

Community Dynamics in Technospiritual Interventions: Lessons Learned from a Church-based mHealth Pilot

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ABSTRACT

HCI researchers have increasingly examined how social context shapes health behaviors. Much of this work operates at the interpersonal level. Communities such as churches play important roles in supporting wellbeing and addressing health inequities. While some work has investigated creating digital health tools for religious populations, few have explicitly focused on the incorporation of community support in the form of prayer support. Embedding health interventions in any community has the potential to support or challenge the community’s dynamics. We report on findings from interviews with 17 church members who used a church-based mHealth application over a 4-week period and provide guidelines for developers based on these results. Through their use of the system, participants characterized several community dynamics including a desire for social intimacy, communicating care, creating opportunities for fellowship, maintaining privacy and discretion, and building community connections, and how these dynamics influence their aspirations for a church-based health app.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**; • **Social and professional topics** → *Religious orientation*.

KEYWORDS

mHealth, faith-based, community dynamics, technospiritual, African American, Black, social capital, historically marginalized communities

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1 INTRODUCTION

Researchers within and outside of the Human-Computer Interaction (HCI) community have examined how technology, especially mobile applications, can support wellbeing in health domains such as but not limited to substance use [76], mental illness [109], and maternal and child health [20]. This work has increasingly been driven by an appreciation for the social context of health promotion, understanding that an individual’s social network and social ties can either advantage or disadvantage them [6, 8, 31]. Much of this work has examined interpersonal relationships in diverse health contexts and how these relationships and their influence should be considered in the context of digital health [6, 74]. We acknowledge that digital health can take on different meanings especially in transdisciplinary research areas. For the purposes of this work, digital health is defined as the use of “information and communications technologies (ICTs) in medicine and other health professions to manage illnesses and health risks and to promote wellness” [91]. Digital health is intentionally broad in definition and scope as it includes but is not limited to the use of wearables, mobile health (mHealth) applications, web-based applications, and telehealth etc [91]. Research efforts in digital health are driven by work showing the advantages of both tangible and emotional social support, and the association of such support with positive health outcomes, e.g., improved weight management and increased physical activity [4], and reduction in postnatal depression [19]. An individual’s close, trust-based personal network not only assists in reducing negative health outcomes through social influence and social support, but also provides access to health-enhancing material resources and knowledge, known as *social capital* [31]. Communities with high-levels of social capital can promote normative health behaviors through the rapid spread of new health information and community social norms and practices, and have the resources and skills to enact social change when necessary [8, 31].

In many communities in the United States (U.S.) churches are key sources of social capital and support, providing services and resources such as food, shelter, legal support and informal healthcare opportunities to both church members and the broader community [15]. In particular, churches play a central role in the Black

community in the U.S., driving social action and community mobilization efforts to reduce social inequities and supporting political justice efforts [15, 87, 102]. Beyond explicit community health promotion efforts, churches represent key cultural institutions where members connect through their shared experiences to exchange social support including spiritual and prayer support. This type of community support [32] has become even more critical during the COVID-19 pandemic where Black, Indigenous, and People of Color (BIPOC) have experienced significantly higher rates of disease, disability, death, and economic disruptions than their white counterparts [22, 72]. While health promotion programs in predominantly Black church communities have demonstrated some success, these programs are constrained by the church’s capacity (e.g., funding, volunteer burn-out, limited access to resources), and are accessible only to those members who can regularly attend church events [13]. These barriers significantly limit the ability of such programs to scale and sustainably serve church communities.

ICTs offer opportunities for addressing these challenges, presenting cost-effective ways of connecting church members and enabling greater access to and engagement with social and health promoting resources. Churches and their community members have increasingly adopted ICTs inside and outside of formal worship settings, as is reflected in a growing body of technospiritual research, i.e., technologies that support individual and/or collective spiritual practices or experiences [7, 114]. Since the COVID-19 pandemic, some faith communities have adopted remote worship practices using Facebook Live, YouTube, or Zoom video conference software [46]. Some of these remote practices have allowed church members to continue small group meetings and other fellowship efforts typically found within the walls of the church. These trends together with increasing smartphone ownership [18] and the historically central role of churches in Black communities, present opportunities for exploring how digital health tools can address health disparities in church contexts. While some work has explored creating digital health tools for religious populations [7, 14, 58, 78, 114], few have explicitly focused on the incorporation of spiritual and prayer support as part of a health intervention. Moreover, these tools rarely incorporate a focus on spirituality, religious practice, or faith communities, despite the vast number of digital health interventions and products that have been created commercially and in research projects. Given the previously stated health promotion benefits and affordances that churches offer, there is a significant opportunity to investigate how digital health tools can be anchored in faith communities and designed to support a *whole-person* orientation of care, one that addresses multiple aspects of the person and their context including spiritual dimensions and is not strictly biomedical [32, 104]. In using the term *whole-person*, we do not suggest that we have addressed all dimensions of health and wellbeing. Rather, our work examines how an application that incorporates a trifold focus on wellbeing, community support, and spiritual practices can provide value to church members by addressing their physical, social, and spiritual wellbeing.

We report on a 4-week field study that is part of a larger iterative design process with participants from two predominantly Black church communities. Through an ongoing multi-year community-engaged research project, we are investigating how technology can be co-designed to support health and wellbeing in historically Black

church communities. We refer to health and wellbeing using the World Health Organization’s multifaceted definition of health as “a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity” [82], and the United States Center for Disease Control’s working definition of wellbeing which describes wellbeing as an individual’s self-perceived “satisfaction with life, fulfillment and positive functioning” [33]. In this paper, we will use the terms “health” and “wellbeing” interchangeably to describe an approach that includes physical, social, and spiritual health. We include the CDC definition to acknowledge the value of an interpretivist orientation towards studying these concepts, that recognizes the importance of individuals’ subjective interpretation of their functioning.

Our formative work revealed that our stakeholders (church members and leaders) view health and wellbeing as interconnected concepts that are inextricably linked to spirituality. As such, we developed an application—Church Connect—that supports bodily health in a manner that features community support and spiritual practices. In this paper we report on participants’ experiences using Church Connect for four weeks, after which we conducted semi-structured interviews with participants. Our findings address the following research question: How can technology be designed to support physical, social, and spiritual wellbeing within church communities?

In answering this research question, our work makes empirical and design contributions that can help spur future HCI research at the intersection of health, community, and spirituality. First, our findings characterize a set of community values and *dynamics*—processes through which communities change and develop—that shaped the way participants wanted to use the health, community, and spirituality features within the Church Connect application. Our findings further demonstrate how these values and dynamics can in turn be shaped through engagement with the app. We contribute a set of community-level dynamics and values that are salient to church-based digital health intervention design, as well as to directions for future work that investigates and engages community values and dynamics when creating faith-based digital health tools in churches and other community settings. Second, our findings characterize the value of digital health tools that jointly empower people to pursue their physical and spiritual health, and community aspirations. We use these findings to articulate future directions for how to design digital health tools that take a multidimensional approach to care.

Our third contribution lies with our focus on digital health promotion within historically Black church communities. The Black Church is a rich and important cultural environment. However, it is an environment that has rarely been studied within HCI, computer-supported cooperative work (CSCW), and digital health research. Little digital health research has examined how to amplify the strengths of these communities, or explored what important considerations must be made so that any technology introduced does not disrupt current community dynamics and processes. Given the increasing work in the areas of technospiritual design, digital health, and social computing, work is needed to determine how technology can meaningfully and respectfully engage Black churches to enrich physical, community, and spiritual wellbeing. Our work represents an initial step in this space; we contribute a case study of digital

health design and evaluation in Black church communities, the findings from which we use to suggest directions for future inquiry and design in this space.

Lastly, our qualitative findings characterize the value of digital tools that jointly empower people to pursue their spiritual, health, and community aspirations. We use these findings to articulate future directions for the design of digital health tools that take a broad approach to care.

2 RELATED WORK

Until recently, faith-based health promotion had not been translated to technology-enabled interventions. To date, few efforts explore the value of grounding digital health interventions in specific community contexts like church communities [53, 99]. Our work explores the acceptability of an app that supports health in a manner that is grounded in a church-setting, and how existing community values may shape use of the Church Connect app. In the following sections, we provide an overview of technology developed to actively build social capital in communities, health promotion technologies situated in community contexts, church-based health promotion programs, and existing faith-based health promotion technologies. Terminology used within this overview is consistent with the respective citations (e.g., Black or African American).

2.1 Social Approaches to Health Promotion

Digital health research has traditionally focused on the individual. Indeed the proliferation of self-quantifying, self-reflection, and self-improvement technologies have been egocentric with the user interacting directly with the technology [74]. Increasingly, researchers are taking a social-ecological approach to their health interventions, acknowledging that technology can play an important role facilitating interactions with others to promote health behaviors. Prior work has studied how technology can help individuals access social support in their pursuit of behavior change [1, 74, 92]. For example, Murnane et al. found that people managing Bipolar Disorder not only use personal health technologies (i.e., digital tools used to self-manage and promote wellbeing) to support their interactions with mental health professionals but to facilitate interactions with members of their social groups. There has been a proliferation of work focused on mediating interpersonal interactions by encouraging users to support one and other in productive ways. One focus of this work has been health promotion in families, including research demonstrating how ICTs can encourage physical activity in the parent-child dyad. For example, Saksono et al. explored how *social rewards* incorporated within an mHealth intervention could motivate caregivers and children to complete their collaborative step count [92]. In their qualitative evaluation, the authors found that by centering participant values as a reward for completing a healthy behavior, their intervention facilitates what they call *satisfying moments* between the caregiver and child. Adams et al. present VERA, a mobile phone application that allows users to share photos documenting daily health decisions, leading to high levels of information support in the form of advice-giving, and esteem support (i.e., complements and short validations) [1]. These efforts show how personal use technologies can increase the depth of interpersonal interactions around matters of health and

increase social support by building an individual's social network around a health topic.

Outside of existing social ties, researchers have explored how virtual health communities leverage shared experiences and offer opportunities for computer-mediated social support. Lefebvre et al. present a review of surveys of user behavior on social network websites documenting their impact on health-information seeking and health-related behaviors [62]. The review shows that "social media and social network websites are moving us away from an individual view of health to one that encompasses social connections among patients, their families and caregivers, and their healthcare provider team." Ba et al. found that there is a high level of correlation between users' exercise activities and their participation in these digital health communities, showing that online social networking activities and one's support network motivate people to increase their physical activity [5].

In summary, a large body of work has demonstrated the critical role that interpersonal interactions play in helping people achieve their wellness goals and how designing for such factors is central to the creation of effective digital health systems. Despite the important role communities can play in health promotion, this work has typically focused on interpersonal constructs (e.g., peer support, social influence, normative behavior, role modeling)—considerably less work has examined how community values and dynamics can be drawn on and enhanced to better support health and wellbeing.

