

Mobile-healthcare Application on the Cardiovascular Health
Awareness Program

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Abstract

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Cardiovascular diseases represent the leading cause of stays in long-term services (such as hospital), it is the leading cause of death in Canada, and is associated with a number of other diseases. The Cardiovascular Health Awareness Program (CHAP) has been shown to be an effective intervention in terms of primary care services, reducing emergency room (ER) visits due to cardiovascular diseases by 9%. The purpose of this study is to harness the potential of assistive technology to promote active and healthy adults with chronic conditions in specific areas defined by CHAP. Specifically, this project aims to design and develop a system to manage cardiovascular diseases using protocols defined by CHAP. We created a C-CHAMP iPhone/iPad application for CHAP using MYSQL servers. We also used XCode6 to unify interface design, coding, testing, and debugging into a single workflow. The application was designed to serve a number of functions related to CHAP protocols, including saving each new blood pressure reading for participants in local database, collecting information about the Risk Factors, and measuring body mass index. The system was first tested in the university's lab, and then we made a survey for users, health professionals, and CHAP working groups in order to evaluate the usability, reliability, and functionality of the app.

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List of Abbreviations:

M-Health	Mobile Health
CHAP	Cardiovascular Health Awareness Program
CVD	Cardiovascular diseases
C-CHAMP	Canadian Chronic Disease Awareness and Management Program
C-CHAMP App	Canadian Chronic Disease Awareness and Management Program application
App	Application
ER	Emergency Room
BMI	Body Mass Index
PDA _s	Personal Digital Assistants
HIS	Hospital Information System
COPD	Chronic Obstructive Pulmonary Disease
BP	Blood Pressure
DREAM	Diabetes Risk Evaluation and Micro albuminuria
A-CHAMP	Airdrie Community Hypertension Awareness and Management Program
ICA-CHAMP	Indo-Central Asian Cardiovascular Health and Management Program
CHAP-EMS	Community Health Assessment Program through Emergency Medical Services
UI	User Interface

RDBMS	Relational Database Management System
SQL	Structured Query Language
SBP	Systolic Blood Pressure
DBP	Diastolic Blood Pressure
EMR	Electronic Medical Records
HER	Electronic Health Records
E-health	Electronic health

Chapter 1: Introduction

The role of information and communications technologies within health care has expanded rapidly in recent years. While these technologies vary widely, they have similar purposes related to developing health information infrastructures and improving the safety, quality and efficiency of patient care. Examples of these technologies include having an access to electronic health records and supporting clinical practice, service management, research and policy. Of particular relevance in recent years has been the emergence of M-Health or mobile health, which is defined as “medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices“ (World Health Organization, 2011).

According to the latest survey by the American Electronic Health Records (EHR) Partners (2013), only 28% of smartphone users and 18% of tablet users described themselves as "very satisfied" with the quality of apps for their profession, and medical app usage in medical practices was much higher among smartphone users (51% daily) than tablet users (30% daily). Importantly, a recent report by Juniper Research (2016) predicted that the number of individuals using the m-health information services market will exceed 157 million users by 2020, more than tripling the number of users from last year (50 million) (Smith, 2016).

Cardiovascular diseases (CVD) represent the leading cause of stays in long-term services (such as hospital), it is the leading cause of death in Canada, and is associated with a number of other diseases. In fact, high blood pressure (hypertension), which contributes greatly to CVD, increases one’s risk of suffering from heart disease, kidney

disease, Alzheimer's disease, or stroke. High blood pressure is difficult to prevent and treat because it has no warning signs or overt symptoms. Further complicating matters, blood pressure is challenging to accurately monitor due to its natural variability, as well as the fact that it is difficult to measure. Only by having regular, accurate monitoring we can that high blood pressure is diagnosed before it leads to other health problem and that affected individuals are being treated in the best way possible (CHAP Implementation Guide, Retrieved from www.chaprogram.ca, 2013).

