



Personal Health Management System for Diabetics

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Abstract: According to WHO (WHO, 2013) fact sheets on diabetes, there is an estimated 347 million people worldwide who has diabetes and in 2010 there was an estimated 3.4 million deaths related to it. And 80% of these deaths are from low- and middle-income countries. WHO is projecting that in 2030, diabetes will be the 7th leading cause of death in the world. But there are ways in order to avoid the possibility of death for a diabetic and that is to have a healthy lifestyle - healthy diet, regular physical activity, maintaining a normal body weight and avoiding tobacco. In order to do this, one has to constantly monitor what they have taken in and what they have done within their day. With the advancement in technology, one can already have such power within the palm of their hands.

The study formulated an ICT-solution that would help people suffering from diabetes to monitor their health status through their mobile phone. The mobile personal health record (mPHR) is a portable tool that an individual can use to store, keep track and share their medical health records through the utilization of mobile devices.

In order to come up with the appropriate application design, some medical specialists and diabetics were interviewed regarding the management of their illness. A prototype was developed that will allow possible users to test the usability of the application. The prototype has three main modules and these are the journalizing module, records management module and the reports generation module. eJournal enables users to record their activities such as their medicine intake and food intake, eRecord module enables users to store different laboratory results and other transactions with the doctor and eNotify module reminds users when to take their medication or if they have consultation/appointments.

Key Words: Diabetes; eHealth; Health Manager; Personal Informatics; Mobile Application

1. INTRODUCTION

According to World Health Organization, health is a state of complete physical, mental, and social well-being and not merely the absence of

disease or infirmity. Information and Communication and Technology helps in improving the health and health care of people by coming up with eHealth. Some examples of it are tracking diseases and monitoring public health, educating the health

workforce, and conducting research. It is an electronic means to transfer health resources and health care. The three main areas that it encompasses are first, through the use of Internet and telecommunications, health information are being delivered to health professionals and health consumers. Second is improving public health services by the use of IT and e-commerce through the different training and providing knowledge to health workers. And third is practicing health systems management through the use of e-commerce and e-business. (WHO, n.d)

The PHR is a portable tool that an individual can use to store, keep track and share current and previous medical health records through the utilization of web application and mobile devices. With this definition, the group wants to incorporate more useful modules into it rather than just merely recording the health record of the patient and sharing it to the doctor. Some of which are the ability of patients to record his personal health information outside the doctor's care, which the doctor could use in diagnosing or giving recommendations to the patient. Moreover, this PHR will be able to produce graphical and summary of the health records that were stored in the PHR. Another difference that the group will be making is that it will focus more on the needs of a diabetes mellitus patient in order to store what needs to be stored and make it more customized for diabetes patients, making it a customized PHR for Diabetes patients.

This Management System will hopefully solve the different problems that the group identified. These problems are the following: cannot remind the patient of when to take medicines, time-consuming way of backtracking previous health records, tedious way of summarizing personal health records for personal assessment, personal health records are not accessible at all times, and papers containing the health records are prone to lost or damaged.

2. METHODOLOGY

The group conducted several visits and interviews of different doctors that specialize in diabetes, Endocrinologist, also the doctors that specialize in kidney and heart problem. Aside from the doctors that are knowledgeable with the disease, the group also interviewed different patients of different types of diabetes to further understand the disease.

The group benchmarked 8 different mobile applications with a corresponding web application that help people in recording their personal health information. Two of these 7 mobile applications are specific to recording and maintaining diabetes. The group patterned some of its modules and features from these different applications.

Rapid application development (RAD) is a user-oriented method that allows its users to be involved in every step of the way that's why it's somewhat similar to the entire SDLC model. Rapid application development speeds up the development of an information system while producing a functional information system through a team-based technique. To shorten the development time and cost while involving users in every stage of the development of the system is the main objective of all the rapid application development approaches.

The reason why the group chose this methodology is because it relies heavily on prototype and user involvement that's why the group needs to come up with a prototype so the group members would know if the requirements of the user are met or not. Also, this type of methodology increases speed of the development process while ensuring the quality of work is met since it involves the users. There are four phases and activities that consist of the rapid application development model. These are the requirements planning, user design, construction, and cutover. (Shelly, G., & Rosenblatt, H., 2012)

3. RESULTS AND DISCUSSION

This is the graphical representation of how the proposed system will work.

