

The Use of Mobile Technology for Proactive Healthcare in Tribal Communities

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1. Introduction

In Arizona, a state with one of the largest Native American populations in the United States, life expectancy is 55 years for Native Americans compared to 74 years for white Americans (Arizona Department of Health Services, 2000). Diabetes, in particular, is of epidemic proportions in most Native American communities; approximately 15 percent of those receiving healthcare from Indian Health Services are diagnosed with type 2 diabetes (National Diabetes Information Clearinghouse, 2002).

There is a healthcare crisis in tribal communities because of insufficient medical staff, facilities, and funding. Often times, patients wait for months to get an appointment or resort to emergency room visits to obtain critical healthcare. The number of patient visits to the Phoenix Indian Medical Center illustrates the strain on existing healthcare resources, as it has a capacity for 40,000 annual outpatient visits but handled 250,000 during 2001 (Arizona Department of Health Services, 2000).

Innovative approaches to managing healthcare are needed to address the health crisis facing these communities. One such approach is the use of telemedicine such that a patient's health is monitored proactively to improve longevity and quality of life. Telemedicine could result in a significant decrease in the number of patient trips to the clinic, thus reducing the strain on healthcare resources.

Telemedicine is relatively new in the use of the Internet to provide remote healthcare services. Much of what has been developed is the result of innovation and entrepreneurship. In the past, it has been hindered by the lack of research on effective user interfaces, high cost of technology, and few field champions for its use. Given the healthcare crisis facing many communities in the remote areas of Arizona, champions are rising to the occasion to promote proactive healthcare. In addition, the cost of mobile technology and supporting services continue to decline at a rapid pace. The user interface issues can be addressed by innovative software development and usability studies in local communities.

This research proposes to use mobile technology to proactively monitor a patient's health. The mobile device allows for data gathering by a healthcare provider or a patient. A localized version of the patient database allows for transparent synchronization of data gathered using the mobile device with a centralized system. As such, patient data is maintained electronically promoting the opportunity to monitor both personal and community health trends.

Health personnel from two tribal areas have contributed to the medical component of this work. The health focus is on foot care given the high rate of amputation in the local communities. The U.S. National Institute on Health's foot form, used by local health clinics to monitor foot health, is the basis for much of the automated support that is currently under development. Additional health data related to diet and exercise will be added incrementally for proactive health maintenance.

2. Technology Overview

The Viewsonic® PocketPC, a mobile computing device, is used in this research for the purpose of monitoring the health of a diabetes patient living in a remote area of the U.S. The PocketPC is being used because it is relatively inexpensive at less than \$300 per unit. It has secondary storage capability at a low cost, a built-in digital camera, and a relatively simple to use interface. It also supports wired and wireless capabilities both of which offer opportunities for data transmission in remote communities.

This mobile device is used two-fold. In one scenario, it is used by a healthcare practitioner during a home visit to enter information about the health of a diabetic patient. In the second scenario, it is used by the patient for personal monitoring of diabetes. Each of these scenarios is described below.

Mobile Technology Support for Healthcare Provider

The healthcare provider uses the PocketPC in order to gather information about the patient's diabetes while conducting a home visit. This device is very useful in this environment because of its mobil-

ity and support of both wireless and wired capabilities. Information gathered by the healthcare provider includes a thorough analysis of the patient's foot in order to uncover potential foot wounds. This information, along with other healthcare data, is entered into the localized, relational database residing on the device. Once the visit is completed, the healthcare provider is able to enter notes, schedule appointments, make referrals all of which are stored as part of the patient's record. There is the capability to transmit this digital data via a wireless Internet connection. As such, data can be transmitted to a medical facility in real-time expediting personal healthcare that might be needed.

The user interface of the device is modeled after the foot form that is currently used by the Tuba City health clinic. It is a standard mechanism for gathering patient data during a visit to a clinic. The screen size of the PocketPC is prohibitive in showing the foot form as a whole document. As such, it is decomposed into components in which the healthcare provider enters data. The data for each component is stored in the localized database that can be easily synchronized with a central system located at the healthcare facility or transmitted wirelessly.

Data is currently entered manually in the foot form during a patient visit to the clinic. As such, it does not allow for data mining capabilities to study health trends. The use of the PocketPC to automate the data gathering process will promote long-term analysis of diabetes and related health-issues.

Mobile Technology Support for Patient

A patient may live in a remote part of Arizona making it difficult to obtain proactive healthcare. As a result, diabetic patients may only seek medical treatment upon a severe foot wound not healing or some other medical crisis occurs. The PocketPC would enable a patient to enter data on a regular basis regarding proactive foot care and other health information. In addition, the patient would receive reminders ("Did you examine your feet today?"), and information about diet and exercise. The localized database residing on the mobile device stores information that would assist the patient in daily activities.

The use of the PocketPC by a patient has unique usability issues in terms of health literacy, vision, and physical steadiness of the hands. In terms of health literacy, information has to be provided at an appropriate reading grade level. The user must be able to enter responses using a stylus pen with no typing required. This means that questions about the patient's health must be presented such that buttons are clicked. The design of information content is such that it must appear in a larger font size in order to accommodate those patients with degrading vision.

One of the usability aspects currently being studied is the technical support of audio and video capabilities in order to assist the patient in using the technology. For patients with low English proficiency, the device would read questions aloud and in a native language. The video capability would allow the user to take a picture of a wound that could then be transmitted as part of the patient data. Thus, foot problems could be addressed while still in a treatment stage.

3. Ongoing Research

There are unique obstacles that need further study. Healthcare personnel from Tuba City and Winslow Arizona health clinics have provided medical resources necessary to formulate the patient diabetes monitoring system. However, the monitoring questionnaire for foot health alone is quite extensive. Further study is needed to determine an appropriate number of questions that would make it feasible and more likely for a patient to use this home monitoring system.

The use of wireless technology in tribal communities is becoming a viable option given the rapid entry of cellular service providers into these areas. The capability of the PocketPC is such that the patient's data can be stored on a secondary device, which can be sent to the healthcare facility when wireless capability is not available. Chapter houses and community centers have been wired for Internet connectivity, which also provides a mechanism for information dissemination.

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