2.2 Digital Health Promotion in Community Contexts

Using a social-ecology of care model (i.e., a model that acknowledges multiple factors that affect individual health [37]), we understand that individuals operate within various social contexts, including geographically-defined communities (e.g., neighborhoods) [85]. Community contexts can affect individual health and wellbeing by leveraging the assets and affordances of community-based organizations (CBOs). HCI and CSCW researchers have examined how socio-technical solutions are implemented and adopted within a variety of CBOs. This work has explored a broad set of topics ranging from civic engagement [34, 48, 59], community initiatives and resources [26], volunteer capacity [107, 108], and community activism [47]. HCI researchers have also explored how community technologies can support health. This work has focused on a multitude of community contexts including but not limited to schools [9, 61, 65, 70, 89] and community centers [84, 86, 93].

Health technologies can also support wellbeing by facilitating social support and social capital. First conceived in the field of sociology, social capital has been conceptualized and reconceptualized by academics from the fields of political science and sociology, and operationalized in health promotion research [31, 67]. For purposes of this work, social capital "refers to resources developed through one's social relationships" [30]. Individuals with high social capital have access to health-enhancing social relationships, such as those who can provide emotional support, model positive health behaviors, or provide tangible resources [31, 67]. Communities where social capital is high are associated with collective action and tend to have resource rich health promoting environments (e.g., parks,

recreation areas, healthy foods, health services, community centers, libraries, schools).

Community development researchers, policy-makers, and practitioners have operationalized the concept of social capital using the asset-based community development (ABCD) framework. In recent years, HCI researchers have incorporated asset-based approaches into the design of community technology working directly with community members to identify community assets and to realize desired change in marginalized communities [21, 25, 26, 35, 111]. Outside of explicit asset-based design work, there has also been research that centered on building social capital in marginalized communities (e.g., refugee and new asylum seekers [45], economically distressed communities [27]) much of this work focuses on socioeconomic security [2, 3] or community engagement [48]. In addition, researchers have also explored how health journey specific peer support communities [88] and general social media (e.g., Facebook) can be leveraged by some social networks to build social capital [29].

Other work has uncovered concerns over how digital health interventions in community contexts can create community tensions [36, 51]. Kanstrup and Bertelsen, developed the MOVE app, a group-based application where app users can create, share, view, and commit to planned exercise-based activities with other users in their neighborhood [51]. Both residents and community health-care workers raised concerns about who would handle maintaining and sustaining the lists of activities, with each group volunteering the other. This concern highlights the complexities of how a community-based health technology may create tensions between community actors. Similarly, Gooch et al. describe community members’ concern over design concepts that encourage competition between neighborhoods (i.e., displaying community-level step counts in comparison to another community) stating that the competition could fuel inter-community tensions [36].

This work reveals that researchers recognize the importance of situating health interventions in various communities using social capital theory and asset-based approaches. Some of this work has explored how digital health interventions, anchored in community contexts, impact not just health outcomes but community values that drive or inhibit health and wellbeing. However, further health promotion research in faith communities is warranted as they aim to promote health and wellbeing for church members who, in other formal healthcare settings, may be difficult to reach [53]. Churches are essential in delivering culturally-informed health programming in trusted and familiar settings [12]. In particular, historically Black churches have long played a pivotal role in public health efforts to reduce health disparities that exist between African Americans and other ethnic groups [12].

2.3 The Role of the Black Church

To better understand the context of our findings, it is important to recognize the historical and contemporary significance of the Black Church to Black and African American communities. The Black Church is a term that refers to seven major Protestant denominations that serve predominantly Black members [69]. In using the term Black Church we do not mean to suggest that all churches that serve predominantly Black and African American people are

monolithic or singular in their religious practices [75]. Rather, we refer to the Black Church to acknowledge its institutional, political, and societal importance and its role in the liberation of Black and African American people in the United States [75]. Firmly built outside of white society, Black churches were built, organized, and run by Black people [64], and while their role is certainly to serve as a house of worship, the cultural and social significance of these institutions is undeniable. Black Churches have acted as social service institutions and as places of safety and refuge providing protection to enslaved Black people and as the “backbone of the American Civil Rights movement” [64]. In contemporary society, the Black Church remains a powerful organization for both believers and non believers alike, as well as being a “cultural repository” [64]. It is through this history that we acknowledge the rich foundation that comprises how these churches and their members connect in service to each other as well as to the larger community. The tenants of fellowship and ministry are cornerstones of these faith communities and thus shape church member values and expectations for technology in service of community wellbeing.

The current reach of the Black church remains high with 79% of Black and African Americans stating that they are religiously affiliated [73]. Given current racial and ethnic health disparities and the churches presence in Black and African American communities, predominantly Black Churches are well situated as sites for the provision of care to BIPOC [87].

2.4 Faith-based Health Interventions

Twenty years ago, United States President Bush established the White House Office of Faith-Based and Neighborhood Partnerships solidifying a partnership between the federal government and faith-based organizations to better serve individuals from historically marginalized communities [87]. While this partnership was suspended during the Trump-Pence administration, the Biden-Harris administration has reinvigorated the effort with community-aid focused on addressing COVID-19 related health disparities and race-based health inequities at the forefront of its agenda [44]. Such partnerships have made numerous church-based health promotion programs possible supporting a number of predominantly Black church communities throughout the United States on a broad range of health topics, such as dietary changes [90], exercise promotion [110], hypertension [56], advance care planning [42], substance use [50, 96], HPV vaccine promotion [55], promoting peer support for adults with advanced cancer [40], breast cancer prevention [23], and diabetes self-management [68, 94]. Such health promotion interventions typically incorporate a series of health education workshops delivered in the church. However, existing barriers can limit an intervention’s effectiveness, for instance programs wholly delivered within a physical setting can only be accessed by those who regularly attend church activities [13].

While digital health is a promising area of research that may increase intervention inclusivity, only a small subset of this work focuses on technology-enabled solutions for church members. Digital faith-based health interventions have been shown to successfully improve cardiovascular health [14, 78] and substance use [50] health outcomes in Black church contexts. The interventions designed have primarily leveraged short messaging service (SMS) [58, 78]

and health-focused technology features like goal-setting, educational messaging, self-monitoring behavior, reminders, and feedback on performance [14, 78]. In their CBT4CBT project, Jordan et al. used a church support group facilitated by lay community advisors to administer their technology-enabled substance use program for church affiliated Black adults [50]. While the intervention was individually-focused, its administration in a group-setting provided opportunities for social support and created a social network for participants who shared a similar health behavior. Similarly, Newton et al.'s hybrid diabetes prevention program utilized the church context by establishing regular face-to-face group sessions facilitated by a church member supplemented by a spiritually-tailored SMS intervention [50]. *FAITH!* an app developed by Brewer et al. is the only project that incorporated an app-based community social support feature (i.e., a group forum) in their cardiovascular health promotion intervention [14]. However, none of the digital health interventions for Black church affiliated adults mentioned included community support features for capacity building. In addition, while some of these applications included spiritually-tailored health content (e.g., connecting Scripture or Bible stories directly to health behaviors in health education) none incorporated spiritually-focused features or facilitated spiritual and prayer support for their priority populations.

Outside the church community context, some HCI researchers have explored opportunities for technology to support spiritual practices and create spiritual experiences, e.g., prayer [7, 113], Islamic pilgrimages [66], and mindfulness practices [112]. Smith et al. examined the role of prayer support within the online health community *CaringBridge*, a patient-facing support exchange tool designed to help a user experiencing a significant health crisis share health updates with close family and friends [98]. Although *CaringBridge* has no explicit religious or church community affiliation, authors found that *CaringBridge* users rated prayer support as the most important social support exchanged through the website [98]. Their findings speak to the fundamental value of spirituality as an underlying component of health and wellbeing. In later work, authors conducted participatory design workshops with *CaringBridge* users to define spiritual support. They defined spiritual support as “an integral dimension that underlies and can be expressed through social support categories including: prayer, instrumental, informational, emotional, network, and esteem support” [97]. With the exception of *SoulGarden* (a spiritual network visualization tool developed for hospitalized and chronically ill users to reduce stress and loneliness and increase a sense of belonging) [52] these technospiritual pursuits are typically outside the focus of digital health promotion efforts.

Thus while church-based digital health interventionists have considered how to spiritually-tailor health content, they have not provided communal or spiritual support. Furthermore, to our knowledge, prior work has not investigated how church-based digital health interventions that do incorporate community support features may enhance or challenge pre-existing community values and dynamics in church communities.

3 METHOD

This work is part of a multi-year project to design and evaluate a mobile application that promotes health and wellbeing in churches with predominantly Black memberships. During our first year, we worked directly with church members using an assets-based approach to identify community strengths and to engage church members in the design of the application [80, 81, 99]. Using findings from this formative work, we created the Church Connect mobile application. In this paper, we report qualitative results from our first field deployment, where 25 church members used Church Connect, during a four-week pilot study. Following the study period, 17 of the 25 pilot study users volunteered to participate in a semi-structured interview with a research team member. In the sections that follow, we begin with an overview of the Church Connect application and then describe our study, including our methods and analytical approach. We conclude with reflections on our research team's positionality and ethical considerations.

3.1 Church Connect Health App

The Church Connect application provides users with multiple features designed to support health, community engagement, and spirituality.

3.1.1 Formative Work. Our initial goal was to explore how to design an mHealth tool to support wellbeing and health promotion in Black Church communities. We spent the first part of the project engaging community members and conducting ten participatory design focus groups [80, 81, 100]. These focus groups explored various dimensions of participant experiences in their church communities, e.g., religious practices, social support, community health priorities, and church member technology use [80]. We found that church members were not interested in a health behavior change app where their church's role is merely providing access to the app. Instead, they conveyed a desire to have an app that engages them on a physical, spiritual, and community level [81, 99]. We ended this formative work by engaging participants in the design of preliminary concepts for the Church Connect app, allowing us to examine opportunities for spiritual, community, and physical health and wellbeing feature requirements. Table 1 provides an overview of the key design implications that we derived from our prior work, mapping each implication to the corresponding Church Connect features that we developed.