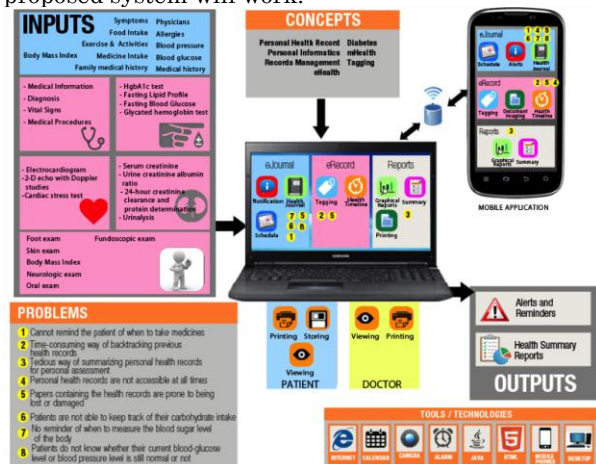


Figure 1. Conceptual Framework

3.1 eJournal Module

This module contains the following functions: notification, schedule, and health journal. In the health journal function, this is where information such as personal information which contains the name, birthday, type of diabetes, medical history, and allergies, food intake, blood glucose, blood pressure, weight and height, medicine intake, doctor appointment, physical activities, and symptoms will be recorded. Basically, it is like a diary wherein you will input or record the said information by filling up the form in the mobile application. One of the features of the module is scheduling which has the function of adding the schedule of when to take medicine, when to inject insulin and appointment to the doctor. For the appointment to the doctor, it would have a calendar view of the appointments.

3.2 eRecord Module

This module contains the following functions: health timeline, and tagging. In the health timeline function, it is the summary of your profile in the mobile application; you can see there the results of different laboratory examinations, history of blood pressure, and history of blood sugar, diet plan, exercise, medication you take, and insulin intake if ever. It is the compilation of all the information related to health of the diabetic patient. When the patient is adding information to the mobile application, the patient needs to put tags to that information so that it would be easier to search.

3.3 Reports Module

This module produces several reports from the inputs, which consist of the diagnosis from the doctor, the vital signs, laboratory results, and food intake. The reports that it would generate are the summary of the data recorded and it will be presented through graphs, and tables. For example, blood pressure report that will show the difference of your blood pressure daily and if it's increasing or decreasing or if it's normal.

3.4 Mobile Application Module

This module includes the following function: eJournal, eRecord, and Reports Generation. In the eJournal, it would be the same as the web

application, the difference is that it would have an alert feature which will notify the user if ever he/she needs to go to the doctor already or if the blood sugar that the patient inputted is higher than the normal range. For the eRecord, it would include the document imaging which will allow the patients to take a picture of the laboratory results and such. And for the Reports Generation, the patients will be able to view it in the mobile application.

3.4 Sharing and Storage

The system has two platforms - a web-based application and the mobile application and is connected to a centralized database between the two platforms. Using an Internet connection, the inputs of the web-based application will be reflected on the mobile application and vice versa. There are just some differences between the two platforms. The reviewed 8 related systems were benchmarked in order to come up with the design for both platforms. From the researched conducted most of the related systems require users to encode all the required information. Though the prototype allows encoding through both applications, the capturing images of documents such as lab results will be through the mobile application. These documents are tagged for easy searching and retrieval. The mobile application also allows alerts or notification of when medicines are to be taken and when there will be consultations with the doctors.

Aside from diabetic patients, through the web-based application doctors can have access to the selected patient's information. The patient will provide a synchronization code to the doctor which allows him/her to have access to specific patient information. Once the synchronization code has been inputted, the patient will now be in the doctor's list of patients. From this list, the doctor can choose a patient and will now be able to view the medical information of this patient. The group thinks that if the doctor is able to view all that is happening with the patient then the doctor will have a better treatment for the patient. The information that the doctor/s can view are the following: health journal, health timeline, graphical reports, and health summary. The health journal contains the symptoms, food intake exercise activities, medicine intake, family medical history, physicians, allergies, blood pressure, blood glucose, and medical history. The health timeline is the summary of all the records that the patient has inputted based from the health journal plus the medical information, diagnosis, vital signs, medical procedures, results of different tests like HgA1c test, fasting lipid profile, fasting blood

glucose, and glycated hemoglobin test. Also part of the information that are shown in health timeline are results of test that are related to the heart which are electrocardiogram, 2-D echo with Doppler studies, and cardiac stress test. The results of the test that are related to kidney such as serum creatinine, urine creatinine albumin ratio, 24-hour creatinine clearance, protein determination, and urinalysis will be included. And lastly, the results of the foot exam, skin exam, body mass index, neurologic exam, oral exam, and fundoscopic exam. The graphical reports would be based from the inputs of the patient, one example of it is the blood sugar report of a patient, which will show the progress of the blood sugar of the patient if it is increasing or decreasing or normal in a specific time.

