation, including (1) key path information architecture, (2) style guide for implementing preliminary M-Healer branding, (3) examples of animated video and text content, and (4) specifications for loading the free-standing app onto smart phones, was written for non-technical audiences and tested with clinical research colleagues at the University of Ghana.



(a) *Community/Medical* (b) *GhanaianCulture*

(c) *Nature* (d) *ExplicitlyReligious*

Fig. 2. Four visual motifs

4 Preliminary User Feedback

An initial set of user feedback findings emerged from our fieldwork. While still in Ghana, we created a series of five visual design directions for the look and

feel of the app, ranging from highly medicalized to explicitly religious, as shown in Figs. [2a, 2b, 2c, 2d]. The explicitly Christian imagery (e.g., a bible, a dove, and a wooden cross) was very popular with focus group participants. However, several of the faith healers argued that the design concept that drew on images of nature (e.g., water droplets on grass blades, sun beams bursting from behind clouds, glowing candle flames) would be the most accessible option for prayer camp leaders of different faiths, such as Islam and traditional religions, who are also intended users of the app.

Once we had a functional prototype of the app, our colleagues in Ghana took it to our primary stakeholders to gather feedback. The protocol focused on assessing the interface and content for usability issues. Several users mentioned being excited about the application and could envision themselves using the application on a daily basis. Users were mostly able to navigate through the application, access the video content, and summarize the video content [4]. However, the testing sessions took place on phones not owned by the participants which caused minor hurdles for some. The video content was found to be broadly acceptable and useful for the participants. Participant feedback on how to improve the design of the application was focused on the meaning of icons and the dark background. The previously cited paper also found some of the participants had trouble understand the connection between specific icons and content areas. Additionally, one participant mentioned that the main application icon was blurry. Some participants also mentioned the colors in the application being a bit dark, noting that a brighter interface could be easier to see for users with vision problems. Finally, when participants were asked about future features in the application, they mentioned wanting more spoken voice cues describing different modules of the application. Participants described future iterations of the application that might include these features as intriguing and exciting.

4.1 Influence of Technical Constraints on Design Process

One of the major technical constraints on our application development process was the need to balance infrastructure requirements with design of an engaging user experience. For complex interventions that require having access to dynamic data or more extensive software architecture designs, balancing these types of design requirements can be challenging. This project forced our mobile app development team to rethink assumptions, both implicit and explicit, about the ubiquity of reliable data connections and power sources. Thinking about workflows and processes to easily incorporate people and environments that do not have access to traditional development tools is valuable for future endeavors.

In the case of M-Healer, the environment in which our application operates lacks consistent access to a mobile grid and power. Therefore, content was integrated into the application itself and loaded at startup. Because we identified this limitation early in our development process, we were proactive about considering implications in all aspects of our design. Application file size became a primary design requirement throughout the development process, playing a role in decisions from color to length of scripted animations.

Building the application with these design constraints also meant having to go without some of the usual tools associated with Android development. With no backend to the project, the application had to be manually loaded onto phones. Without typical manual processes used with Google Developer Console tools, the application was shared in APK form and installed directly on devices by colleagues in Ghana. Tracking usage data such as clicks without using Google Analytics or another user data tracking API was also a challenge. For applications that operate in resource-constrained environments like ours, devising extensible tracking methods that do not require connectivity is particularly challenging. This continues to be a major focus of our work as we prepare to roll out a large-scale field trial of the M-Healer intervention.

4.2 Code-Sharing and Workflow

In future stages of the app development, we will prioritize introducing concrete code-sharing plans and workflows that are both accessible to non-technical team members and in line with traditional software development tools (i.e., Git Hub). Two factors made it necessary for the code base to be more available to the full team than perhaps is typical for app development projects like this: (1) close coordination across design activities (i.e., platform, interface, brand/identity, content) resulted in an iterative process involving multiple cycles of code updates and evaluation by the team and (2) user feedback sessions run by local collaborators who are trained as clinicians rather than technologists made it necessary to package a preliminary release of the app in a format that was easy to extract and install. From an application development standpoint, a key hurdle was sharing code. With only one member of our team experienced in the Git environment, a lot of code was shared over email, making version control very challenging.

Gathering and responding to software bug fixes also presented challenges. The team members tasked with installing the preliminary version of the application on phones in Ghana mainly used WhatsApp for communication among themselves and with other international team members. This meant issues, fixes, and eventually updated software were frequently shared over WhatsApp. During this process, we noticed that as a chat and messaging platform WhatsApp was not quite as optimized for developer communication as is a platform like Slack. For instance, Slack has a feature called Share Code Snippets that allows users to share code snippets and have the code appear very similar if not the same as it does in the development environment it was copied from. An interesting solution for this issue would be for WhatsApp to add more features to support software developers and create an identity for itself as the communicating platform of choice for international software development.

