DESIGN AND ANALYSIS OF SMART PHONE BASED SELF-MONITORING SUPPORT SERVICE FOR DIABETES

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ABSTRACT

Self-monitoring support service is gradually viewed as a core component of the management of chronic diseases to enhance patient engagement in their daily self-care. However, the support service for self-care is insufficient and ineffective for disease management in the current healthcare system. This study aims to analyze the strategic planning of self-monitoring support service and design a smart phone based application for Diabetes. The study was conducted at a local hospital setting in northern Taiwan. First, this study examines the existing service flows in the hospital setting, and analyzes the strategic planning of self-monitoring support service, then presents a self-monitoring support service framework, and designs a prototype system based on smart phone applications.

Keyword: Self-care, Self-monitoring, Chronic disease, Diabetes
INTRODUCTION

Diabetes can be a life-long disease that patient needs to learn to live with dynamic illness condition [1] and identify self-care strategies to prevent further complications induced by the disease [2]. Managing such dynamic conditions for different patients has created a substantial challenge to current healthcare systems. Thus, The American Association of Diabetes Educators (AADE) proposed seven important skills to help patients to manage their diabetes. These skills are healthy eating, being active, monitoring, taking medications, problem solving, risk reducing, and healthy coping which are also known as AADE7 [3]. Several evidence-based studies have showed that through web-based interventions to support self-monitoring activities can significantly improve glycemic control in type 2 diabetes patients [4]. Unfortunately, the self-monitoring activities are bound with patient’s everyday schedules that can easily be forgotten or neglected and the care support from providers has not yet been fully implemented. Therefore, placing emphasis on how to use these interventions to continuously support self-monitoring activities has become an imperative for the healthcare systems. With the rapid growth and development of user-friendly mobile devices and mobile Internet, it is not only changing the way people access information but driving to develop various mobile applications (mobile app). Meanwhile, it can bring immense potential to extend current healthcare systems to the area where diabetic patient conducts self-monitoring activities and has yet been fully supported [5]. One of the distinguishing features of mobile device is that individuals can maintain their social network, interact with friends, receive and publish information without tempo and spatial limitations. However, this advantage cannot be achieved without a well-designed mobile app. This study develops a prototype system named diabetes care assistance system which is based on a set of self-monitoring scenarios designed to describe dynamic condition of patient’s daily care activities including the health problems and the technical solutions. The system provides self-monitoring support function for both diabetic patients and healthcare providers. On the patient side, mobile app is introduced to implement the self-monitoring support function and to facilitate operations among patients, their illness conditions, and the healthcare providers. The lightweight healthcare mobile app uses the Android platform for smart phones and tablets.

LITERATURE REVIEW

Diabetes care is a long term self-regulation and life style adjustment process for patients [6] where healthcare practitioners have very limited control over the development of the disease [2]. Many diabetic patients are suffering from high
complication rate and lacking of well-coordinated care supporting networks [7]. An integrated and community-based care support system [8] is needed to make the diabetes care information available for patients and to facilitate patient-provider communication with friendly tools [9]. With the advanced information technology, the care support system can have the potential to effectively extend the services of current healthcare systems [10, 11]. The popularity of mobile app has empowered the usability of mobile devices. Individuals are now familiar with using a mobile devices to communicate with their family and business activities. For example, mobile app has been used for building collaborative clinical practice and education, supporting continuing professional training, and enabling chronic disease management. It is difficult to have a rigid definition for mobile app because of its dynamic and evolving natures. The natures have continuously changed our daily activities and further shifted software developers’ focuses from mimic human behavior with sophisticate software to offer light weight and friendly tools that support interactions and message exchanges among individuals. This trend creates impacts on the development of healthcare applications especially for the areas requiring integrated collaboration and dynamic interactions.