Since 2000 in Ontario, there has been an innovative program, the Cardiovascular Health Awareness Program (CHAP), designed to manage cardiovascular diseases. CHAP is “ a community-based program that brings together local family physicians, pharmacists, volunteers, public health representatives and other organizations to work as partners to promote and actively participate in the prevention and control of cardiovascular disease” (CHAP Implementation Guide, Retrieved from www.chaprogram.ca, 2013). The motivation for instituting was recognition by the World Health Organization that high blood pressure is leading risk factor for death and that it was reaching epidemic levels. In particular, CVD, which is strongly associated with hypertension, accounts for 30% of all deaths worldwide; in addition, more than 54% of deaths from stroke, 47% of those from Ischemic heart disease, and 14% of all deaths are attributable to high blood pressure (Kaczorowski & et al., 2011).

Currently, the primary objective of CHAP is the development of an integral program that harnesses the potential of assistive technology in order to promote active and healthy lifestyles while reaching both older and younger populations with chronic conditions. This program, the Canadian Chronic Disease Awareness and Management

Program (C-CHAMP), focuses not only on blood pressure assessment but also diabetes risk assessment and screening for atrial fibrillation. In an effort to reach new and younger populations in large urban communities.

We chose to work with CHAP because of its successes and sustainability over the last decade and a half. Researchers have been conducted many studies over this period in order to evaluate various aspects of the program. For example, one study demonstrated the effectiveness of community-based CHAP with respect to morbidity from CVD (Kaczorowski et al., 2011); another study evaluated the effect of community-based CHAP on participants' blood pressure (Ye et al., 2013). In addition, in 2014 CHAP developed a theoretical framework for complex community-based interventions, with specific and possible community, individual, mediating outcomes. In addition, CHAP has received numerous awards including Outstanding Family Medicine Research Article of the Year 2014 and Notable Achievement in Hypertension Reduction at the Population Level by World Hypertension League in 2015.

In hopes of reaching younger populations, we sought to develop a C- CHAMP (Canadian Chronic Disease Awareness and Management Program) iPhone/iPad application to manage cardiovascular diseases using protocols defined by CHAP. Development of the application involved three steps. The aims of this application are to manage blood pressure recording, collect information about hypertension risk factors, and measure the body mass index (BMI). Specifically, the main objective of this study was to implement CHAP by replacing paper and fax-database technology. The system was first tested in the university's lab; we then conducted a survey through which users could

evaluate the usability, reliability, and functionality of the app. In addition to these goals, our general contributions would be by realizing following aspects:

- Design and develop an M-health application based on medically proven interventions in Primary care services.
- Provide a useful tool to support individual patient for self-management, and support health professionals and services providers to connect with their patients.
- Evaluate the above M-health application on its usability and functionality.

This thesis is organized as follows. Chapter 2 provides an overview of existing mobile healthcare applications, considering particular types and examples in terms of their impacts on patient care, the challenges that face developers, and opportunities for improvements. Chapter 3 describes the Cardiovascular Health Awareness Program (CHAP), including protocols, evaluation studies, and overarching goals; community-based programs are also discussed. Chapter 4 describes the design and development of the C-CHAMP application. Chapter 5 discusses evaluation and analysis of the application. Finally, Chapter 6 presents conclusions and future directions for the application.

Chapter2: A Review of M-Healthcare Application

2-1: Overview of M-HealthCare Applications

Like all aspects of human life, healthcare has been profoundly affected by the digital revolution. Indeed, in a time when most people, including doctors, rely on their smartphones, such technologies must be harnessed to provide better communication among healthcare professionals and with patients, to practice evidence-based medicine, to get the information at the point of care, and to improve the available treatment options. The number of tech-savvy physicians, including recent graduates, has increased greatly during the last ten years, with many of them relying on digital and internet-based tools in order to improve the medical services they provide.

Considering the information stated above, it should be noted that analysis of the healthcare applications available for smartphones requires the exploration of many different types of applications, occurring on a variety of platforms. The impacts, challenges, and opportunities associated with these applications are discussed below.