3.1.2 Features and Design Rationale. *Health and Wellbeing Content delivered by ECA.* The application contains health education modules that address physical activity, nutrition and stress reduction based on the first key design implication “prioritize health and wellbeing topics”. The application features *Clara* an embodied conversational agent (ECA) designed as a health counselor (Figure 1A). An ECA is a digital character designed to simulate face-to-face conversation utilizing both verbal and nonverbal behavior cues [16]. Through our formative work, participants co-designed the ECA and gave feedback on her name, persona, role as a peer health advisor, as well as identified the health topics they would like the agent to address [81]. Clara was created using the Unity 3D game engine [103] and deployed on iOS and Android devices [79, 81]. Clara uses a hierarchical task-network based dialogue manager coupled with

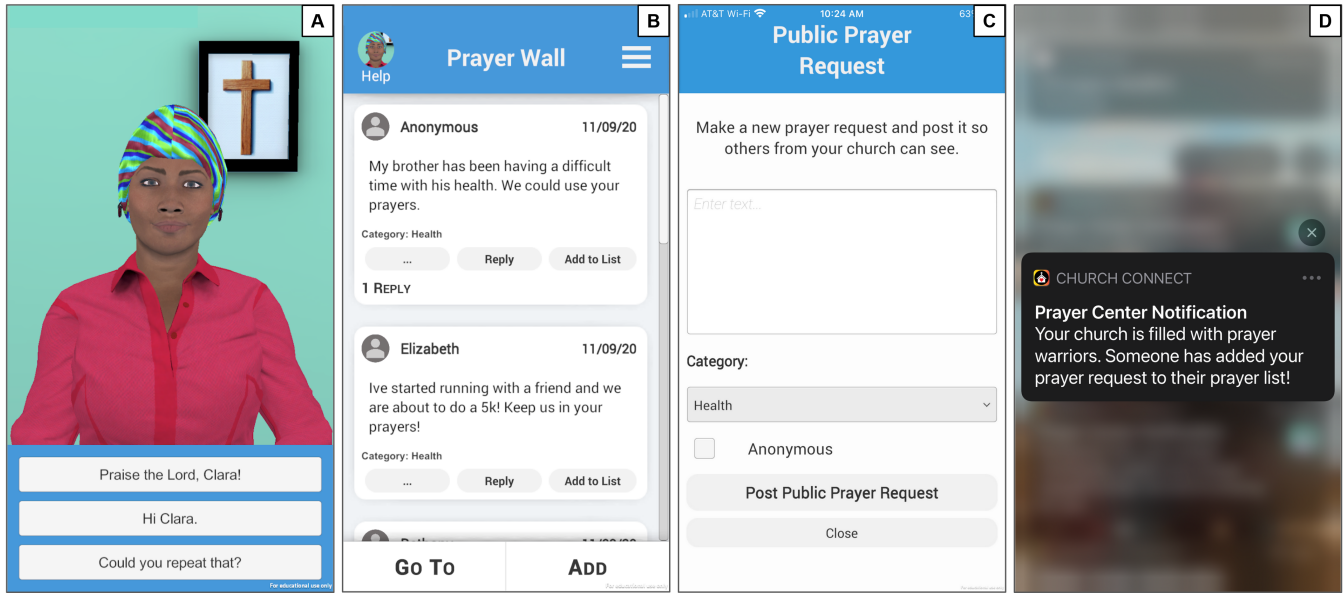


Figure 1: Images from the Church Connect app: a) the ECA Clara waiting for the user to respond using the menu, b) the church prayer wall, c) prayer request submission form, and d) prayer center push notification. The prayers shown are archetypal and are not actual prayer requests from participants.

Table 1: Features Mapped to Key Design Implications

Design Implication	Feature
Prioritize health and wellbeing topics: 1. nutrition 2. exercise 3. stress [81, 100]	Health and wellbeing content & Logging
Integrate content & features that address the value of spirituality [81]	Spiritually-tailored health content, Bible story of the day, & Prayer Center
Include features for church member support exchange [100]	Prayer Center
Include features for building church capacity [80, 81, 100]	Prayer Center & Pastor Announcements

template-based text generation to drive ECA dialogue [10]. To interact with Clara, church members select from an on-screen user menu updated at every turn of conversation. ECA synthetic speech is accompanied by conversational nonverbal behavior, such as hand gestures, procedurally generated using BEAT [17].

During the first conversation with users, Clara introduces each health topic (nutrition, physical activity, and meditation) and explains the benefits of engaging in each of the health behaviors. From this introductory conversation, users are encouraged to select a wellness topic that interests them. Clara uses counseling techniques from an established person-centered counseling method called motivational interviewing [71]. These counseling sessions with Clara are structured using principles of motivational interviewing (e.g., expressing empathy, supporting self-efficacy, etc.),

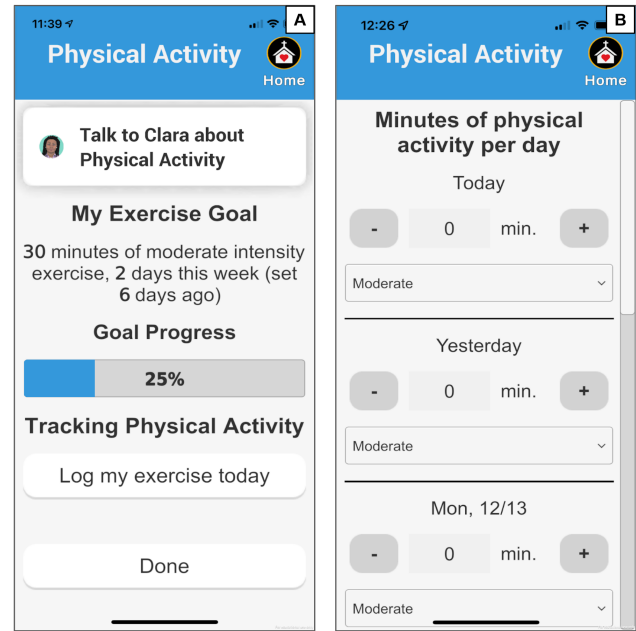


Figure 2: Images from the Church Connect app: a) the health behavior dashboard featuring a talk to Clara button and the user's weekly health goal and b) the activity logger.

where Clara plays the part of a motivational interviewer who assists users with defining and setting incremental behavior change goals

by identifying user reasons for change. During the first counseling session, Clara encourages the user to engage in conversations about the health behavior by asking them what they think about exercise or healthy eating, why they are interested in change, what barriers they are concerned will stymie their progress, and the benefits of the health behavior to them personally. Clara used this framework for both nutrition and physical activity. At the end of the initial counseling session, users can set an incremental goal such as increasing fruit intake by 1/2 a cup a day, or increasing their physical activity by 15 minutes a day. All goals are set on a weekly basis (Figure 2A). While Clara suggests goals based on the user's current baseline behaviors, stage of change, and current population-level health recommendations based on gender and age, users are also able to increase or decrease the goal to suit their current level of self-efficacy, motivation, and degree of confidence. At the end of these initial counseling sessions, Clara provides an overview of app-based support users can draw on (e.g., post on the prayer wall to draw on community support, or follow up with Clara to receive health-related tips/suggestions, etc.). These initial counseling sessions lasted approximately 20 minutes.

During weekly follow-up conversations, Clara employs ipsative health behavior change strategies to positively influence behavior change (e.g. setting a new goal, providing feedback or problem solving) based on current behavior change best practices [39, 105]. These sessions are shorter and typically last 10 minutes. Should users check-in with Clara prior to their weekly follow-up, Clara encourages users to log their progress using the in-built activity logger and offers motivational statements and affirmations (e.g., "you've got this"). In these instances, a session with Clara is only a few minutes long.

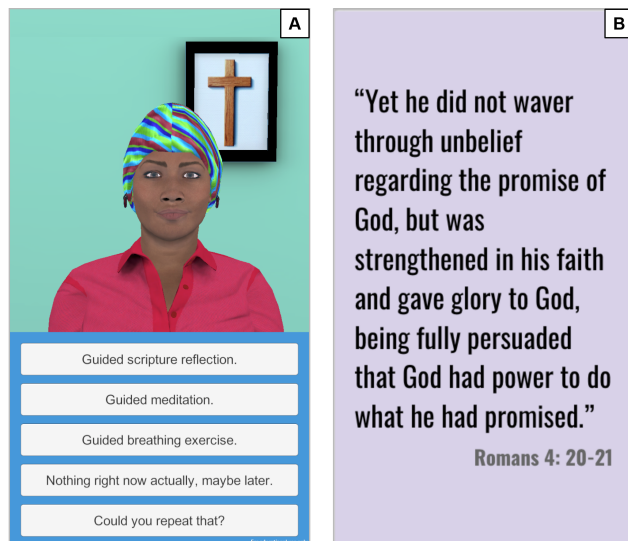


Figure 3: Images from the Church Connect app: a) the agent with menu options for different types of guided meditation and b) an example of Scripture displayed on screen during the scripture-based meditations.

Outside of the physical activity and nutrition motivational interviewing sessions, Clara leads guided meditation sessions (Figure 3A). For these sessions, users can choose both an ambient background scene (e.g., snow falling, stars twinkling), as well as choose between a selection of ambient background music (e.g., piano, crashing waves, church bells etc.). Users can also specify the length of the meditation session (e.g., 5, 10, 15, or 20 minutes) as well as the type of meditation they would like to perform (e.g., body awareness, breathing exercises, scripture-based meditations.). Following our second design implication "integrate content & features that address the value of spirituality", users can choose scripture-based meditations. These sessions ask users to select a theme for meditation (e.g., love, faith, forgiveness, anxiety etc.). Once selected, Clara chooses a scripture related to the theme and presents it on screen (Figure 3B). Clara reads the Scripture out loud and asks users to reflect on the Scripture throughout the session using reflective prompts that ask users to consider how the Scripture impacts their life and current circumstances. Clara begins each meditation session asking users to find a comfortable and quiet place to meditate. Through the meditations, Clara verbally cues the user providing step-by-step meditation instructions and prompts (e.g., "Continue to become more aware of God in his spirit and his son as you breathe now. Let your eyes become heavy with each deep breath, let your eyes softly close. Focus more and more on your breath."). These sessions can last anywhere between 5 to 20 minutes based on user preference. Users were able to repeat these sessions as often as they liked.

All health dialogue was spiritually-tailored to include content related to Christian faith. Focus group participants also worked directly with research team members to tailor agent-led health conversations to incorporate spiritual content related to Christian faith in a way that felt authentic, genuine, and culturally-situated [81]. Throughout the conversations, users are presented with both secular and spiritual options. Examples of spiritual responses include the following: "It sustains me to do the Lord's work"; "It honors God's temple, my body"; "I want to be a better steward of God's temple"; "I'd like you to encourage me using scripture." Clara then reflects the user's responses back later in the conversation, so they become part of the dialogue. In accordance with the second key design implication, "integrate content & features that address the value of spirituality" Clara also offers a Bible story of the day. If selected, Clara would select a Bible story from our study database and read the story aloud to participants. Participants requested this feature during the final focus group discussion as they wanted a feature that exclusively served a spiritual focus.

Logging. Following best practices for helping people achieve nutrition and physical activity goals, we implemented an activity logger (Figure 2B) that supports behavioral goal setting and physical activity self-monitoring [60]. The application shows a screen, accessible from the main menu of the app, where users may log their physical activity or nutrition. The logging interface displays the goal users are working towards, if they have set one, and lets users set new goals by talking to Clara (Figure 2A). Taking physical activity as an example, users can set goals for how many minutes of physical activity they plan to do for the next week, and the logging screen allows them to input the number of minutes they exercise on a given day of the week.

Features Supporting Community Support Exchange & Spirituality. Based on the second and third key design implications, “include features for church member support exchange” and “integrate content & features that address the value of spirituality”, we designed two features to help users connect with their church community. The first is a prayer center, which has a community prayer wall (Figure 1, B and C) and a private prayer list. All prayer center feature requirements were specifications that focus group participants requested and/or evaluated favorably. In a similar manner to sequential group posts on contemporary social media platforms, users can post prayer requests and praise reports on a church-wide prayer wall. Prayer requests can be characterized as concerns, crises, or challenges (e.g., a family death, news of a terminal illness, anxiety over an upcoming job interview) that an individual would not only like to share with others in their community, but through their request, ask for communal support. Sharing praise reports allows people the opportunity to share expressions of joy or gratitude (e.g., getting a new job, recovering from an illness, engagements, births). Posting to the prayer center can be done anonymously or in an identified manner. Posting to the prayer wall can be deeply personal and may place the poster in a place of vulnerability. Accordingly, the poster may not feel ready to post the information associated with their name. Allowing for anonymous public facing posts gives members flexibility regarding self-identification while asking for communal support.

