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Diabetes Connect: Developing a Mobile Health Intervention to Link Diabetes Community Health Workers with Primary Care

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Abstract

Community Health Worker (CHW) interventions can help improve diabetes self-management and health outcomes. There is limited evidence on how to effectively integrate CHW programs with primary care efforts. Mobile health technology (mHealth) can connect CHWs to members of the healthcare team and enhance care. We tested a model for the integration of a CHW delivered mHealth intervention to improve diabetes self-management. Seventy-two African American patients with diabetes were followed using the mHealth tool. This project partnered an academic institution, a safety-net clinic, and African American churches. The integration of mHealth technology into CHW programs was successfully achieved and readily accepted.

Keywords

Community Health Workers; Diabetes Mellitus; Type 2; minority health; community networks; telemedicine; community-based participatory research

Introduction

The Community Health Worker (CHW) model is a promising strategy for diabetes management, with increasing evidence to support its effectiveness, particularly in underserved communities.[1-3] While the implementation of such programs is rapidly increasing, there is a less evidence on how to effectively integrate community-based peer support programs with primary care efforts.[4] Mobile health technology (mHealth) has the potential to bridge the community and clinical settings, connecting CHWs to members of the

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healthcare team, creating synergy through the bidirectional exchange of information leading to improved disease management and health outcomes.

CHW-delivered peer support is typically provided by trained, lay individuals who are ingrained in their communities and either have diabetes themselves or have helped provide support to a close family member or friend with diabetes.[2,5] Historically, community-based peer support typically occurred in parallel rather than in concert and integrated with clinical efforts.[5] An increasing number of programs have attempted to bridge that divide by hiring CHWs into primary care teams.[3,6] While this strategy may work in some settings, there are important benefits to maintaining *community-based* CHW programs, particularly in underserved communities where trust in the healthcare system is low and the reach of clinic-based CHW programs may be limited.

Community-based CHWs can feel disconnected from the healthcare system leading to dissatisfaction and turnover.[7-9] In our experience, CHWs desire increased interactions with the healthcare team for their own professional development and to help better facilitate a connection to resources and services for the individuals they serve.[8] This represents a clear opportunity to deploy mHealth technology to intimately connect CHWs to the healthcare team while providing the healthcare team a mechanism for reaching into the community. This innovative approach capitalizes on strengths and attenuates weaknesses that currently limit the effectiveness of community-based CHW programs.

The goal of this study is to develop an effective model for the integration of a community-based CHW program with primary care-based efforts to improve diabetes health outcomes through mHealth technology. We developed and pilot tested an interactive mHealth web-based application (web application) that allowed for the effective and secure exchange of information between CHWs and the primary care team, bridging both environments and allowing patients to benefit from coordinated efforts.

Methods

Study design

We developed the web application using and iterative user centered design approach.[10] We then pilot tested the web app with 4 CHWs over a 6-month period. Though the pilot study was designed as a small RCT, in this manuscript we report the baseline characteristics and process data only for those individuals followed by CHWs using the web application (intervention condition). We conducted a qualitative discussion group after the pilot ended to obtain feedback on the app. All processes and procedures were approved by our university's Institutional Review Boards.

Community Partners

This project leveraged an existing partnership among three organizations, namely the University of Alabama Birmingham, Cooper Green Mercy Health System (CGHS), and Congregations for Public Health (CPH). CGHS is a public safety net system that provides health care services for residents of Birmingham (Jefferson County) using a sliding scale based on income level. CGHS is committed to community outreach for diabetes and entered

into a partnership with UAB and Congregations for Public Health to that end. CPH is a 501(c)3 organization whose mission is to reach out to surrounding neighborhoods with services to promote health equity. CPH is composed of a network of African American churches located in some of Birmingham's oldest and poorest neighborhoods. Poverty rates in these CPH neighborhoods ranges from 44.2% to 68.8%, compared to 18.9% in the state of Alabama as a whole and 15.8% nationally.[11] A defined geographic radius of 1 mile surrounding each church includes over 118,000 low income African Americans, representing approximately 60% of Birmingham's African American population. CPH builds on the existing experience of their own CHWs, called NOSeys (Neighborhood Outreach Specialists). The CHWs manage operations, communications, program activities, and community outreach within each church's one-mile radius. For nearly a decade, they have been working in these neighborhoods to promote health and reduce disparities.