2-2: Types of M-healthcare Apps

There is great diversity in the types of mobile healthcare applications used by the patients and by the healthcare professionals, which can be categorized into nine groups basing of function (Mosa et al., 2012; Ventola, 2014):

1- Disease Diagnosis: These were designed in order to access diagnosis and treatment on smartphones. In addition, offline versions “of the printed medical references for disease diagnosis were available on smartphones, providing information on infectious diseases, pathogens, diagnosis, treatment, medications, differential diagnosis etc.)”. Perhaps

most importantly, smartphone-based disease diagnosis apps can serve as vital resources for evidence-based diagnosis, helping doctors to identify the appropriate laboratory tests basing on the patients' symptoms while reducing the cost of care and decreasing the use of unnecessary tests that are often quite expensive (e.g., radiology tests).

2- Drug Reference: These apps include the names of drugs, their indications, necessary dosages, contraindications, drug-drug interactions, various identifying characteristics, and even prices.

3- Medical Calculator or Clinical Calculator: These help to calculate different clinical scores like body surface area (BSA), individual drug dosing, body mass index (BMI), as well as risk levels for various diseases including coronary heart disease.

4- Literature Search: These apps facilitate searches biomedical literature databases.

5- Medical Education and Training: These are aimed at medical or nursing students.

6- Hospital information systems (HIS) Client: These apps serve Hospital Information Systems like picture archiving, electronic medical records, electronic health records, or communication systems, offering various options to access patient information.

7- Clinical Communication: These apps play a significant role in healthcare by facilitating communications among clinicians via video calling, email messaging, text messaging, and voice calling. It is clear that mobile phone communication is crucial within the modern critical care environment, enabling information and discussions to be relayed quickly.

8- Chronic Diseases Management: These apps are designed assist patients with disease management by providing necessary treatment information, important instructions, or required records. Such applications exist for many diseases, including diabetes,

obesity, hypertension, coronary disease, asthma and chronic obstructive pulmonary disease (COPD).

9- Patient monitoring: These apps are used to remotely monitor the health or location of patients with chronic diseases, keep track of rehabilitation, collect clinical data, and monitor heart function has already become possible. For example, a clinical monitoring system can be used to monitor an entire unit or single bed in intensive care via smartphone, displaying alarms, color-coded according to severity, based on patients' vital signs.

2-2-1: Examples of M-healthcare Apps

The following table provides examples of the most popular and frequently used M-healthcare applications, and includes information regarding their main functions and their frequency of use. This information was extracted from three articles (Ocano, 2015; Schiola 2015; Dolan, 2012), as well as the top charts in IOS app store and in Galaxy apps store.

Application	Type	Platforms	Downloaded	Function:	Supported by	Websites
WebMD	Diseases Management	IOS, Android & web	5 million+ downloaded in Android	For patients access to health information and decision-support tools.	WebMD	http://www.webmd.com/
Epocrates	Medical Training app	IOS, Android, & Windows	1 million+ downloaded In Android	To review drug prescribing and safety information, select health insurance formularies for drug coverage information, perform calculations like BMI and GFR, access medical news and research, and all these services are for free.	Athena Health	http://www.epocrates.com/
Medscape	Medical Education & Training app	IOS, Android & web	1 million+ downloaded In Android	Offers prescribing and safety information for drugs, procedure videos, a medical calculators and access to continuing medical education (CME) materials.	WebMD	http://www.medscape.com/
iPharmacy Drug Guide & PubMed Direct--- iPharmacy Pill ID & Drug Info	Drug Reference App	IOS & Android	1 million + downloaded in Android, More than 60,000 pharmacies	To manage your medication, access dosage, side effect and warnings.	Med Connections	http://medconnections.com/
Drugs.com Medication Guide	Drug Reference App	IOS & Android	1 million + downloaded in Android	To look up drug information, identify pills, check interactions and set up your own personal medication records	Drugs.com	http://www.drugs.com/apps/
I'm Expecting Pregnancy	Diseases Management	IOS & Android	1 million+ downloaded in Android	For soon-to-be mothers, logs doctor's appointments, includes a kick counter, has a place to upload color baby scan images, and provides daily information about the user's pregnancy.	Med Help	http://www.edhelp.org/pregnancy-health
MyChart	Clinical Communication	IOS, Android & Web	1 million+ downloaded in Android	Offers a direct communication channel between patients and health care providers. Patients can access lab results, appointment information, current medications, and immunization history.	Epic Systems Corporation	https://www.myonlinechart.org/mychart/