Users can publicly reply to prayer and praise posts, creating a means for church members to give and receive public acknowledgment of communal affirmation. Users can also add posted prayer requests from the prayer wall to a private list of prayers only visible to them, as well as add their own prayers to their private list. In doing so, they can refer back to this list as a reminder during times of prayer. In addition, when a person adds a prayer request to their private prayer list the original poster is notified to their phone with the message, “someone in your community has added your prayer request to their prayer list” (Figure 1D).

If an inappropriate post is placed (e.g., inappropriate content or language, content that reveals private information about another member) members can immediately alert study staff. If a post is marked as possibly inappropriate, an immediate notification is sent to the first author. Once received, the first author would review the content and notify the community partner to determine if the content was inappropriate. This feature was never used during the study as no posts were deemed to be outside communal norms.

The second community feature was based on the final key design implication, “include features for building church capacity”. In response to this design requirement, we developed *Pastor Announcements*, a one-way communication channel from the pastor to congregants through the application. This allows church leaders to share content directly with their church community, such as information about events, words of encouragement, scripture, or church announcements.

3.2 Study Overview

Participant Recruitment. This work was done in collaboration with a CBO that provides services, programming, and financial support to over 100 faith-based organizations serving predominantly minority

communities in a United States city located in the northeast. We refer to this organization as our “community partner”. Through our community partner’s network connections, we established a long-standing relationship with two church communities. Church A is a historical Baptist church with approximately 600 members. Church B is an African Methodist Episcopal (AME) church with approximately 700 members. Church members from both communities participated in the field deployment. To be eligible, church members had to be 18 years or older, English-speaking, and have access to a computer, tablet, or phone where they could connect using video conference software. In coordination with church ministry leaders (i.e., leaders who represent different church affiliated groups that provide services to both members and non members in the residing community) from both church communities, we advertised the field study in both church e-bulletins as well as by word of mouth via church ministry liaisons who were actively partnering with our research team. Church members interested in participating were provided contact information for the lead author to schedule their first remote study appointment. Due to the fact that we recruited via church ministries, almost all of our participants knew one another as they shared social contacts within their respective ministry groups. Prior to recruitment, the study protocol was approved by our university Institutional Review Board.

Data Collection. Participants were consented by a project member over video conference, administered surveys and provided a brief tutorial on how to install the application and a direct link to download. Once installed, participants were asked to use the application at least a few times per week for the 28-day study period. After their final study day, participants were contacted by the lead author to schedule a semi-structured interview. Interviews were conducted no more than one week post participation in the field study. Participants were given the option to talk by telephone or video conference for the semi-structured interview. Participants were compensated at a pay rate of \$24 an hour for both the initial study session, an hour of application use over the 28-day period, and the follow-up semi-structured interviews. Total compensation was \$84 per study participant for a total of 3.5 hours. The semi-structured interviews averaged 75 minutes.

Given the numerous features and health behaviors that participants could engage in using the Church Connect app, usage statistics were obtained and reviewed prior to the semi-structured interview. The lead author annotated the interview guide with overall usage statistics for each health and technospiritual component. In doing so, the interviewer prioritized time based on actual use and was able to probe on why certain aspects of the system were not used more.

During interviews, participants were asked for their overall impressions using the system and probed component-by-component to elicit their attitudes, preferences, and motivations for using or not using different areas of the system (e.g., explicit health features versus technospiritual features). In addition, participants were asked the following questions: 1) to what extent did they see Church Connect as making use of or strengthening their community? 2) in what ways did Church Connect reflect or fall short of their community values? and 3) in what ways would participants like Church Connect to incorporate connections to others to more effectively support wellbeing within their community?

Data Analysis. Interviews were audio recorded and transcribed, resulting in a total of 18 hours and 24 minutes of audio files and 845 pages of transcription. We conducted an inductive analysis informed by grounded theory of semi-structured interview content guided by sensitizing concepts such as community strengths, desires, and values as they relate to health promotion [11]. We used elements of the grounded theory method, including open coding, axial and selective coding, and memo writing [101]. While we understand the value of incorporating community members directly in the analysis, we were unable to involve participants in this stage of our research. Using NVivo 12.6.1 software, the first author inductively coded all transcripts, labeling emergent phenomena in the data to arrive at a codebook. The first and last author met regularly during the analysis process to discuss discrepancies in the applications of the codes, review analytic memos, and reflect on contradictory data.

3.3 Positionality Statement & Ethical Considerations

We acknowledge that there are ethical considerations when partnering with marginalized communities and that how we handle these issues should be shared with the wider academic research community. In the following subsections, we address our positionality as a research team and reflect on the ethical issue of ensuring that participants continue to have access to research technologies even after their formal participation in the research process ends.

3.3.1 Positionality Statement. Positionality statements are an important aspect of community-engaged research especially when working with marginalized populations [28, 63, 95]. Given that researchers often define research questions, lead data collection and analytic processes, and are responsible for the communication of our results, we must acknowledge the power we have as practitioners in not only shaping the interpretation of our work but in shaping the field. And though our team was well-intentioned, we cannot claim that our self-identified race and religious identities do not implicitly impact the questions we asked and the analyses we performed. Thus, we join others in our community in providing our positionality statements so that readers can examine our findings with this knowledge [63].

The authors of this paper come from a range of faith and racial and ethnic backgrounds. Multiple authors grew up and two continue to attend various Protestant churches. One author is a religiously observant Jew. One author self-identifies as Black, another as South Asian and the remainder are white. The first author who facilitated all participant activities and led the qualitative data analysis self-identifies as a white woman. The first author was raised attending a Catholic Church and school. She currently attends a multicultural Unitarian Universalist Church.

We share our backgrounds to acknowledge that, while the authors of this paper shared some religious vocabulary with church members, there may be nuances unique to the participants' religious communities and cultural practices that we missed or that participants did not feel comfortable fully exploring with us [41].

3.3.2 Maintaining Research Technologies in Marginalized Communities. Prior work has highlighted ethical issues surrounding the

introduction of research technologies and the subsequent harm that removing such technologies can cause once formal participation in the research process has ended [106]. We introduced Church Connect to two church communities during this field study. As previously mentioned, this field study is part of a larger multi-year project. Given the long-term nature of our project, our team actively maintains the application as part of our iterative process of design, development, and evaluation with our community partners. Part of our ongoing work will be to identify a long term solution for sustaining and transferring the Church Connect app to the church communities beyond our current multi-year community engagement.

4 FINDINGS

Through our iterative co-design process with community stakeholders (i.e., church members and leaders), it became clear that participants wanted an mHealth app that incorporates spiritual and social components that church members identified as valuable to their community. Accordingly, we undertook a co-design process to create Church Connect.

Our findings characterize participants' engagement with and reaction to Church Connect, as well as their perspectives on how future tools can be designed to effectively promote wellbeing in church communities. Participants reflected on their desires for an app that builds on and enhances their community values, as a way to strengthen not only the health of their bodies but also the church community and their ability to engage in valued spiritual practices. Drawing upon their experiences with the Church Connect app, participants characterized their perceptions of social cohesion (i.e., sense of closeness and solidarity shared among group members [30]) and elaborated on how certain community values and *community dynamics* (i.e., processes through which communities change and develop) are reinforced, enhanced, or disrupted through technology. Furthermore, church members used their experience with the system to imagine how additional community-based features may leverage existing values and dynamics to augment the effectiveness of Church Connect to promote social cohesion and increase social capital i.e., resources developed through group membership [30]. In combination, these perspectives on community values and dynamics represent important insights into designing technology that supports people by building upon a church community's strengths and minimizing community disruption.

4.1 Participant Overview

Twenty five church members used the Church Connect app during the study period. Fourteen were from Church A and eleven from Church B. *Demographics:* Nineteen church-members self-identified as Black or African American, two self-identified as Black and American Indian, two self-identified as Black and Latinx, one self-identified as Latinx, and one self-identified as white. Eighteen self-identified as women, five self-identified as men, and two self-identified as non-binary. Participant ages ranged from 19 to 75. For education, one participant reported having a high school degree, three participants reported having had some college, three had an Associates degree, nine had a Bachelors degree, five had a Masters degree, three had a professional degree, and one had a

Doctorate. Participants have been members for an average of 14 years ($SD = 8.9$, Range: 4–31). They range from no involvement in any church affiliated groups to serving multiple roles in the church. These roles include attendee, co-pastor, ministry leader, fundraiser, Bible study leader, choir member, and trustee. Seventeen church members participated in the field deployment interviews reported in this paper.

4.2 Church Connect App Usage

Before describing our qualitative findings, we begin with a brief overview of Church Connect's usage. During the four-week field study, 25 participants used the app 560 times with each participant logging in to the app an average of 22 times (Min=4, Max=54, $SD=13.3$). Participants posted 82 prayer requests, added 43 prayer requests to private prayer lists, and wrote 45 replies on the prayer wall. Participants in Church A each received one pastor announcement, whereas Church B received two pastor announcements. Participants interacted with Clara for 36.6% of their sessions with the app. Participants used the meditation feature 84 times, Bible Story of the Day 50 times, Physical Activity 26 times, and Nutrition 25 times. Participants used the logging feature a total of 801 times, with each participant, on average, logging their health behaviors 32 times. Given that Clara is designed as a central component of the application, she delivers the majority of content outside of pastor announcements and the prayer wall. As a result, participants interacted with Clara more compared to any other app component or community feature (e.g., the prayer center). It should also be noted that we did not capture passive usage of the prayer center, and as a result do not know the frequency by which church members may have checked for new content, reviewed posts on the prayer wall, or utilized their private prayer lists.

These usage statistics reveal that the spiritually-focused and community-focused features were used more than the physical activity and nutrition counseling sessions with Clara. To explore this discrepancy, we feel it's important to highlight how each of these features were framed. For instance, the Bible story of the day feature provided new content every single day in the form of a new Bible story, setting the stage for daily usage. In addition, there were three types of guided meditations, five types of scripture-based meditations all of which could be tailored based on user music preferences, background scene selections, and time-based preferences. Users were encouraged by Clara to join her multiple times a week to meditate and could partake in meditation as frequently as they desired. In contrast, the physical activity and nutrition sessions were framed as weekly interactions with Clara. If users returned prior to the 7-day followup, Clara would offer a short tip and ask them to log their health behavior. Otherwise, the majority of the wellness content was offered on a weekly basis (e.g., providing feedback on a goal, setting a new goal, or problem solving). Therefore, how the nutrition and physical activity content was framed compared to the other components may be in part why the physical activity and nutrition sessions were used less when compared to the other features.