4.3 Innovation and Broadening Impacts of User Centered Design

Initial user feedback was elicited and gathered by Ghanaian members of our team who are clinical psychologists familiar with the contexts of the prayer camps but with limited exposure to user centered design practice. Members of

our team trained in usability studies attempted to craft a protocol that was clear, concise, and easily understood by both the clinicians eliciting feedback and the participants providing it. While these questions did provide some insights into what was working and what was not in the preliminary version of the app, we recognize that mastering techniques for follow-up questions and clarifications can be challenging, even for very experienced designers. Additionally, questions were written in English and translated to Twi in the moment. For the most part, responses were given in Twi, and were then translated by researchers, sometimes at that time and sometimes later, when notes were compiled on standardized data sheets to send to colleagues in the U.S. As we have reported, participants in this initial round of user feedback interviews found the application usable and feasible. We are confident that this feedback is reliable, while at the same time looking forward to larger scale field tests where we will have the opportunity to refine our approach so that participants can give us more pointed feedback regarding alternatives to navigation, graphic design, and visual identity.

For example, we used a modified fusion of Microsoft's Metro and Google Material Design. While a current design trend in mobile development is bottom navigation using a carousel of selectable icons, our application differs quite a bit from this trend and uses large evenly space squares for navigation through the main content. Future testing could compare both navigation methods in terms the accessibility issues most commonly experienced in this content. Further, future rounds of user feedback will include training in user centered design to local colleagues, and ideally direct observations of the app being used in situ. From a software engineering standpoint, this project can be used as an example of thinking about innovation and accessibility in different ways. To make this intervention feasible it required thinking about innovation from the standpoint of resource-constrained environments, users with low literacy and experiences with technology distinct from Western user groups . In this context, our innovation focused on permanence, longevity, and cultural competence rather than speed, accuracy, or monetization. This app development project has been a platform for our design team to explore the ways that constraints can enable us to shift the focus of innovation from "the next new feature" to broadening the impacts of user centered design insights.

5 Conclusion

Our methods were selected for their capacity to (1) avoid a "one size fits all" approach to mHealth technology design and (2) support strong collaborations with local stakeholders. However, we also recognize that our work exists and relies on the global mobile telecommunications industry, including its endemic inequities. Preliminary user feedback and emergent themes resulting from our design research approach signal potential for this work to contribute a methodological resource for HCI researchers working in the areas of ICT4D, mHealth for mental health, and supporting personal informatics for vulnerable populations. We offer them here as a signal of the value we see in case studies of DEI efforts.