CHW Recruitment and Training

CHWs were recruited from within CPH and CGHS. We sought candidates that either had diabetes themselves or had a close relative (spouse, partner, child) with diabetes such that they were familiar with diabetes self-management and who also were dedicated to serving their community. We required that they have a valid driver's license and standard criminal background check. We hired five CHWs, 3 from CPH and 2 from CGHS. All CHWs completed training; however, one CHW was unable to continue with the project due to a medical illness.

All CHWs participated in a training designed to help them provide peer coaching to individuals with diabetes. Specifically, the intervention incorporated features previously identified as requisite to successful peer support interventions for diabetes self-management, including assistance with self-management in daily life, ongoing adjustment of management plans and provision of social and emotional support.[12-15] (Table 1) CHW training focused on communication, problem-solving, goal setting and principles of motivational interviewing over a three day time period (24 hours). Training included modules on group facilitation skills and basic research training and confidentiality. During the training, CHWs interacted with members of the healthcare team and discussed roles with regard to care of the participants as well as when to reach out for support or with questions. Upon completion of the training, CHWs were ready to encourage patients to set goals, problem solve and reach out to their existing social support network and/or the healthcare team.

mHealth Web Application Development

We applied a user-centered design (UCD) approach to develop the web application. As the name implies, UCD is an iterative approach to development that involves heavy engagement with the targeted end-users, in this case the CHWs as well as members of the health care team. UCD was coined by Donald Norman in the 1980s.[10] UCD is comprised of several key principles:

- Communicate often, favor face to face over documentation;
- Minimal Viable Product (MVP). Build only what is needed to complete intended task;

- Informed by users. Developers work with end-users to understand usage patterns and user interfaces;
- Tested by users and have a feedback loop from the end-users.

These principles were employed at every level of development, implementation and refinement.

First and foremost, frequent communication was an essential element of developing the web application. Our study team met on a weekly basis; this included investigators, staff, programmers and IT specialists, CHWs, and the clinic's Diabetes Educator. Meetings continued through the duration of the project and continued to inform refinement of the web application. Secondly, inherent to UCD is the idea that any creation is informed by users. Working with the CHWs and members of the health care team, we conceived of an initial conceptual model of the web application. (Figure 1. Web application) Paper versions of tracking forms were obtained from prior projects, adapted and then used in real time to allow for refinement to the content based on project needs. Once finalized, the content was used to create the online tracking and reminder system. The third principle of UCD suggests an initial focus on the minimal viable product (MVP). This means that to start, it is best to focus on building only what is needed to complete a task in order to achieve efficiency in the development process and an end product that is maximally useful. To achieve this, we collectively revisited our initial conceptual model and elected to begin with a tracking and reminder system as well an internal secure messaging system. Once these items were completed we went on to create a progress report for use by all involved (healthcare team, participants, CHWs). This report provided information on behavioral goals, barriers to goals, and medication adherence. Additionally, CHWs navigated participants to community resources to facilitate ongoing diabetes management and behavioral goals using MyDiabetesConnect.com. This website was launched to house local, free and low-cost resources for those living with and affected by diabetes.[16] A final principle of UCD emphasizes the importance of real time testing and feedback by users. We achieved this through both the weekly meetings and ongoing feedback from users. We obtained real time feedback on technical aspects of the web application. Some examples of issues that were addressed included problems such as character limits in free text fields and the capacity to only communicate with a single intended recipient. The continuous real time feedback from CHW end-users, allowed the programmers to continually refine the web application to meet implementation needs and enhance usability.

Diabetes Connect: Web Application Description

The Diabetes Connect web application consists of 3 core features: 1) contact tracking and call reminder system, 2) secure communication system, and 3) progress reports.

Contact tracking and reminder system—Each CHW had a unique work list generated by the application. Upon signing into the application, each CHW saw their work list that consisted of the pending contact forms (new and previously enrolled patients). This work list described the name of the participant, type of contact (initial or follow-up), and contact due date. In the case of newly enrolled patients, the CHW would initiate contact within a pre-

specified time interval and would complete the initial registration form using a tablet while they were talking with a participant. The initial form included demographic information on the patient as well as information about their behavior change goals and any barriers they thought would interfere with completing their self-identified goals. The Tracking/Reminder system would then bring up each subsequent contact form and its due date, at the defined study intervals, to help CHWs keep track of where each patient was in the process.