In addition, participants explained that at the time of the field study (March–May 2021), the continuation of the COVID-19 pandemic was causing immense strain on their mental and social

wellbeing. Participants reported that their social connections with friends, family, and other members of their church were eroding and that the effects of long term isolation were taking a toll on their mental wellbeing.

Beyond the trauma and strain of the pandemic, participants explained that the collective racial trauma of George Floyd's murder also impacted their use of Church Connect. George Floyd was an African American man residing in Minneapolis Minnesota [43]. While in police custody, he was murdered by the arresting police officer, Derek Chauvin, on May 25, 2020. George Floyd's murder was filmed and shortly after the murder went viral. After his murder, protests against police brutality swept across the United States and global community. At the time of the participant interviews, Derek Chauvin's murder trial was ongoing. Participants acknowledged the importance of physical activity and nutrition overall but explained that the combination of the pandemic and continued police brutality inflicted on Black people diminished their interest in the wellness content. Participants noted that devoting time and their limited energy to what seemed like a less acute problem was not high on their priority lists. P17 shared:

"You gotta understand, I know that these things [nutrition and physical activity] matter. And it's great that it's there. But, when you've been living like this and you're going day in and day out exhausted from the pandemic and the news with...I'm not even going to say his name [Derek Chauvin]. The eating better or working out more was just asking me to do things. And I *can't* do any more. But, hearing a Bible story and closing my eyes or doing a breathing exercise that's...that's what I need right now."

Participants explained that compared to nutrition or physical activity, Bible stories of the day, daily meditations, and the prayer wall offered comfort as well as a personally meaningful and identity affirming way to address the stress of the times through spiritual and community support. In the remainder of this paper, we present findings that characterize how participants used these spiritual and community features, why they used them, and the impact of their use. We use our qualitative findings to provide a more nuanced picture of participants' engagement with Church Connect and their perspectives on how such holistic digital health tools should be designed in the future.

4.3 Community Dynamics: Promoting Social Intimacy

Throughout our interviews, participants emphasized the value they place on building and maintaining close personal relationships within the church community. In this paper, when we refer to *social intimacy* we mean the value placed on facilitating the development of close friendships with others in the church community. Church members explained that even prior to the COVID-19 pandemic, creating opportunities to nurture social intimacy was a priority in both churches. Participants described meetings devoted to increasing communication between church ministries and other small groups as well as creating programming for church members to meet others based on different types of interests and needs. Church ministries are largely volunteer-based groups that provide supportive services

to church members, community members, and to church services directly. These ministry groups nurture the church's mission to serve the local and broader community. Examples of ministries include prayer groups, arts ministries, community service groups.

P4: "I know for some ministries, they create opportunities to sit together on Zoom. I think the [name redacted] ministry spends time together making their own crafts and chatting. But, that's rare—not all the groups have that"

Participants explained how meeting new people and finding opportunities to bond over shared experiences is difficult both during, but also prior to the pandemic. This challenge was driven in part by individual routines and family schedules that drove what worship time an individual attends, making it difficult to meet members who attend different service times. While the majority of participants described a deep sense of community and belonging (e.g., P2: *"the church does feel like a, one big family"*), other participants shared a sense of isolation and loneliness:

Int: do you feel like, really connected to other people there?

P4: "Hmm. I think I better plead the fifth on that one. Because I feel like I'm on the outside looking in."

Regardless of the participant's sense of belonging in their church, all participants felt that building a sense of social intimacy is a priority. P17 explained how this is even more important for new community members:

"I'm one of those I already have established connections...But I know from hearing from others and working in different areas of ministry, that it's important, especially when they come in as new members to make a connection. And that can be hard with the size of our church."

P17's and P4's insights provide examples of how communities high in social cohesion are at times difficult for outsiders to access.

4.3.1 Developing Social Intimacy through the Prayer Wall. Our participants went on to discuss the ways in which Church Connect, particularly the prayer wall, supported the community value of social intimacy. To understand the context of our findings, it's important to describe how prayer request posts in Church Connect are different from typical posts on a community forum. First, posting on a prayer wall is a request for reciprocity from a community predicated on caring for one another through faith, prayer, and social support. Secondly, it is a call to others within the community to participate in a communal and highly valued and honored spiritual discipline. Previous work in HCI has further illuminated that for religiously affiliated people spiritual support is an underlying dimension of all social support categories and that prayer support is an additional social support category [97]. In their work exploring spiritual support used in an online health community, Smith et. al., defined prayer support as a triadic experience which includes the prayer requester, prayer partner, and the Sacred. Members shared the power of prayer throughout the interviews stating that while prayer is often a deeply personal act of communication between

oneself and God there are instances where building a prayer community is a powerful display of togetherness, fellowship, and devotion to one another. By gathering in prayer:

P13: "we become one voice and God will answer that person's prayer. And we have seen prayers, you know, answered. So I just know that, you know, I know, um, I, and like probably most people say, "God, I would like you to do this for me now." Well, we all have to wait. But it's...good for people to know that others are waiting and watching with them and they'll soon be rejoicing together."

When asking participants how they felt about the prayer wall compared to Facebook, church members stated that Facebook is not a safe online environment and that the prayer wall is an asynchronous means of communicating with God, practicing a spiritual discipline, and supporting fellow church members. Participants further stated that on Facebook their religious beliefs and values are not always shared with others in their Facebook community. Furthermore, given recent political and social events in the United States (e.g., the 2020 United States Presidential election, collective racial trauma due to police violence, and the COVID-19 pandemic), participants largely perceived a site like Facebook as a hostile space for BIPOC that lacks credibility due to its perceived role in the propagation and spread of misinformation. In contrast, they perceived the Church Connect prayer wall as a largely safe space to self-disclose a need for prayer and engage in a communal spiritual practice with people who share a similar cultural identity.

Through their use of Church Connect, participants showed how certain features enhanced social intimacy by creating authentic opportunities for communication offline. P10 emphasized:

"I saw someone, you know, on the prayer wall, who I don't necessarily talk to but I see them intermittently, but if I saw them on Zoom I would be like "hey," like how is that person or like how was your trip? Imagine being able to see details on the prayer wall and like being in a foundation for more."

Essentially, the ability to view the prayer concerns of others gave this participant new information about the poster, creating a foundation for a more personal interaction outside the app.

In addition, the prayer wall created a general awareness of what church members are struggling with or challenged by giving members insight into who requires assistance and what matters they could personally connect on. P13 described the importance of reaching out to members personally:

"The pastor believes in community. And he looks for us to all be part of reaching out to anyone if it, whether it's, uh, like during this COVID time and he said, if you haven't heard from somebody pick up the phone and call and see how they're doing."

The prayer wall afforded members opportunities to connect on new topics that might either remain undiscussed during church-related activities or remain unaddressed until those activities take place. As a result, participants imagined that the prayer wall could benefit their community by allowing members to share their prayer

concerns as they happen potentially to those who have shared a similar path. P7 stated:

“So like COVID-19, somebody was ... One, one of our members got COVID-19, and you know, his wife sent us [the same ministry] all a note. He said he felt really good by the fact that three or four of the guys who also had COVID-19 came out on their own, basically got on the phone and prayed with him. And they called him, and he was in hospital. So, you know, it's having a group of people who had a similar malady, praying with you. That's incredible stuff.”

Though this interaction happened by phone, P7 reported how the prayer wall could allow for this type of practice to occur across a variety of mutual experiences. He stated that for COVID-19, people generally know who's had it because the church has provided those with support publicly. However, other mutual experiences such as substance use, mental illness, chronic health conditions, disabilities etc. are not so easily known. Thus, a computer mediated mechanism for sharing personal experiences can act as a springboard for creating mutual bonds. Furthermore, P7 describes that connecting this way is not simply important because it enables identifying others with like experiences but rather such connections are *powerful* because they can support the valued spiritual practice of prayer support.

4.3.2 Supporting Community Health and Wellbeing through Social Intimacy. When discussing how future iterations of the Church Connect app could leverage their church community to further their health and wellbeing goals, participants wondered if a matching feature could assist them in fostering buddy relationships with current church members based on their health goals, health challenges, shared experiences, or interests. Members stated that currently there is no well-defined mechanism for naturally making these buddy relationship matches within their current churches. Participants described how the COVID-19 pandemic has made this practice even more difficult, with the majority of church interactions hosted on video conference software that do not effectively support *hallway* interactions with members. Participants were similarly dissatisfied with health behavior change smartphone applications (e.g., Noom or Weight Watchers), finding that the community components (e.g., group forum and health coaching supports) did not feel relatable. P14 stated:

“the advice I was getting from the coach just, I couldn't connect with it kind of thing, but I did give him the feedback about it feeling... that this was much more focused on...a certain age, you know. You know...I'm not going to work, working out with friends, or drinking beers so... it's not really offering me any kind of help for the situation I'm facing.”

Participants brainstormed how such connections could create opportunities for initiating activities outside of the application:

P10: “it's just another tool for us to connect. Uh, and, and it's a, you know, as a church body. Um, and, and, and be there for one another and with one another. You make that connection, and then hey if I'm going

to do my walking, I can reach out to this person now and we can meet up as walking partners.”

And members insisted that virtual health communities that are not anchored in their church context are not effective. P11 declared:

“Oh, here's what I know for absolute certainty. I am no good with Noom, I'm no good with Weight Watchers online, I'm no good with anything that is strictly interactive and online. That is not me. It does not work, it will not work. I don't even pretend anymore. I need...my church community.”

As the quotes in this section on social intimacy begin to highlight, many of participants' aspirations for the Church Connect application were centered on it taking a whole-person orientation—integrating health promotion with community engagement and spiritual practices.

4.4 Community Dynamics: Communicating Care

In addition to social intimacy, members identified caring as an important community value driving church services and activities. The value of community service both in-reach (e.g., serving church members directly) and out-reach (e.g., supporting local, regional, or global community initiatives) is a priority and one of the main missions of both church communities. Participants explained that since the COVID-19 pandemic, their typical volunteer activities have been disrupted. Members expressed a desire to serve their community directly and found that the prayer wall created an opportunity for an actionable and meaningful way to provide prayer support. When asked how it felt viewing the prayer wall, P4 stated, “*it made me feel good, it was something I could do for them.*”. Church members explained that in their communities “*we make sure everyone is covered*”. When asked how it felt to respond to a posted prayer request P10 stated:

“It felt good. I felt like there was something significant and meaningful that I could do for someone's life.”

The caring value is an intrinsic part of both church communities that is closely associated with the phenomena of reciprocity (i.e., the provision of support based on the notion that others from the community will respond in kind [83]). However, in religious communities, caring for others is another type of spiritual practice that brings both the care recipient and caregiver closer to God [97]. Church Connect's prayer wall creates additional mechanisms for demonstrating caring (e.g., the reply feature).

4.4.1 Providing Immediate and Intentional Prayer Support. Currently, outside of the Church Connect application, church members from both communities are able to submit a request for prayer publicly during their video conference worships, or during synchronous remote based prayer meetings called prayer conferences. However, church members pointed out that through the Church Connect prayer wall they are able to offer prayers, encouragement, and support with greater immediacy. P16 shared the benefits of the wall in terms of caring for members of the community:

“it's definitely a place for people to, to say, you know, can you please pray for me in this situation. Otherwise we have the bulletin but the prayer is down at the

bottom or at the back, you know, this, this [Church Connect] is more intentional. And, it will be like a quick format. Like you [the poster] wouldn't have to wait till Tuesday to call, to ask for it, to be put in the bulletin you can just go there [to the prayer wall] and just do this on your own in the, in the moment. When you need it."

