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## Personal Health Informatics for Patients at Risk of Heart Attack (SoPHIA)

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### Abstract:

Heart attack is one of the most deadly heart diseases in the Philippines. Patients at risk of heart attack have to constantly monitor their vitals, diet, and daily activities. Any changes in the heart rate and blood pressure can be early signs of the possibility of a heart attack. In such instances, the healthcare provider would want to know as early as possible those that are beyond normal range. With the advent of technology, it is now possible to communicate such vital information from patient to healthcare providers.

The students study developed a personal health informatics system, SoPHIA, for patients at risk of heart attack. The system is comprised of a web application and a mobile application, which is comprised of four modules namely MyPortfolio, MyPlanner, MyHealth, and MyReport. Through these components, SoPHIA allows patients to store, organize, analyze medical data and schedules, and view medical reports. It can also collect information using a wearable device like a smart watch. Aside from managing personal health information, SoPHIA can also provide emergency response immediately to the patients who need them. Using algorithms to determine the danger level of an emergency case, the software automatically sends the proper information to the patient's guardian, doctor and emergency response team.

The proponents conducted a series of interviews with patients that are at high risk of heart attack and several cardiologists and other healthcare providers such as Pilipinas 911, an emergency response unit. A technology review was also performed to identify appropriate devices that can be included i.e. smart watch.

After the creation of the system, the system was subjected to a series of testing to ensure functionality. User acceptance tests were also conducted to ensure the viability and usability of the system.

**Keywords:** Heart Attack; eHealth; Health Manager; Personal Informatics; Mobile Application; Emergency Response



## 1. INTRODUCTION

In the Philippines, "heart disease was cited as the cause of 100,908 deaths or 21% percent of the 480,820 deaths reported from January 2009 to March 2010" (ABS-CBN News, 2011). Heart disease remains the top killer in the past ten years and it is projected that it will remain the primary cause of death. Two thirds of these cases are not medically attended to (National Statistics Office, 2011).

Personal informatics is a class of tools that collect personally relevant information to gain self knowledge about behavior, habits and thoughts (personalinformatics.org, 2015). Health informatics include patient- focused informatics, health literacy and consumer education all of which empowers the patient to manage their own health (amia.org, 2015). The Personal Health Informatics allows the users to store, organize, analyze the patient's medical data to improve the quality of patient experience. The Personal Health Informatics goes beyond the function of simply storing data. In this day and age, patients and patient guardians should have the information they need to make decisions. For example, A person having a heart rate of 130 bpm while being at rest may be usually ignored but according to interviews with several doctors, a heart rate of 130 bpm while being at rest could be indicative of an impending heart ailment. In addition, the patient also has access to medical value (vitals, hematology, blood chemistry, etc.) history summaries through charts and reports. The patient can see at a glance what he or she needs to look out for.

Through several patient interviews, the group has identified the problems of a

regular cardiac patient. The proposed PHI aims to solve the problems namely:

1. There is no central repository of historical medical data that could be shared with specific doctors that leads to a redundancy in data sharing.
2. Increased instances of the patient's forgetting of prescription and diet programs.
3. Patients have a lack of information on their current condition that makes them complacent enough to neglect doctor's recommendations.

Also, the group was able to find further opportunities for the project which are:

1. Inability to provide emergency response immediately.
2. The emergency response units' lack of access to patient's medical information.

The Personal Health Informatics for Patients at Risk of Heart Attack is designed to address and tackle the aforementioned problems and opportunities.

## 2. METHODOLOGY

The group opted to use the Rapid Application Development methodology for the development of the project because the team needed fast development and maximum user involvement. For the requirements modeling phase, the group gathered data from reviewing related studies and interviewing different people from the chosen domain. The interviews included

the cardiac patients, guardians, cardiologists, doctors of internal medicine, emergency doctors and emergency response providers (Pilipinas 911).

The User Design phase takes the group from the requirements modeling to user-involved prototyping. This stage goes hand in hand with the next stage, Construction Tasks. The group met with different users for general feedback on the prototype. As the group was designing the system, the proponents took into account the users who are possibly of older age. Also, the group has met up with several doctors who have given tips in the designing of the system and its components.

In terms of system testing, the group has started with the interface testing. The information seen in the graphical user interface was fetched accurately and is properly presented to the user. All screens have been properly tested.

Next, unit testing involved first testing each of the modules separately to see if each module functions well as a module. All the functions under each module are tested. The group used test cases for the unit testing. After the unit testing, integration testing follows. After the group tested each module individually, the connection between modules have to be tested. Each module was checked if the data from one module was passed successfully to another module.

The group scheduled several batch testing sessions according to the user's availability. The first batch testing session consisted of 4 patients. The next batch consisted of another 19 patients. Another batch consisted of 4 guardians. Other than that, there were several other individual testing sessions done separately with doctors and other guardians

after which, the group tallied and organized the UAT data to make post-UAT revisions.

### 3. RESULTS AND DISCUSSION

Figure 1 shows each module, input and output of the system and the entities involved.