3.5 Screenshots

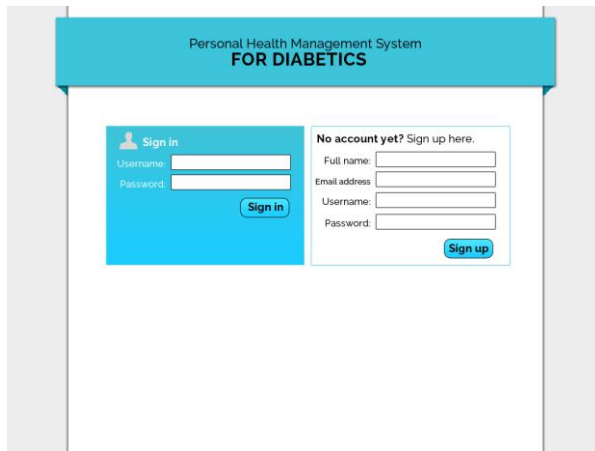


Figure 2. Log in page

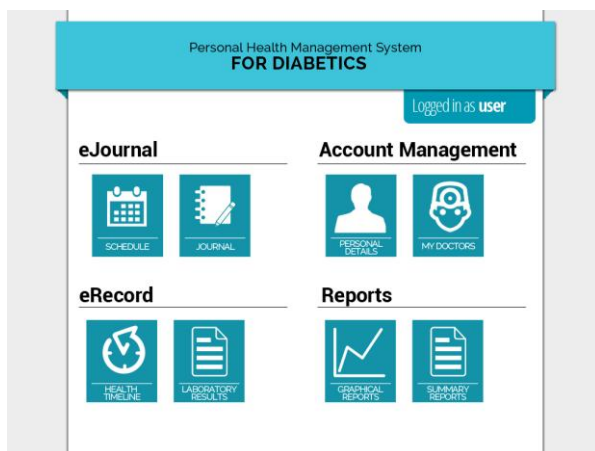


Figure 3. Homepage

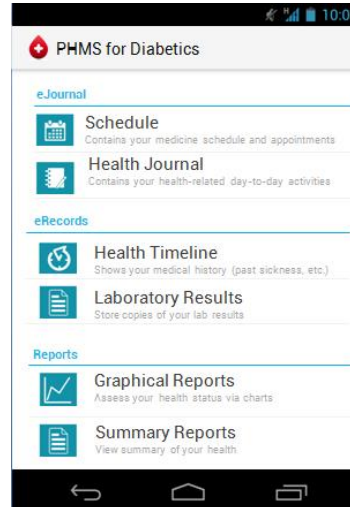


Figure 4. Mobile version

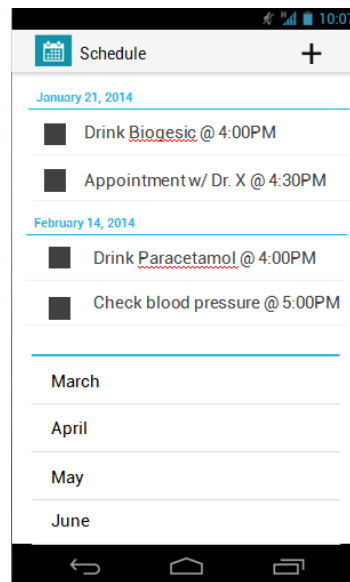


Figure 5. View Schedule

4. CONCLUSIONS

The main goal of the study is to develop a web-based information system for diabetics that also has a mobile application that would help people prevent diabetes and help diabetes patient monitor their health status by offering them a repository for their personal health information, notifying them using their inputs and monitor their personal health

information for better health assessment. Though the study is still in the development stage, testing of the system by the user will be conducted in order to refine the prototype. Based also on the user's acceptance testing that will be the next stage of the study, validation of how the system solves the identified problems will also be conducted.

The modules that the group came up with aim to solve the different problems that the group identified. For the first module, which is the eJournal, this would solve the following problems: time-consuming way of backtracking previous health records, tedious way of summarizing personal health records for personal assessment, personal health records are not accessible at all times, and papers containing the health records are prone to lost or damaged. The scheduling function and the notification function of this module would be able to solve the problem regarding the inability to remind the patient of when to take medicines and the no reminder of when to measure blood sugar level of the body. The user input could capture the necessary time and day of when the user must take his/her medications and when to properly measure his/her blood sugar level. Another function of this module is the health journal. This will address the problems pertaining to health records being prone to lost or damaged; not being able to keep track of their carbohydrate intake, and not knowing whether their current blood-glucose level or blood pressure level is within normal limits.

For the eRecord Module, this has the following functions health timeline and tagging. The health timeline will solve the problem of time-consuming way of backtracking previous health records. Health timeline has a search feature wherein the patient can look for his/her record easily. Basically what the timeline does with the information captured through the eJournal is to show the date when a specific medical occurrence happened so that the backtracking of previous health records could easily be done. For the search function, the user can type specific keywords associated with their health information. This function also eliminates the time consuming way of backtracking previous health records of the user since the results of the search function will already show the related items related to the search query of the user.

Another problem that the group has identified is the tedious way of summarizing personal health records. This problem can be solved with the report generation module, which would enable the person to see the summary and graphs of their health status.

The patient could also print these reports on the web-based application. On the other hand, the mobile application could only view these reports.

5. ACKNOWLEDGMENTS

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