Multiple participants pointed out that reading the prayer posts as they are posted and written by the requester themselves felt even more genuine than requests at the back of the church bulletin. The practice of being able to add the prayer to your Church Connect prayer list, thereby sending the passive push notification to the poster as well as the ability to post a reply in the public thread created opportunities to respond to the poster with "intention". The prayer wall created a front-and-center prayer request environment allowing participants to access prayers, act on prayers, and respond to prayers in a direct and immediate manner.

4.4.2 Supporting a Wider Range of Health Challenges. Members stated that the addition of the prayer wall in the Church Connect app was not duplicative of their current prayer conferences or prayer requests printed in the church e-bulletin. Participants described how using the mobile application, they felt that prayers could be added to the wall for milder health situations. P8 explained:

"A lot of times, you know, the past we announced certain things but those are worst case scenario situations. Someones in the hospice, or someone is on their way out [terminally ill] but sometimes, some people are just going through mild situations or challenges or maybe it's a, you know, friend, right."

Calls for prayer to the entire church community by church leaders is typically reserved for health crises or extreme situations, and thus participants discussed how Church Connect offers an additional mechanism for receiving support around health challenges that aren't necessarily dire. We found that the app enhances the communicating care dynamic by creating a platform to support everyday health challenges through community and spiritual support.

4.4.3 Identifying Member Needs for Focused Outreach. Five out of the 17 participants self-identified as ministry leaders and spoke about how they planned on using Church Connect to support members of their community and their ministry directly. For instance, one participant leads a Bible study group and states that the prayer wall would be part of the application that he would enjoy using to make sure that everyone in his ministry is receiving the spiritual support they require. Similarly, a health ministry leader indicated wanting to use the application to get a better sense of what members of her ministry needed in a more timely manner:

P4: "Well, the alerts that we get [alerts sent by Pastors], we usually have to wait till Sunday. Um, somebody could post those daily [using the app]. Um, if somebody is sick, or if there's been a death in a family. And, um, then we could get on it 'cause we send cards and we make calls and texts and things like that...it would make the information that we receive as ministry members, uh, even more timely. And, um, it could be specific."

By alerting members in the Church Connect community that prayer support is needed, participants who occupied leadership positions imagined how Church Connect could create opportunities for more focused and rapid service allocation to those community members in need.

4.4.4 Disrupting the Communicating Care Dynamic. Church members illustrated how the action of posting a prayer concern places the poster in a vulnerable position, and that responders feel a strong sense of responsibility and accountability to those members who are submitting requests for prayer. While the phenomenon of the social pressure to respond on social media is not completely new, this phenomenon embedded in the practice of spiritual and prayer support makes it complex.

Participants explained that unrealistic expectations for posted replies could lead to feelings of isolation for the prayer poster. While members appreciated the ability to reply to the individual who posted, some mentioned how the public nature of the reply made them worry that others in the community who posted a prayer concern would wonder why they hadn't replied directly to other posts on the wall. P17 shared:

"I guess maybe this is it. You have these people on, and maybe some prayer requests you wanna respond to, and then some you don't, but somehow, when you did, it was there for everybody to see, and it was kind of like, whoa, she didn't, she didn't, she didn't reply to mine. That made me pause a bit".

In fact, in a separate interview a different member mentioned that they were surprised that more people from the church community did *not* make an effort to reply to other prayer concerns. P10 lamented:

"I was really surprised that a certain person didn't respond, that kind of hit me."

Similarly, one participant shared his disappointment that members of his ministry hadn't responded to his post:

"It was confusing once I wrote it, and then I came back, I didn't get the level of response from certain people who I knew. Like the guys from my Men's group. That felt bad."

In summary, while the Church Connect app enhanced the communicating care dynamic in some ways (e.g., offering opportunities to receive more immediate prayer support) it also challenged the communicating care dynamic by creating new expectations for digital prayer support (e.g., the burden of responding immediately).

4.5 Community Dynamics: Adjusting Community Scope to Maintain Privacy

In addition to communicating care, another set of community dynamics revolved around the topic of privacy. Participants' use of Church Connect inspired conversations around the importance of maintaining church member privacy when using aspects of the church-wide application, mainly the Church Connect prayer wall. While all members endorsed the prayer wall as a valuable aspect of the application, some shared concerns over how privacy could and should be maintained when members post prayer concerns. P13 shared this concern:

"I had to be mindful about how much health information I was putting on the prayer wall, because I realized that it's more widely shared with others in my church."

Church members emphasized wanting to keep the space safe and continued to use discretion through the study period by curating posts to limit personal information and specifics. Participants stated that the subject matter of a prayer concern often contains private information about another church community member. For instance, a post asking for prayers with regard to a family member's chronic condition or diagnosis posted without the permission of the family member could create issues and would have to be managed appropriately by community members (e.g., establishing procedures for taking down the post, establishing guidelines for protecting other's privacy when posting). P17 stated:

"what if somebody put up a prayer request and somebody else knew that person and, you know, they kind of got into a verbal battle of what was actually the need for a prayer. Or, even question why the first person put the prayer up in the first place."

Through the interview, P17 explained that prayer posts made about others could be inaccurate. Moreover, she described how tensions over whether or not the prayer should have been posted is also a concern.

Participants offered solutions for the perceived privacy problem. One such solution was altering the audience size of the prayer wall to allow for varying levels of detail in the prayer concern posts. For instance, one church member described wanting to post a prayer for his Men's Bible study but felt that posting the prayer church-wide would feel both impersonal and reveal too much private information. P3 shared:

"I wanted to share a prayer request about Men's Bible study, something specific that only those guys know about. But..But..I couldn't find a way to limit the post. But, that would have been a nice way to really ask for prayers around something close to my heart."

Other church members echoed this desire, sharing that sometimes prayer support from a curated small group not only reduces feelings of vulnerability but may be more responsive in that those prayer supporters are privy to the context surrounding the post. Giving participants the ability to adjust the social configuration would also support the community values of social intimacy and caring. On the opposite end of the spectrum, another participant spoke of widening the scope of the post so broadly to lessen the feeling of vulnerability through anonymity. P5 reported:

"Well, I think being able to post to more than just your church that's a good idea. Um, but just because I just, you know, it's a bigger community. Someone might find, um, you know, they may find, um, a bigger community less intimidating. There's a lot of people who don't wanna share, about personal stuff you know, where they get [spiritually] fed."

Our findings illuminate a contrast between the idea of sharing prayer concerns to a specific subset of people within the church versus a large group of people beyond the church. Both sentiments

stem from a desire to ameliorate feelings of vulnerability when asking for prayers. On one hand, participants hoped to accomplish this by shrinking their audience to those they feel close to. In contrast, others desire an audience so large that their post is one of many; P5's quote suggests that this desire may stem from feelings of intimidation when sharing with a small community. While our data does not directly explain where these feelings stem from, possible explanations include not feeling a sense of connection to the larger community that makes sharing feel comfortable, or having sensitive health concerns that one does not want those in their closer-tie network to be privy to.

4.6 Community Dynamics: Creating New Opportunities for Fellowship

While members expressed the importance of managing privacy when using the app, they also identified fellowship as an important community value intrinsic to their overall health and wellbeing. Church members described fellowship in their church as coming together to share space with those who share one's values. At the beginning of the session, participants were asked to share three words that describe their church. "Fellowship" and "family" were selected the most with 10 of the 17 participants including them in their church descriptions. This resonates with related work finding that fellowship is defined as a strength in historically Black church communities [100]. In this initial pilot phase, Church Connect was introduced remotely to a small group of individuals from each community. Due to the pandemic, participants reported important ways in which their community had changed. During the four-week deployment, both church communities were shut down and all in-person services were suspended. While Zoom activities for ministries and church services did continue, participants lamented that they were unable to introduce Church Connect or use the app with others from their church. P7 stated:

"But- but I really wish, it's- it's the thing that, the thing that plagued me more than anything else was that I really didn't have a chance to have a discussion with other people within the church by sitting down and actually sharing the app with them. So, I never got to talk with them about it and get a sense about their thoughts."

He and other participants insisted that as part of their own decision-making process about how, when, and to what extent to use the app, they wanted to know the opinions and thoughts of other members. Even as the app was just introduced, participants immediately mentioned wanting to use Church Connect together as a fellowship activity. P16 stated:

"I think I'd like to be able to have used it more in a, just in an interactive situation with people, with other people from the church. Getting their thoughts and going through the app together."

When asked what specific Church Connect content they wanted to explore with other members, P16 reported both the prayer wall and health modules delivered by Clara. In all interviews, participants introduced the concept of hybrid programming that leverages both in-person and app-based activities. Even with only a small number

of church members using the app, two participants shared anecdotes where they recommended parts of the app (e.g., Clara guided meditation) during a remote video conference ministry meeting to another member of the church community:

P13: “I brought up, and that’s from my experience with Clara and the meditation because the recommendation, the first recommendation was for the person to, um, to meet with our Men’s group. And then what I said was, I think that he’s a busy person, so the first thing he needs to do is calm down. And I said, and meditation would be, you know, the best thing first to learn how to get quiet.”

Other members explored how interest in aspects of the application could create health and wellbeing initiatives in the church community itself. Some participants felt that the app could assist in structuring church-wide cooperative health challenges. While others brainstormed instances where Church Connect could assist in responding to current church member needs. For instance, P11 remarked:

“I think that if there was a component that was um, specifically um, called the church health ministry-Or something like that, then that allows you to um, address whatever kind of the health topic Du Jour is [going on]. Whatever, we might be dealing with...to delve into different kinds of topics that members are truly struggling with. For instance if a lot of my members are struggling with blood pressure, we could use the app to address those topics”

Church members shared that people within the community are often in a variety of spiritual places and have different levels of familiarity with scripture and the Bible. P8 stated:

“You know, there are some people who are lower in knowledge. Sometimes the higher-knowledge individuals have a tendency to overpower the grouping, but with [the app] I can hear myself think and still be part of the conversation.”

Creating additional platforms for reflection could promote an inclusive environment allowing users of varying levels of expertise to participate (i.e., those learning scripture as opposed to those with scriptural expertise). Indeed, in all communities there are varying levels of expertise around any topic—similarly, this will be true of health knowledge. Thus, for those communities where fellowship and togetherness is a central tenant, establishing creative ways to increase representative participation could be useful.

In summary, participants shared how the Church Connect App could create fellowship opportunities ranging from using the app together, recommending parts of the app to each other, creating initiatives based on prayer posts or in-app content, and creating spaces for varying levels of expertise. These suggestions for future features reflect a desire for tools that jointly engage health, spiritual and community values. Participants saw value in tools that promote health through features that spur church member fellowship online and offline.

