A Peer-Facilitated Diabetes Self-Care Management Support System using Mobile Telephony

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***Abstract*—This paper presents a mobile health system called Mobile DSMS which is based on the collaborative disease management framework using mobile technologies. Mobile DSMS allows patients with similar disease management interests to virtually gather and share experiences, ask questions and provide support and problem-solve remotely through the use of mobile devices.**

Keywords- collaborative disease management, human-computer interaction, remote peer-support, mobile dsms

I. BACKGROUND

Research [1] defines collaborative disease management (CDM) as interventions based on social learning and self-regulation theories that improve outcomes of a disease. CDM enables patients to mitigate the complications associated with a disease by learning from others in their community and by practicing better self-management habits. Unlike some existing remote peer-facilitated systems [2,3,4] this research focuses on the delivery of CDM using mobile telephony. It concentrates on engaging the communication between patient and patient, built on the social networking culture of the power of communities. In the proceeding scenario, we present a use case scenario for CDM using mobile technologies, and then we discuss the different components of the supporting framework. This research is expected to contribute to both the fields of CDM and Mobile Health.

Meet Rajesh the farmer. Rajesh has been living with diabetes for the last 15 years. He has recently started noticing that his feet are giving him problems on occasion. Rajesh suspects it may be related to spikes in his sugar level but he does not have any written record of his past blood sugar readings to confirm this. He lives in a rural village and is not scheduled to visit the clinic for another three months. He knows that one of his neighbours, Carlos, also lives with diabetes but he is not sure when next he will be meeting him. Rajesh wants to take action soon before his condition starts to worsen. This is where CDM can make a difference. The objective of the framework is to demonstrate how CDM using mobile technologies allow users with similar disease management interests to virtually gather and share experiences, ask questions and provide support and problem-solve remotely through the use of mobile devices [5]. The term problem-solve in this context refers to the person's ability to identify patterns in their disease management routine and how this information can be used to influence health outcomes. The framework is broken up into five components: the CDM Mobile User, The Support Context, Data Management and Sharing, Socio-Economic Aspects: Facilitators & Inhibitors and Security & Privacy. The first four components are summarized in the following sub sections.

A. The CDM Mobile User

CDM mobile users share the characteristics of mobile users, self-managed people and collaborative people. Mobile users are seen as always on the go, heavily influenced by their environment, are constrained by the affordances of their mobile devices and have the feeling of always being connected. Self-managed peoples' main objective is to better manage their illness. They see prevention as the key to control. Collaborative people are willing to share and see the exchange of knowledge as a valued resource. Given these general characteristics, special consideration must also be given depending on the demographics of the particular target group.

B. The Support Context

For collaboration to take place there is a need to establish a community with defined roles and privileges within a shared context. Thus, mechanisms to discover users and connect with them and their interests in a mobile environment and in a seamless manner are necessary. A key issue for coordination among users is the implementation of a group formation using user specific data and constantly changing individual goals.

C. Data Management & Sharing

While there has been significant research work in developing CDM protocols, the interactions typically proceed in a web-based fashion. With a mobile-based system, new protocols for data sharing are needed. New constructs are required to express personalized sharing options offering a finer grain of control and data visibility.

D. Socio-Economic Aspect: Facilitators & Inhibitors

The success of collaborative systems depends on the socio-economic incentive mechanisms that enable each user to work for the "common good". Challenges such as lack of motivation where some users may choose not to participate or may participate infrequently may occur; especially since users are not located in the same physical setting. Therefore there is a

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need for an appropriate incentive system in place, with some form of reward, in order for CDM to occur else the intended support will be ineffective.

In the next section we demonstrate how the framework was realized through the design and development of a collaborative disease management system called Mobile DSMS.

II. MOBILE DSMS

Our research is intended to validate the framework presented in previous section through the design and development of a collaborative disease management system called Mobile DSMS that facilitates both self-management and peer-support using mobile telephony. The system allows patients to use a mobile phone to record observations of their daily life (ODLs) and share their knowledge and experience of their disease with their peer group. In this context, ODLs include the patient's physiological readings, exercise in minutes, caloric intake and current location. The assumption is that through regular monitoring of one's health and learning from others who share similar experiences, the patient's overall health status will improve thereby decreasing the mortality rates associated with poor self-care practices. Patients will now be empowered to manage their own health through the learning and sharing processes.

The Mobile DSMS system is made up of three main parts: the *peer interface*, the *peer web services* and the *communication network*. The peer interface includes the patient, the patient monitoring equipment and the application running on the patient's mobile phone. It was developed using a user-centered approach [6]. In this version of the system, the patient monitoring equipment consists of the patient's blood sugar meter - the device used to measure the patient's blood sugar level. In the future, when the system is scaled to include the tracking of other diseases, the respective sensor/meter will be included. The mobile application is the main interface with the patient. The application runs on a mobile Smartphone running Windows Mobile OS. The application also uses an onboard database called SQL Server CE to hold all the ODL data entered by the user. Storing the patients' data on the phone ensures that patients will own their personal data and have the authority and freedom to share data with whomever they choose. A 4 Gigabyte micro SD storage card is used to hold all the extra resources needed by the application so as to expand the storage capability of the phone. The peer web services comprise a remote server hosting a variety of web services used to coordinate the sharing activities of each patient using the Mobile DSMS system. The services allow the users to share information relating to the ODLs and other health related information. The peers control what other peers within their group can see regarding their personal health data. For the communication network, data is transferred using SMS and GPRS over a GSM network.

Screenshots of the peer interface are shown in Figure 1. The first screenshot depicts the main screen for the peer services, the second displays the interface used to share information within the peer group and the third screen shows the visualization used for comparing group members' ODLs. In January 2012, a focus group was held to obtain preliminary feedback on the system's concept and the peer interface design. In June/July 2012 a field trial will be conducted so that users can access the system in their local settings and further design changes are expected based on usage in uncontrolled environments.

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Figure 1. Mobile DSMS Peer Interface Screenshots