Secure messaging system—This was created to allow for real-time messaging. All team members had access to the system. The CHWs could send messages or questions to a member of the healthcare team (this included a certified diabetes educator (CDE), a registered dietician, and a physician). Our goal was a response to any patient concern within 24-48 hours.

Progress reports—Finally, the web application also included a means for generating a "progress report", which provided information on medication adherence and any problems or barriers identified by the patient and progress towards self-identified behavioral goals. The report was intended to provide a snapshot of the patient's progress.

Pilot Study

Study population—Patients with poorly controlled diabetes were identified through the CGHS electronic database and mapped to one of 10 CPH (Congregations for Public Health) neighborhoods using zip codes. Potential participants were mailed an opt-out invitation letter from the CGHS diabetes clinic with information about the study. Afterwards, the CHWs with the help of the study coordinator and CGHS certified diabetes educator, followed up with a telephone call for recruitment. Participants were eligible if they were African American, 19 years of age and older with poorly controlled type 2 diabetes (HbA1c >7.5%). At the time of enrollment, we measured potential participant's HbA1c using a point-of-care HbA1c testing device (Bayer Now+). To be eligible, participant's HbA1c had to be greater than 7.5% mg/dl. Individuals with end-stage medical conditions with limited life expectancy (<6 months), no access to a telephone, expected to move out of the area in the next 6 months, not community dwelling, or unable to speak English were excluded.

Intervention—All participants were invited to attend a community-based diabetes self-management education (DSME) session that was held at either one of 10 participating CPH churches or CGHS. Prior to DSME, potential participants provided informed consent and screened for eligibility. After DSME, eligible participants completed an interviewer-administered baseline questionnaire. Following the questionnaire, eligible participants met with an assigned CHW face-to-face when they either completed an initial intake interview or scheduled a follow-up visit at a more convenient time for the participant. This face-to-face encounter allowed CHWs to develop a rapport with the participant prior to initiating the telephone contacts. CHWs then called the participants weekly for 3 months and monthly for another 3 months. They also held monthly support groups. CHWs helped participants choose a behavioral goal related to diabetes self-management and then helped track their progress over time.

CHW focus group procedures and analysis—Upon completion of the project, we invited the 4 active CHWs to participate in a discussion group to get feedback on the project as a whole and specifically on the web application. They completed a brief questionnaire that included basic demographics as well as a scale to measure computer self-efficacy.[18] An interviewer trained in qualitative methods conducted the group using a moderator's guide. The discussion was digitally-recorded and transcribed verbatim. For analysis, the transcript was read, independently coded by two investigators and a research assistant using constant comparison and content analysis.[19,20] The transcript was then discussed line-by-line until 100% consensus was achieved on each code. Codes were revised and added as subsequent transcripts were reviewed, using an iterative consensus process. Codes were then groups into themes and sub-themes.

Results

CHWs tracked 72 participants using the Diabetes Connect web application. Two participants did not complete a baseline survey. Appendix Table 1 provides the baseline characteristics of CHWs and participants (n=70). Participants (n=70) were African American with physician diagnosed type 2 diabetes. They were low-income, earning on average less than $1000 per month, majority female (67.1%) with a mean age of 54.9 years and over half were divorced/ separated or widowed. Almost half (47.1%) had some college or were a college graduate. Ninety percent owned a cellular telephone. However, 50.8% of those owning a cellular telephone stated that they never or rarely used text messaging and over half of all participants (n=45) stated that they never or rarely used the Internet. Mean baseline HbA1c was 10.1 mg/dl ranging from 7.5 to 13.0 mg/dl and the majority (n=41) reported that they were on insulin therapy. Participants had a mean baseline Body Mass Index (BMI) of 35 (range 19.0 to 57.2).

Active CHWs had all completed some college or were a college graduate and were between the ages of 39 to 66 years. (Appendix 1) Three of the 4 CHWs reported a diabetes diagnosis by a physician. And the majority was not married. Perceived self-efficacy regarding the use of the Diabetes Connect web application was assessed using a 10-item measure with response from 1, not at all confident to 10, totally confident. [Add ref] CHWs reported a mean score of 52.3 (range 20-87) out of a total possible score of 100.