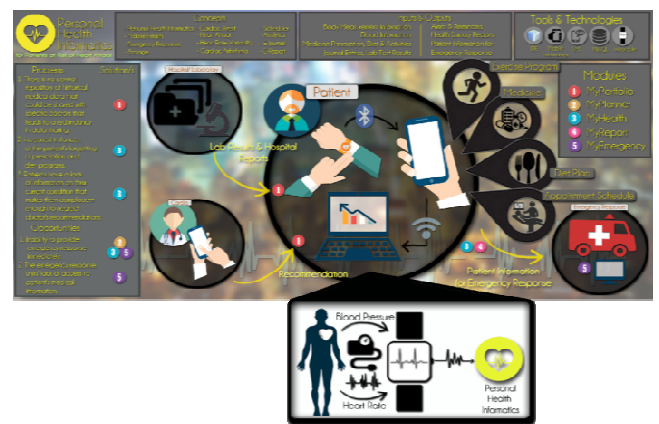


Figure 1 Conceptual Framework for SoPHIA

#### 3.1. MyPortfolio Module

MyPortfolio is a module that is used for acquisition, repository, and retrieval of patient records such as test results from the hospital, laboratory, medicine prescriptions from the doctor, exercise programs, and diet plans. The patient will use this for comparison and analysis for second opinion.

After the medical documents have been acquired, the patient first creates an event in the MyPortfolio module. An event is like an album that consists of one doctor consultation including all related documents.

After the event has been created, the medical documents are either uploaded or captured. The patient opens the event and adds a

medical document. Documents are captured by taking a picture of each medical document using the mobile application. The documents can also be uploaded in specific in the web application.

The system then automatically sorts all the documents. The patient can view all documents by type (test result and prescription) or by event.

This module solves the problem on the lack of centralized data. The patient will be able to scan or take a picture of the test results. The patient will also be able to organize the pieces of information by date so that there is a comparison for the medical history of a patient.

### 3.2.MyPlanner Module

The next module is MyPlanner. Figure 2 is a screenshot of the module. Based on the prescription, exercise program, and diet plan recommended by the doctor, the patient will create an organized schedule plan for each.



Figure 2 Screenshot of MyPlanner

In order to comply with the appointment schedule, the patient follows a strict schedule by plotting the dates on the calendar. The diet plans have different food groups and the patient is allowed to customize the specific food item and the limit in each food group.

The exercise program, just like the diet program, can be customizable with an intensifying degree according to the recommendation of the doctor. The patient can edit the frequency and duration.

Just like the weekly medicine container, the patient can add and organize the medicine by day and time. The patient can also make notes on the purpose of each medicine to determine the instances when the patient has to take or to stop a particular medicine.

### 3.3.MyHealth Module

The next module, MyHealth, is a module for two purposes. The first purpose is to do data gathering which will be used for the second purpose is to display analytics and system recommendations. Figure 3 shows screen displays of the blood chemistry results and graph.

Also included in the module is the feature of e-Journal in which the patient could list down all the food taken for the day, activities for the day, and instances of discomfort. Also, if the system detects an irregularity in the heart beat, system will ask the patient to input his/her current activity and any discomfort.

Finally, the last function included in this module is the MyEmergency. This function allows the patient to have a one click access to Pilipinas 911 or any emergency response unit.

Pilipinas 911 has agreed that the use of this system is beneficial although they are unwilling to incorporate the group's system to their existing system so the team opted to use a call function instead so as to confirm to Pilipinas 911's existing process.



Figure 3 Blood Chemistry Results

### 3.4. MyReport Module

The fourth module is the MyReport module where the processing of information and the generation of reports like a health summary report, monthly food consumption report, and irregularities per month report are located. The details from the MyHealth and the MyPlanner modules are used to create the MyReport module. These reports could be printed and it could be shown to anyone who needs the information on a particular patient.

## 4. CONCLUSIONS

The Personal Health Informatics for Patients at Risk of Heart Attack that the group has developed is a good investment of time and effort. Aside from the primary purpose of the project to provide emergency response function to patients with high risk of heart attack, the group was also able to solve the problems in the redundancy in data sharing, the forgetting of appointments, medicines and diet program, and complacency of the patients in their heart health.

According to the user's acceptance testing, the three users: patient, guardians and doctors were generally accepting of the system. The scale used has four degrees. The lowest is unsatisfactory, followed by satisfactory with major revisions, satisfactory with minor revisions and very satisfactory, the highest in the scale.

The system has a general acceptance rate of 89.25% considering all aspects of the system. In the functionality part of the test case, an average of 78.94% (15/19) patients answered very satisfactory.

The MyPortfolio module has an average of 84.21% (16/19) who answered very satisfactory. In the MyPlanner module, around 73.68% (14/19) answered very satisfactory.

For the Home and Tasks for Today, 78.94% (15/19) answered very satisfactory. In terms of layout, 63.16% (12/19) thought that it is very satisfactory.

Most of the interviewees are agreeable agreed that the Personal Health Informatics is very satisfactory (3/4) to satisfactory (4/4) in terms of layout, functionality and security. The





feedback that the group got from the users are diverse.

The general comments for the patients were to make the fonts bigger as they cannot see the fonts well. The aged patients are who benefits from the system but the guardians are technically the main users of the system. The patients and doctors acknowledged the usefulness of the system.

Besides the UI, the patients and guardians recommended simple process improvements like tagging the prescription to a particular event so that the system will remind them to organize the new medicine.

They also asked the group if it is possible to make the process of journalizing food entries less cumbersome. They told us that this process takes too much effort in their part.

In terms of cost-benefit analysis, the payback period for the system is around three years which is a good value altogether; however, the return on investment and net present value are both negative for many possible factors. Even if there are negative values, the main focus is of the intangible benefits which the patients and doctors have acknowledged in the UAT.

The main objective which was to solve all the problems encountered by the patients were properly addressed by the modules of the system. The lack of data sharing is solved by the MyPortfolio module giving the ability to the user to control data shared to other doctors. The problems of forgetting of medicines and appointments have been addressed by the notifications in the MyPlanner module. Finally, the patient's

negligence is lessened due to the supplemented vital and blood test information in the myHealth module.

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