References

1. URL. https://www.cnet.com/news/using-androids-dark-mode-improves-battery-life-google-confirms-p/
2. Ardito, L., et al.: Effectiveness of Kotlin vs. Java in android app development Tasks.. Inf. Softw. Technol. **127**, 106374 (2020). https://doi.org/10.1016/j.infsof.2020.106374.
3. Ben-Zeev, D.: Mobile health for mental health in west Africa: the case for Ghana. Psychiatr. Serv. **69**(7), 741–743 (2018). https://doi.org/10.1176/appi.ps.201700555.
4. Ben-Zeev, D., et al.: Development of M-Healer: a digital toolkit to improve care and reduce human rights abuses against people with mental illness in West Africa. JMIR Mental Health **8**(7), e28526 (2021)
5. Ben-Zeev, D., et al.: Feasibility, acceptability, and preliminary efficacy of a smartphone intervention for schizophrenia. Schizophrenia Bull. **40**(6), 1244–1253 (2014)
6. Chibanda, D., Weiss, H.A., Verhey, R.: Effect of a primary care–based psychological intervention on symptoms of common mental disorders in Zimbabwe: a randomized clinical trial. JAMA **316**(24), 2618–2626 (2016). https://doi.org/10.1001/jama.2016.19102
7. Donker, T., et al.: Smartphones for smarter delivery of mental health programs: a systematic review. J. Med. Internet Res. **15**(11), 247 (2013). https://doi.org/10.2196/jmir.2791
8. Esan, O., et al.: A survey of traditional and faith healers providing mental health care in three sub-Saharan African countries. Soc. Psychiatry Psychiatr. Epidemiol. **54**, 395–403 (2019). https://doi.org/10.1007/s00127-018-1630-y, PMID: 30456425
9. Firth, J., et al.: Can smartphone mental health interventions reduce symptoms of anxiety? A meta-analysis of randomized controlled trials. J. Affective Disord. **218**, 15–22 (2017). https://doi.org/10.1016/j.jad.2017.04.046
10. Gureje, O., Lasebikan, V.: Use of mental health services in a developing country: results from the Nigerian survey of mental health and well-being. Soc. Psychiatr. Psychiatr. Epidemiol. **41**(1), 44–49 (2006)
11. Gureje, O., et al.: The role of global traditional and complementary systems of medicine in the treatment of mental health disorders. Lancet Psychiatr. **2**(2), 168–77 (2015)
12. Samba, D.: Ibadan, Nigeria, University College Hospital, Department of Psychiatry, Mental Health Leadership and Advocacy Programme (mhLAP). http://www.mhlap.org/country-of-activities/gambia (2012)
13. Johnson, K., et al.: Association of combatant status and sexual violence with health and mental health outcomes in postconflict Liberia. JAMA **300**(6), 676–690 (2008)
14. Kessler, R.C., et al.: The global burden of mental disorders: an update from the WHO World Mental Health (WMH) surveys. Epidemiol. Psychiatr. Sci. **18**(1), 23–33 (2009)
15. Kola, L., Abiona, D., Adefolarin, A., Ben-Zeev, D.: Mobile phone use and acceptability for the delivery of mental health information among perinatal adolescents in Nigeria: survey study JMIR Ment. Health **8**(1) (2021). https://doi.org/10.2196/20314
16. Mburu, C.W., et al.: Co-designing with mothers and neonatal unit staff: use of technology to support mothers of preterm infants. In: Proceedings of the Second African Conference for Human Computer Interaction: Thriving Communities (AfriCHI 2018). Association for Computing Machinery, vol. Article 12. New York, NY, USA, pp. 1–10 (2018). https://doi.org/10.1145/3283458.3283487

17. Mobile Operating System Market Share Ghana. Accessed 25 Nov 2020. https://gs.statcounter.com/os-market-share/mobile/ghana
18. Ae-Ngibise, K., et al.: Whether you like it or not people with mental problems are going to go to them: a qualitative exploration into the widespread use of traditional and faith healers in the provision of mental health care in Ghana. Int. Rev. Psychiatr. **22**(6), 558–567 (2010)
19. Norris, L., Swartz, L., Tomlinson, M.: Mobile phone technology for improved mental health care in South Africa: possibilities and challenges. South African J. Psychol. **43**(3), 379–388 (2013). https://doi.org/10.1177/0081246313493376
20. Esan, O., et al.: Mental health care in Anglophone West Africa. Psychiatr. Serv. **65**, 1084–1087 (2014)
21. Ofori-Atta, A., et al.: A situation analysis of mental health services and legislation in Ghana: challenges for transformation. African J. Psychiatr. **13**(2), 99–108 (2010)
22. Read, U.: I want the one that will heal me completely so it won't come back again: the limits of antipsychotic medication in rural Ghana. Transcultural Psychiatr. **49**(3–4), 438–460 (2012)
23. Read, U.M., Adiibokah, E., Nyame, S.: Local suffering and the global discourse of mental health and human rights: an ethnographic study of responses to mental illness in rural Ghana. Globalization Health **5**(1), 13 (2009)
24. Rey-Moreno, C., et al.: Co-designing a billing system for voice services in Rural-South Africa: lessons Learned. In: Proceedings of the Fifth ACM Symposium on Computing for Development (ACM DEV-5 2014). New York, NY, USA: Association for Computing Machinery, pp. 83–92 (2014). https://doi.org/10.1145/2674377.2674389
25. Roberts, H.: A way forward for mental health care in Ghana? Lancet**357**, 1859 (2001)
26. Rusatira, J., et al.: Enabling access to medical and health education in Rwanda using mobile technology. Needs Assessment Dev. Mob. Med. Educator Apps JMIR Med. Educ. **2**(1), e7 (2016). https://doi.org/10.2196/mededu.5336.. https://mededu.jmir.org/2016/1/e7
27. Sabiescu, A.G., et al.: Emerging spaces in community-based participatory design: reflections from two case studies. In: Proceedings of the 13th Participatory Design Conference: Research Papers 1. PDC 2014, pp. 1–10 (2014). https://doi.org/10.1145/2661435.2661446
28. Human Rights Watch. Living in chains: Shackling of people with psychosocial disabilities worldwide. ISBN: 978-1-62313-8653, 6 October 2020
29. Whiteford, H.A., et al.: Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. Lancet **382**(9904), 1575–1586 (2013)