Contact Tracking and Secure Messaging

CHWs made 1,129 contact attempts, of which almost half were successful. On average, participants received 8 successful contacts. (Table 2) One hundred and twenty five behavioral goals were set. Goals primarily focused on physical activity and diet. A smaller proportion of goals were set to improve self-monitoring of blood glucose and medication adherence. Over the course of the study, 314 unique messages were sent regarding 53 participants. CHWs sent 74.5% of the messages and 25.5% were sent by a member of the health care team. Messages from CHWs was varied and focused on diabetes management and patient updates. Almost 50% of the messages were related to diabetes management issues and questions about getting in contact with participants (telephone/address). Messages about diabetes management often focused on uncontrolled blood sugars: “[Participant] says

blood sugars running high (in the 200's) and says he's not eating right. I encouraged him to make healthier choices but he wants to know else he can do to bring his sugars down." Others were complications related, "Patient is suffering severe neuropath, has trouble sleeping...What do you recommend?" Other messages included communications about patient appointment needed (primary care, podiatry, etc), medical questions, updates on participants' visits to the clinic or the Emergency Department/Urgent Care, and questions related to web application use. Message content from the health care team was primarily in response to CHWs or contained a progress note about a participant. The remainder of the messages was requests to follow-up with participants regarding medication adjustments: "[Participant] is going on insulin...he is to check his sugar every morning and write it down. Please ask for his numbers next time you talk and let me know so we can adjust his insulin." Another message requested follow-up after a participant began a steroids for rheumatoid arthritis, "last A1c elevated, increased insulin needed. Continue 45 units in am and increased pm dose to 40 units BEFORE dinner. Check am sugars, desired BS goal 70-130. Please follow-up with her in 3-4 days."

CHW Focus Group Qualitative Results

The discussion group focused on CHW roles and activities and the functionality of each of the web application, particularly the contact tracking and secure messaging system.

CHW roles/activities & challenges—The first part of the discussion group focused on CHW roles and activities and challenges faced. CHWs described their role using words like "helper" and "encourager." For example, one said "I was an encourager, to encourage individuals with diabetes to take better control of themselves and to, to love themselves." Activities included the weekly calls to check progress towards participants/behavioral goals, identification of barriers and problem solving to address barriers. They facilitated support groups, linked participants to resources in the health system and to community resources and some CHWs started walking groups. They also talked about challenges they faced; these included a number of participant level barriers, including limited resources, transportation issues and lack of motivation. The latter was noted as a source of frustration. For example, one CHW said: "It was challenging like when you get in touch with them and they say they weren't doing right or, you know, they say they ain't gonna do right even though they know it's hurting them."

The CHWs discussed strategies used to overcome the lack of motivation, including: 1) continued calls with offers of support and assistance and 2) lots of patience. One CHW explained, "[You] keep hanging on in there... never giving up... and you keep hoping that they'll turn around." And another said, "Just being patient and listening to what's going on. Just being there." The CHWs also discussed a learning curve related to using the web application, this is discussed more below.

CHWs & web application implementation—A significant amount of time during the discussion group was spent getting feedback on the web application, focusing primarily on secure messaging and the tracking system. In general, the CHWs liked the messaging system and felt supported by the health care team. One CHW explained, "Whatever you needed,

you got it....if a patient needed something, I was able to contact [the nurse] and she'd get me back and I'd relay the message to my participants." Another said, "When a [participant] called with a problem, if it was something I couldn't answer, I could always send a message to ask what I needed to know..."

CHWs noted the importance of getting answers for participants in real time and the ability to link them with health system resources. One CHW explained, "With the messaging system, I could get them connected to [the diabetes educator] if they were out of meds or if they needed an appointment or something like that." Another reported: "I think it was a very useful tool because if you came up with a problem with someone, you could quickly respond back to them." One CHW also noted that she felt that getting answers for participants in real time showed they cared:

> "They would feel like, 'Oh they care,' because if it was something that I didn't know the answer to and then, [someone] would get back with them. It was just a tool to really show them that we really care about their condition and improving their condition."

CHWs reported variability in the frequency with which they used the massaging system, with some reporting a learning curve, "I just had to get more proficient in using it, once I had the hang of it, it was almost like the telephone." Also, there were initial problems with the turn-around time for when they received a response from the health care team, noting "Initially it wasn't good...it wasn't always 24-48 hours. But I think after a while it did get to that point." And other instances where the CHW felt they needed help faster than the 24-48 hour messaging system would allow. For example, "Because, say, for instance, they come over the problem at night, you can't get [a response] until the next day."