4.7 Community Dynamics: Building Inter-Community Connections

In addition to church-wide fellowship, church members identified building community connections to facilitate fellowship with other organizations as a community dynamic. All participants were aware that our partner organization provides resources and assistance to a network of predominantly African American and Black church communities. Participants were also aware that multiple church communities were using the system at the same time. Both during recruitment and in the interviews, participants expressed wanting to connect to and network with other church communities using the Church Connect app for a variety of health, spiritual, and social pursuits. Our partner organization serves and connects over 100 faith-based organizations in the region, and while leaders may have access to their resources more directly, participants explained that church members typically are unaware of what the other church communities within the organization offer. It’s customary that churches have public events open to the rest of the community, however, advertising those events widely to members of other churches seems limited. Our results further confirm recommendations from related work on the importance of facilitating access to inter-community resources [80]. Beyond access to a greater variety of resources and people, participants explained that tying the network together could make them “*feel like you are part of something bigger. I think that God wants us to branch out*”. P6 points out how creating a larger, more accessible network of those with a shared faith tradition is not only empowering, but also spiritually fulfilling.

Several ministry leaders when interviewed suggested that having a mechanism for announcing their own events to the broader community would be helpful. P11 stated:

“I had wanted to start this COVID-19 grief support group. We’ve lost so many people, especially the older of us. But, I wanted it to be circulated, not just our church. But, I had no way of really getting it out there.”

A pastor mentioned using the app to give participants access to events and services offered by other churches stating that if one ministry addresses a topic at their church, then their own ministry could address another pressing topic. Through such resource coordination, churches could offer a greater variety of quality services to church members throughout the region.

These results highlight that building community connections is valued for two reasons: it supports increased care provision through resource coordination, and provides spiritual fulfillment by being a part of something “bigger”.

5 DISCUSSION

We created the Church Connect app with features that promote physical wellbeing, support social interaction among church members, and spiritual practices. Our study findings characterize participants’ reactions to a church-based mHealth app that aims to deepen social ties and spiritual practice for members of a church community – and their perspectives on how tools can further support such efforts in the future.

Our findings further highlight participants’ desire for health promotion tools that support church community values and social

dynamics. First, through our evaluation of Church Connect, we identified a set of community values that participants identified as integral to the design of digital health tools for church communities: social intimacy, caring, fellowship, privacy and discretion, and inter-community connections. Second, we conceptualize community dynamics as processes of change and development within communities, such as the ways in which social connections are forged and broken, or the ways in which social capital is built and wanes. Bringing these concepts of community values and dynamics together, our findings characterize how Church Connect supported community dynamics—shifts in social interactions and community characteristics that helped participants realize their community values and instances in which these values were challenged. In the following subsections, we build upon our findings to examine opportunities for the design and study of health technologies that respond to and recognize community values and dynamics, and that support a technospiritual and communal approach to wellbeing promotion.

5.1 Engaging Community Dynamics to Mobilize Social Capital in Faith Communities

Community Informatics is a field of study concerned with the design and evaluation of technology that promotes “community processes” and practices [38]. It follows then that to support health, *Community Health Informatics* would first identify the processes and practices used by a community to support health (e.g., collective social capital and community dynamics) and mobilize these practices through the careful implementation of technology. One way of doing this would be to examine different social configurations within the community and discern how each type of configuration can be engaged to support wellbeing through the mobilization of collective social capital. In our study, participants discussed altering the scope of *community* within Church Connect by flexibly minimizing and expanding their audience to support physical, social, and spiritual wellbeing.

In each of our Community Dynamics Findings sections, we discussed participants’ proposals for various social configurations that could support different forms of social capital. In the field of sociology, researchers have defined three types of social capital. They are bonding, bridging, and vertical social capital [31] (Table 2).

Table 2: Types of Social Capital

Type	Definition
Bonding Social Capital	Strong network ties form close personal bonds that provide emotional support.
Bridging Social Capital	Weaker social ties between members create a heterogeneous network that enables greater access to material resources and informational support.
Vertical Social Capital	Vertical ties between people who occupy different places in an institutional hierarchy create opportunities to access a greater number of resources.

These three types of social capital are associated with both individual and community positive health outcomes [8, 31]. In the health promotion community-based literature, researchers demonstrate that anchoring health promotion in community contexts is a way to build upon existing assets as a means of supporting community health [8]. However, we cannot assume that the introduction of technology alone can nurture the necessary community relationships that build social capital. In our interviews, participants expounded on their desire for social intimacy to develop friendships in the church community that lead to enhanced social support (e.g., expressions of empathy, validation, acknowledgment and prayer support). At the same time, participants admitted that these close ties can exclude others and limit the heterogeneity of their social network (i.e., newcomers have difficulty forging social connections). Indeed, an ability to add diversity and widen the scope of one’s network provides additional benefits in the form of greater access to information and material resources [31]. While discussing community values, participants described how different social configurations within the Church Connect app could build on each value thereby increasing social capital to promote community health and wellbeing (Table 3).

As we have shown thus far, participants described opportunities for design at increasing levels of scale: from interpersonal buddy relationships to small group interactions to community-wide engagements and they did so across physical health and spiritual domains. As mentioned in section 4.3.2, participants brainstormed mechanisms for Church Connect to create *buddy relationships*, one-to-one peer partnerships, by matching peers with similar health experiences, goals, and challenges. Participants felt that the Church Connect could meaningfully augment care provision in their communities through the linkage of members who might not otherwise meet. Participants also felt Church Connect could leverage their existing relationships to support wellbeing. Participants discussed how the app could catalyze small group formations to ensure that support provision is not reliant on the availability of one buddy, and how the app could support small groups with similar health interests (e.g., walking, meditation, nutrition). In section 4.6, we highlight how members also expressed a desire for additional health-focused features that included the entire church community, such as church-wide health challenges and announcements of health-related events (e.g., invited speakers, group exercise classes). At a wider scale, intra-community features could afford members access to health-enabling material resources (e.g., different skills among community members), and information. Finally, as mentioned in section 4.7, participants discussed how building inter-community networking between church communities could benefit their collective social support by connecting individuals across community organizations. Through a wider network of CBOs, church members can leverage institutional power, and engage in inter-community-wide civic activities. The greater heterogeneity of the networked community would create a diversity of opportunities that are further reaching than previously possible.

Together, participants’ recommendations help to paint a picture of the diverse ways that digital health tools that emphasize both health, wellbeing, and community support can help catalyze community engagements at various social scales, as a way to generate multiple forms of social capital within and between communities.

Table 3: Design Opportunities for Varied Social Configurations and their Connection to Community Values

Design Opportunities	Community Values	Social Capital
Buddy relationships matched on shared identities or mutual experiences	Social Intimacy, Caring, Privacy & Discretion	Bonding
Small groups based off of existing community formations	Social Intimacy, Caring, Privacy & Discretion	Bonding/Bridging
Small groups newly formed based on a health goal or mutual health experience	Fellowship, Caring, Privacy & Discretion	Bonding/Bridging
Church-wide health challenges	Fellowship	Bridging
Announce inter-community health events Inter-community prayer wall Inter-community health challenges	Community Connections, Privacy & Discretion	Bridging/Vertical

Future work should examine the affordances and challenges of varied social groupings in and between churches. Churches with predominantly Black memberships are historically associated with high levels of social cohesion and a strong sense of solidarity or belonging [69]. While other community contexts may also share a common identity and value system, they also may be more heterogeneous.

Future work in Community Health Informatics should identify how a studied community is already mobilizing social capital and identify opportunities for augmenting these efforts. This work should focus on understanding how community members currently, and in the future, would like to engage with others in their community generally and around health and wellbeing specifically. In our work, we found that participants valued social intimacy and that they would like to use the Church Connect app to promote health through the development of close friendships. We encourage community health informaticists to study the community dynamics of importance for each of the social configurations identified by community members. For instance, researchers should identify the important values, processes, and interactions that community members prioritize for community development generally and for health and wellbeing specifically. Once identified, technology can be developed to enhance these dynamics and limit their disruption. We call on HCI researchers to examine how supporting community dynamics through design can strategically build each form of social capital as a means of health promotion.

Conducting work in this area will require particular sensitivity when addressing health topics that are more controversial or sensitive. The current set of health topics addressed in the Church Connect app were wellness-based (e.g., physical activity), with arguably less stigma surrounding them than topics such as mental health and substance use. Additionally, some health topics (e.g., vaccine hesitancy and vaccine promotion) come with strong and conflicting beliefs in the general public, and thus addressing them introduces multiple levels of complexity that warrant further study. Future work should investigate these delicate health contexts, to identify implications for design and the impacts of tools that address sensitive health topics in church settings. For instance, how might disseminating a tool focused on stigmatized topics such as

substance use change church member expectations for maintaining privacy or disrupt the community's sense of social cohesion? Questions such as these must be examined to avoid threatening the social capital within churches and to identify opportunities for engaging churches' social capital to support community wellbeing.

5.2 Mapping Community Dynamics in Community-engaged Work

In their systematic review of church-based health programs, Lasater et al. applied a framework for classifying if a church-based health promotion program is *faith-based* or merely *faith-placed* [57]. This framework provides researchers with a classification system to examine the level of involvement of a CBO in a health promotion intervention when implemented by academic research partners. The framework specifies four levels (Table 4). Although these four levels of involvement were designed to assess the degree to which a religious organization was involved in the design, development, and dissemination of a health promotion program, this framework can be applied to a variety of CBOs.

Asset-based community development framework (ABCD) moves this further stating that an intervention or planned program should not only *involve* community members, but that any community development program should *augment* current organizational practices and build community capacity [54]. In ABCD, researchers take a multi-level systems approach and identify individual, group, and local institution assets (Table 4). Lasater's level of organization involvement views the community as a one-dimensional entity. Whereas in ABCD, community is defined with both a micro and macro lens and takes into consideration how different social groupings within a community can afford various assets. As of late, community HCI researchers have incorporated ABCD approaches into their standard research practices [21, 26, 35].

We believe that utilizing both of these approaches in parallel can assist in creating meaningful, sustainable, and effective community health promotion interventions and feel that in synergy, they encourage researchers to think beyond a single study or project period and instead develop digital health tools that could be leveraged to empower communities beyond research involvement. Informed by our findings, we urge CSCW and HCI researchers to consider not only mapping a community's physical or intellectual assets (e.g.,

Table 4: Frameworks that Drive Community Health Informatics

Framework	Stages	Definition
CBO Involvement	Level I	Community is used as an entry-point for recruitment purposes only.
	Level II	Community members are involved in the co-development and adaptation of intervention content.
	Level III	Community members are trained to administer the intervention.
	Level IV	Content is culturally-tailored to resonate with community values.
ABCD	Gifts of individuals	Identify gifts and skills of individuals households and families
	Citizen associations	Identify existing community associations (e.g., small groups, wellness programs, volunteer programs)
	Local Institutions	Identify public businesses and private institutions (e.g., hospitals, social service agencies, gyms)

material resources, knowledge) as ABCD approaches suggest but also mapping community dynamics (e.g., the processes by which the community leverages assets to create change). We recommend mapping dynamics during levels II and III of CBO Involvement.