DESIGN AND DEVELOPMENT
The diabetes care assistance system aims to facilitate diabetic patient side on managing daily self-monitoring activities and care manager side in a health service center on patient’s support operations. A multidisciplinary research team including nurses, diabetes educators, and technical experts is formed for the system development. The initial system requirements used participant observation approach to collect a discussion session from outpatient diabetes education at a local hospital setting in northern Taiwan. With references from related diabetes care institutions [10, 12, 13], the research team analyzes the requirements, and documents operational concepts of the system in the method of scenario description [14]. Through the method, the authors describe and define both patient side and care manager side function and the required operations in using the system. The patient side function was implemented on the Android platform for smart phones and tablets. With a light weight mobile app, patients can generate their own self-monitoring content, receive diabetes care recommendations and dynamically interact with other operations of the system. On the care manager side, the diabetes care assistance system was used to monitor patients’ self-monitoring status through patient management operations, identify high risk patients for further care attention, and maintain patient-provider relationships through building a diabetes care community with the assistance from the technologies.
Operational Scenario
The scenario descriptions intend to capture the requirements of diabetes care from both diabetic patient and care provider’s perspectives. The scenarios depict the function and the operations required in a descriptive way that allows technical experts to design system components on supporting the care activities. One scenario is provided as an example that depicts how patient and care manager interact with the system presented as follows:

Ms. Lee is an obese 28-years-old single female who suffered the symptom of polyuria and dizziness. She was diagnosed with type 2 diabetes by an endocrinologist last week in local hospital and recommended to follow the self-management behaviors by diabetes educator. Ms. Lee is asked to carry out health self-management at home. Without the complex process of device initialization, she can manage her health information by the user-friendly interface of the Android-based device whenever the device is on hand. After some health self-management behaviors have done, if mobile Internet connection is not available, she stores her health information in the client database of the system. Whenever mobile Internet connection is available, she synchronizes the health information in the client database to the server database of the system. On the server end, the team of the care manager for Ms. Lee can manage Ms. Lee’s health information simply by browsers.

Functional Design
The function of the diabetes care assistance system was designed to support patients’ diabetes self-monitoring activities and to facilitate care managers’ patient management operations. Patients and care managers can use the system autonomously on their own in general situation and interact with each other under specific care events.

Patient side function is a lightweight mobile app which was developed with programming language Java and run on Android platform. Patient can easily download from the web site of health service center and install in his/her mobile device. The software contains graphic user interfaces, rules for conducting self-monitoring activities, contacts of care supporting resources, and a data store for keeping patient’s daily physiological information such as blood glucose levels and calorie intake. Patient can use the software offline and upload the information to the health service center as patient’s computer connecting to the network. Operations were designed to support patient side self-care activities as following:

• Blood glucose management: The system can remind a patient to measure and input blood glucose level at a preset schedule and evaluate patient’s self-monitoring status through physiological information collection. The patient
side function will send input information to the health service center and response with a recent blood glucose variation chart on patient’s request as indicated in Fig. 1. The interface reminded the patient to input blood glucose level and then make a recommendation in Fig. 1 (a). The health service center responded the patient’s blood glucose variation chart with red bars indicating the unstable instances. If the variation is unfavorable, care manager will prompt a warning message to patient for further care attention in Fig. 1 (b).

Calorie intake calculation: The system can take patient’s sex, height, weight and the type of physical activity to calculate required calorie intake with embedded food exchange table in Fig. 2 (a). Then making a recommendation of daily calorie intake of different nutrients. The interfaces of food exchange table including categories of foods where the patient can know his/her maximum of calorie intake per day in Fig. 2 (b). Additionally, the patient can keep their food diaries by automatic barcode scanner or manual. According to the recommendation and food diaries, patients can create a conscious awareness of controlling blood glucose level.

Taking medicine reminder: As showing in Fig. 3 (a) and (b), the system provides an interface to input drug name, drug dose, alarming frequency and time. Then the system will remind the patient to take medicine on time.
Fig. 2 Patient calorie intake calculation

Fig. 3 Taking medicine reminder
DISCUSSION AND CONCLUSION
It is of concern to provide convenient health self-monitoring tools for chronic patients. The study designs a prototype system based on smart phone applications to support diabetes patients doing self-monitoring activities. The health self-monitoring scenario shows that the system does help patients with diabetes in health self-monitoring. The future work of the study is to evaluate the efficiency and effectiveness of the system. In addition, to enrich client end functions of the system to empower the interaction between patients and care providers and to design advanced management tools that can help care providers are required.

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REFERENCES