CHWs reported a number of positive aspects related to the tracking system; these including helping them to "stay on task", guiding the conversation, making sure everyone was "on the same page", and easy to use. One CHW said, "Everything was in the program... it was real simple, self-explanatory." Another explained, "It kept me on task...if I forgot, I would turn it on and it would popped up, 'You're late'...it was wonderful." CHWs also liked the reminders. For example, " And when I'd look at those dates, you know, I'm saying "I've got to get you, I've got to get you—you know, that prompted me to be a bit more aggressive when otherwise if you'd see it on the paper, you wouldn't notice it as much."

When asked what proportion of participants received extra contacts outside of the scheduled contacts, whether initiated by the participant or the CHW, the CHWs gave a range of 50-75%. Often, these exchanges were not captured. One CHW explained, "I tried to [keep track of extra calls], but like [the other CHW] said, if you were in a—if you weren't near your iPad, you might forget to do it." When asked about the content of the calls, they were usually not diabetes specific. "Most of the time people want to talk about other stuff...'How's it going?' 'What're you doing?' 'We're having something at church. I cooked.' Something like that."

CHWs noted a number of "technical problems" when system was fist launched. For example, "My biggest frustration was when I typed a lot of information and I got an error

message at the end. And none of my stuff was saved." They also described the real time improvements of the web application achieved through regular meetings. One CHW said, "Actually the problems that I had were worked out in the process of using it because it was new then they worked and got everything out--all the kinks out of it. It was running smoothly when I got done."

Discussion

In this study, we successfully developed a web application designed to assist community health workers (CHWs) in their daily work and pilot tested the tracking system with 72 patients with type 2 diabetes. The iterative, user-centered design approach allowed the team to create a tool that was user friendly and met the needs of the CHWs. The online system allows CHWs to track patients' progress towards their diabetes self-management goals while also tracking the interactions between CHWs and their assigned patients. The secure messaging system keeps the CHWs connected to the health care team, enabling them to ask questions and seek support in real time. The stand-alone nature of the system could benefit community-based CHW organizations that wish to partner with multiple clinics and patient-centered medical homes.

An increasing number of studies have demonstrated the benefits of including CHWs and peer coaching in the management of chronic disease.[2,21-23] However, there remain important questions about how best to integrate the work that CHWs do with the activities of the existing health care team.[24,25] In some settings, health systems and patient centered medical homes are hiring CHWs directly while others choose to partner with community-based organizations and existing networks of CHWs outside the health care setting.[4,26] While both strategies have merit as well as potential risks, one common feature in need of attention for both is the means by which CHWs communicate with the larger team.[27] In the current study, CHWs were hired through a subcontract to a community-based organization. We employed traditional mechanisms for communication, including weekly team meetings, phone calls as needed, as well as an innovative communication system via the web application. CHWs had access to members of the health care team through the web app in real time allowing them in turn to respond to their participants' questions and needs quickly. A significant proportion of messages included content regarding medications, ranging from patients being out of medications, confusion about the dose they should be taking, and concerns about side effects. In these instances, CHWs were not only able to provide general emotional support and coaching to their participants, they were able to loop back to the clinical care plan by providing clarification and guidance in concert with the clinical care team. The potential for support between the CHWs and the health care team is also two-way. Though they accounted for a much smaller proportion of the messaging, there were instances were the health care team member reached out for CHW follow up after medication changes or adjustment. This demonstrates the potential such a system has for connecting members of the patient care team, including CHWs, in meaningful ways that will ultimately benefit patients' self-managing chronic diseases such as diabetes.