The community values and dynamics characterized by our participants described the processes by which community members currently interact and deliver assets to help their community grow and thrive. They describe tensions that exist, such as a desire for social intimacy while also maintaining privacy or fellowship activities that span both offline and online engagement. They characterized values (e.g., caring for others, fellowship) and preferences for how community members want to engage with a health intervention (e.g., peer support through close friendships, creating new fellowship activities, accessing services in another community). Such community dynamics are as important as physical assets in that they provide a lens for understanding how a digital health tool can indeed support and engage community relationships to drive community development efforts. It is our hope that studying community dynamics intentionally will become part of a *Community Health Informatics* research agenda (i.e., a field of study focused on designing technology that mobilizes community assets and supports community members as active agents in improving community health and wellbeing).

Our work centered on identifying community values and dynamics in historically Black protestant churches. These specific community processes of change may not necessarily apply to other faith traditions. Instead, our work speaks to the importance of the *approach* of studying community values and dynamics as a key step in the design process of faith-based health technologies. In doing so, we were better able to understand how and why a multifaceted approach to wellbeing was personally salient and meaningful to church members in the context of the mHealth app. We encourage researchers to use this approach in other faith communities to explore how other faith traditions’ community values and dynamics may manifest similarly or differently from those identified in this work.

5.2.1 Realizing the Communication of Care Dynamic in Faith Communities. We designed a technospiritual component, the prayer wall, focused on supporting the spiritual practice of community prayer support. In our Level IV intervention, the prayer wall integrates spiritual, social, and physical wellbeing together as well

as mediates the spiritual practice of prayer. Through our findings, participants explored how the prayer wall could both enhance or challenge the communication of care (section 4.4). Community members reported that while the prayer wall was indeed effective at identifying and supporting community members in need of spiritual support, it created, for some, a sense of urgency to respond to posters. This deeply entrenched sense of accountability to others within the community could drive a sense of responsibility that perhaps is burdensome.

To alleviate this burden and to ensure that members within the community received a response, members suggested that a pastor or church leader should monitor the prayer wall to ensure that all members receive a timely response. Other digital health projects have realized similar tensions. For instance, in their MOVE app project, researchers found that community members and community health workers had different expectations for who would update, and maintain content in the MOVE app [51]. Our work demonstrates that establishing roles within the application (e.g., church members vs church leaders) would not only facilitate logistical management but also help realize community values (e.g., “making sure everyone is covered”). When designing technospiritual tools for religious communities, technologists should study how the introduction of such a system may disrupt a core community value. Thus, creating mechanisms to facilitate an immediate response to posts that align with current community practices should be investigated; however, such a solution needs to be designed to not burden church leaders.

5.3 Design Considerations for Technospiritual Prayer Support

Our findings show that one of the features that resonated most with participants was the prayer wall. Participants expressed great interest in a tool that not only mediates asynchronous prayer support but helps build their church’s prayer community. While HCI researchers have explored technospiritual practices, the intersection of community technologies and prayer support exchange is a relatively understudied field [97]. However, recent efforts in the merging of social technology practices and prayer support have been made by both the Catholic Church and the social media platform Facebook.

In July 2021, Facebook formally announced its efforts “cultivating partnerships with a wide range of faith communities from individual congregations to large denominations” [24]. The Catholic Church has created their own web-based online prayer network called the “Pope’s Worldwide Prayer Network” [77] fully equipped with a community forum where anyone with access to an internet browser can publicly post a prayer concern. In addition, the Vatican now sells an eRosary. An eRosary is wearable technology based on a tangible religious object called a Rosary used for prayer. The eRosary was developed in part to help beginners learn to pray the Rosary. The eRosary is part of the Vatican’s “Click to Pray” initiative that uses a smartphone app to deliver regular prayer content (e.g., monthly prayer intentions set by the Pope) and track your prayers [77].

Through our work and the work of other researchers and developers, we find that technospiritual interventions that support prayer can be multimodal. For instance, Church Connect’s prayer wall is text-based whereas the Vatican’s e-rosary and “Click to Pray” initiative includes wearable and sensing technologies. Kauer et al.’s *SoulGarden* is a personal prayer network visualization tool that incorporates ambient visualizations featuring music and contextually-based animations [52]. More work should consider different media formats and their affordances and challenges when supporting prayer support and exchange.

As our findings on the intersection of community dynamics and prayer support demonstrate, designing technospiritual community technologies is a complex endeavor. Designers must carefully consider how their prayer support platform aligns with the expectations of their religious audiences and honors the spiritual practice of prayer. We offer the following recommendations for developers to consider.

Allow for Flexible Prayer Group Configurations. Prayer practices are often done in various social groupings. For instance, individuals may pray on their own, with a prayer partner, with their families, in small groups, and/or with the broader church community. Each combination (praying alone or with others) is valuable and may be influenced by personal preferences or prayer needs, therefore platforms that hope to provide prayer support should allow for flexible prayer group configurations. Our participants shared interesting perspectives on how they would like to scope the audience of the prayer wall. One such perspective was to share a prayer with a group of people who really *know* the poster. A similar desire to control who can participate in an individual’s prayer support network was highlighted in Kauer et al.’s *SoulGarden* [52]. In their work, participants requested an approach to exclude unwanted prayer supporters through the implementation of an approval process. It is possible that in part, users of Church Connect believed that scoping their audience was a mechanism for asserting control over not only who could view their prayer post, but also as a way to limit unwanted replies to their prayer posts. Our findings did not fully unearth what drives these preferences nor did they characterize how changing the audience of one’s prayer request impacts how the poster perceives the prayers said on their behalf. Thus, more research into how flexible social configurations impacts computer-mediated prayer support is needed.

Reconsider “Likes” on Prayer Posts. In our formative work, participants expressed trepidation with having a public user facing

interaction counter feature that displays how many people have endorsed a post, e.g., a ‘like’ button with a numeric counter. Therefore, we chose not to implement such a feature to avoid any negative connotations around posts, such as whose prayer received the most likes, etc. Instead users passively acknowledge posted prayers by pressing the ‘add to prayer list button’ sending an automated message to the poster. In our work, church members reported comparing posts based on the number of replies. It’s fair to consider that similar issues may result had we implemented a ‘like’ button with a counter. Interestingly, the Vatican community prayer wall does incorporate this feature; however, more research is needed to explore the effect of this type of quantification on the spiritually connective experience, community ties, and mental health.

Promote Posts That Have Little Engagement. Users of the Church Connect App discussed concerns regarding posted prayers that received no replies. We must acknowledge that if we design computer-mediated prayer exchange tools as sequential group posts on contemporary social media platforms there’s potential that any one post may not be seen. This is a likely outcome if the user base is too small and/or if there’s a large volume of prayer requests being posted. In *SoulGarden*, flowers that represented unique prayer supporters would fade if the prayer supporter had not logged in or used the tool for a period of time [52]. Participants explained that in practice, the faded flowers may make the prayer givers feel guilty for not logging in. In addition, fading flowers could result in prayer receivers feeling lonely or isolated [52]. Our participants characterized similar tensions between prayer repplier response burden and prayer poster response expectations. Thus, investigating opportunities for alleviating these concerns and ensuring that all posts receive a timely response is an important technospiritual research endeavor. For instance, when posting a prayer concern what expectations for a response do posters have? And how does the fulfillment or nonfulfillment of that expectation impact the poster and their spiritual experience? These issues are of fundamental importance when studying the intersection of social computing and faith.

Formally Investigate the Impact of Private v. Public Responses. We did not implement an option to privately reply to a prayer wall post. Given that a desire to build close personal connections was a value identified in this work, we can imagine that there are potential socio-emotional benefits to allowing private prayer responses. For instance, a private response feature could make the self-disclosure of personal information that may be relevant to the prayer poster more likely. Thus, we encourage empirical work investigating the advantages and disadvantages of both public and private replies in the context of these prayer forums.

5.4 Exploring Whole-person Orientations to Digital Health Using Spiritual Dimensions

Whole-person models of care were developed in response to conventional reductionist biomedical frameworks of disease that address specific diseases and chronic conditions but ultimately ignore important dimensions [32, 49]. A whole person approach considers the entire person including but not limited to their physical health, environmental context, individual behavior and lifestyle, culture, social connections, mental and spiritual dimensions [49]. Research

in public health, addiction medicine, and general practice demonstrate numerous positive effects of whole-person approaches on patient outcomes including but not limited to improvements in quality of life, work productivity, positive health behavior changes, and increased involvement in healthcare decisions [49]. Accordingly, we aimed to take a broad view of what health might mean for church communities and incorporated elements that bring our work in line with the aim of attaining a less reductionist perspective.

While we acknowledge that there is considerable digital health work that addresses both physical and social health, our work emphasizes the benefit of incorporating spirituality. In the design of Church Connect, we viewed health and wellness from a communal religious stance based on recommendations of related work, which states that designing health applications for faith-based organizations requires not only an understanding of how faith and spirituality impact wellbeing, but also recognizing that for many, spiritual and physical wellbeing are intertwined concepts [81, 100]. Our participants expressed enthusiasm for the spiritual and community components included in the Church Connect app stating that features such as the prayer wall provided them with a mechanism to care for others and receive support from members with whom they share mutual bonds. Future work should explore how to design tools that provide this kind of multifaceted support in context and explore different ways in which tools could realize this mission. We’ve presented one case study for how we incorporated a spiritual and communal approach into the Church Connect health intervention, most notably through the prayer wall, however, there are certainly other possibilities for integrating spiritual dimensions into a health intervention. For instance, adapting spiritual content or language based on an individual’s familiarity with scripture or automatically offering enhanced spiritual support in response to a health crisis or new health diagnoses. We encourage continued work of this type.

6 LIMITATIONS

This four-week pilot study was conducted using a small purposive sample of church members from two church communities. While most of the participants from each church knew one another, future work should consider how a larger full scale deployment with hundreds of church members from multiple communities may change participant expectations and attitudes towards existing prayer support features. Though we specifically asked participants to consider how their expectations, concerns, and desires for this tool would shift if their entire church community were using the app, we cannot ignore that imagined realities may or may not adequately reflect all of the complexities or nuances that arise during full scale deployments. For instance, our participants discussed how scoping the audience of their prayer support posts from church-wide to small groups would be highly desirable. Another church member who used this app with other ministry members expressed disappointment when a specific member did not respond to his post. We do not know how church members’ desires for scoping their audience or disappointment at waiting for a particular church member’s response might change if more members are actively posting and responding on the prayer wall. In practice, nuances such as these may or may not change in a full scale app deployment.

7 CONCLUSION

Through this empirical work, we investigated how community values and dynamics can promote health and wellbeing in two predominantly Black church communities. Our findings highlight how a digital health app can support a community in realizing community values and offer opportunities for how such digital health tools can build on community dynamics to provide multifaceted health-enhancing interventions. We provide recommendations for examining communities with a focus on how community interactions mobilize social capital. To date, we are developing our second iteration of the Church Connect app based on this work with future plans for an evaluation of health outcomes. Our work contributes to research in faith-based health interventions and Community Health Informatics and encourages future researchers to intentionally study how community values drive processes of change when designing digital health applications.

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