In general, the mHealth technology based system was well received and utilized, particularly once CHWs gained confidence and experience using the system. CHWs provided positive

feedback on the tracking system. In general, they liked having a guide to help structure the conversation. They also like having a built in reminder system and work list to help them organize their activities and facilitate their work flow. Tracking CHW activities has historically been a topic that garners much discussion both anecdotally as well as in the literature.[28] While CHWs are typically caring individuals who are very passionate about their work, "paperwork" is often cited as somewhat of a burden.[5] Our application of a user centered design in the development of the web application resulted in a tool designed specifically for CHWs that is easy to use and focuses on the features they really need in order to get their job done. The iterative process we employed allowed us to refine to tool to meet their needs and make necessary changes and additions in real time. For example, qualitative feedback at the end of the study revealed the fact that CHWs often engage in unscheduled calls. In response, we have developed a "free note" where CHWs can log the call and make note of any information obtained through the call. The tracking tool we developed not only helps the CHWs with their daily activities, it could also serve as an efficient means of tracking activities for payment purposes. As more and more clinics and health systems look to include CHWs in the management of chronic disease, CHWs need to have a way to demonstrate the "behind the scenes" work that goes into their individualized care plans.[24] Software designed specifically to support CHW workflows can enhance efficiency, documentation of services, information sharing with clinic partners and ultimately provide the data needed for billing.

The free-standing nature of a web application has both drawbacks and important benefits that deserve mention. As a stand-alone system, it was not integrated into the existing health system electronic medical record (EMR) therefore data collected on the web application did not appear within the EMR, nor could CHWs access patient clinical records. Whether or not the latter is positive or negative is an area of current debate and may ultimately depend on whether the CHW is employed directly by the health system or not. One potential benefit to having the freestanding system, particularly for CHW organizations that exist independently from the health system, is that it allows the CHWs to work with multiple clinics and patient centered medical homes. Upon completion of the project described here, we created a new non-profit, Connection Health (www.connectionhealth.org)[29], designed specifically to provide CHW services to clinics in the greater Birmingham area. We will be providing feedback via the reporting system to providers and providers will have the ability to log into the web application should they want to send communication to the CHW working with their patients. We have designed a formal qualitative evaluation to assess a health systems' satisfaction with these modes of communication.

This study has several limitations. The intervention was brief at six months. The ongoing development process meant that the progress reports weren't available until the end of the study and as such we were unable to evaluate or receive meaningful feedback on that piece from providers and participants. Finally, our evaluation does not include feedback from the health care providers that will be critical for moving adoption and integration of our technology facilitated CHW care model forward in clinical practice settings.

Conclusion

We developed a mobile health web application designed to assist CHWs in their daily activities while connecting them to the health care team in real time. CHWs utilized secure messaging to relay patient questions about medications, diabetes, and other self-management issues, thus closing a loop that is often left hanging between clinic to community and back. Implementation of the system in real time with continual feedback from end-users allowed for refinement of the tool and ultimately resulted in an application that is easy to use and meets the CHWs needs. Future studies are needed to assess health care provider preferences for communication with CHWs in the co-management of patients with chronic disease.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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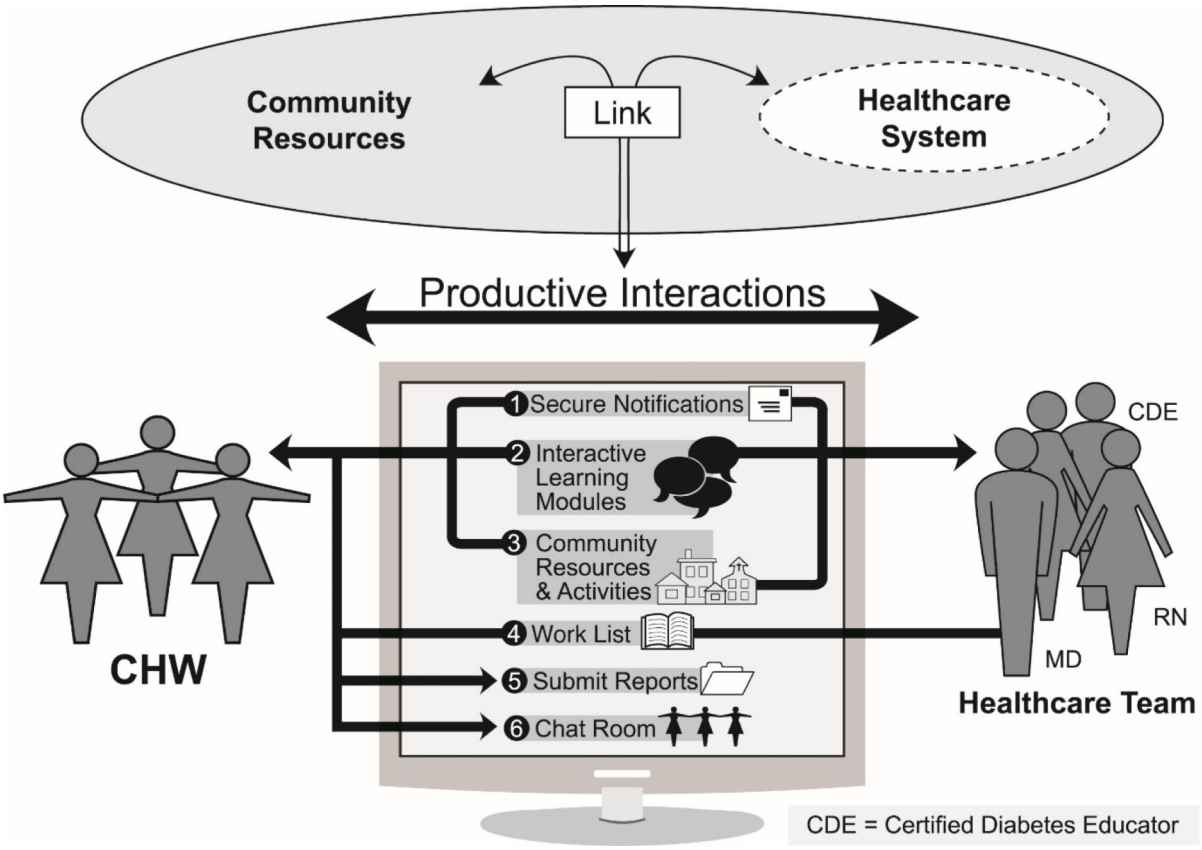

Figure.
Diabetes Connect Web-based application conceptual model. CHW indicates community health worker.

Table 1

Key functions, objectives, and strategies of the Diabetes Connect mHealth pilot intervention implemented by Community Health Workers in a sample of African American participants (n=72) with type 2 diabetes mellitus.

Key Functions of Peer Support	Intervention Objectives	Strategies
Assistance in applying self-management in daily life	✓ To provide individualized assistance for diabetes self-management	• Personalize the education (e.g., reinforcement of personal motivators to be healthy) • Encourage patients to problem solve, adjust or set new goals over time • Review behavioral goals, ensure they are SMART* • Link patient to diabetes information & resources
Emotional & social support	✓ To encourage the use of newly attained skills, stress management, and be available to talk through negative emotions	• Link patient to community resources • Provide supportive listening • Encourage stress management and problem solving when appropriate • Discuss strategies to identify and reach out to one's support network • Lead monthly support groups
Linkage to primary care	✓ To serve as a liaison to clinical care & encourage patient activation related to health care visits	• Communicate with Diabetes Educator regarding patient needs/ issues • Work with patient to identify needs/questions prior to visit • Reinforce attendance at visits, education sessions • Follow-up with patient after doctor visits
Ongoing support	✓ To provide proactive, flexible support as needed over time	• Provide regular monthly contacts • Lead ongoing monthly support groups • Be available for additional phone calls and contacts on an as-needed basis.

*SMART = Sustainable, Measureable, Attainable, Realistic, Timely

Table 2

Diabetes Connect mHealth web application data on participant tracking, behavioral goals, and secure messaging

Characteristic	Participants (n=72) Mean (SD) or Percent (n)
Participant Tracking	
Number of attempted contacts	1,129
Number of successful contacts	49.5% (559)
Average *successful* contacts/participant	8
Total behavioral goals set by participants	125
Type of behavioral goals set by DSM area	
Physical activity	44%(55)
Diet	36%(45)
Monitor (blood sugar/medications)	16.8%(21)
Risk Reduction (smoking/alcohol consumption)	3.2%(4)
Secure Messaging	
Total messages sent by CHWs	237
Message content	
Appointment needed	5.9%(14)
Medical questions	5.9%(14)
Medications	11.8%(28)
Update about participants' ED/clinic visits	13.9%(33)
Questions about web application use	16.9%(40)
Diabetes management issues	21.1%(50)
Questions about participants' contact information	24.5%(58)
Total messages sent by heath care team	77
Message content	
Response to CHWs	79.2%(61)
Participant progress note	13.0%(10)
Follow-up regarding medication adjustment	7.8%(6)

Note DSM=diabetes self-management, CHW=Community Health Worker, ED=Emergency Department