Application	Type	Platforms	Downloaded	Function:	Supported by	Websites
Medical Terminologies	Medical Education & Training app	Android	1 million+ downloaded	Medical Terms and Dictionary with common and uncommon words, terms and phrases. Used by physicians, nurses, PAs, NPs, medical students, nursing students and more.	Medical Group Soft	---
Omnio	Diseases Diagnosis	IOS & Android	500,000+ downloaded in Android	Offers clinical & coding resources, lab & diagnostic resources, references disease guides, drug information, calculators & dictionaries symptom checker, interaction analyzer, and pill identification.	Aptus Health	http://omnio.com/
Calculate by QxMD	Medical Calculators	IOS, Android, Windows, Web	500,000+ downloaded in Android	Focused on highlighting tools which impact clinical practice and serve to impact diagnosis, treatment or determining prognosis.	QxMD	http://www.qxmd.com/apps/calculate-by-qxmd/
Touch Surgery	Medical Education & Training app	IOS & Android	500,000 + downloaded in Android	Offers a step-by-step procedure guide, quantifiable data that allows you to track your progress and interactive 3D anatomy simulations.	Touch Surgery	https://www.touchsurgery.com/
Figure 1 – Medical images	Medical Training app	IOS & Android	500,000+ downloaded In Android	To send, comment on and search through medical images with guarantees patient privacy with automatic face blocking and removal of identifying information.	Figure 1	https://figure1.com/
Uptodate	Diseases Diagnosis app	IOS, Android & web	100,000+ downloaded In Android	To follow the latest medical advancements and news, providing videos on medical procedures.	Wolters Kluwer Health	http://www.uptodate.com/home
Muscle Trigger Point Anatomy	Medical Education & Training app	IOS & Android	50,000+ downloaded In Android	An anatomy reference for the most common trigger points and referral patterns for over 70 muscles.	Realbodywork	http://www.realbodywork.com/

Application	Type	Platforms	Downloaded	Function:	Supported by	Websites
DocBook MD	Clinical Communication	IOS & Android	50,000+ downloaded In Android	Allow physicians to send X-rays, EKGs, and other patient information directly to their colleagues for quick consultations.	DocBook Md	http://docbookmd.com/
Doximity	Clinical Communication app	IOS, Android & web	10,000+ downloaded In Android 60% + of US physicians as members.	The largest medical professional network in US. HIPAA secure communication, electronic faxing, reading medical news, and career management.	Doximity	https://www.doximity.com/
DynaMed Mobile	Diseases Diagnosis app	IOS & Android	10,000+ downloaded In Android	Created by physicians for physicians, the leading evidence-based clinical resource for use at the point of care.	EBSCO Health Industries	http://www.dynamed.com/home/
Spok Mobile	Clinical Communication	IOS & Android	10,000+ downloaded in Android	It is a messaging and alerting application that separates critical messages from less important one with privacy.	Amcom Software:	http://www.spok.com/
Johns Hopkins ABX Guide 2016	Literature Search	IOS, Android, Windows, Web	10,000+ downloaded in Android	ABX, HIV, Diabetes Guides are regularly updated, evidence-based decision resources to help you answer critical questions at the point of care.	Johns Hopkins Medicine and Unbound	http://www.hopkinsguides.com/hopkins/ub
Virtual Practice for Doctors	Clinical Communication	IOS, Android & Web	5,000+ downloaded in Android	For physicians to stay connected with patients and patient health data.	NeedStreet Web Technologies	https://www.needstreet.com/virtual-practice-for-doctors-clinics

Table 1: M-health Applications Table

2-3: The Impact of M-healthcare Apps on Patient Care

The overall objectives of M-healthcare are to improve the quality of life, to decrease health-risk behaviors, to use medical services more efficiently and accuracy, to improve the relationship between patients and physician, and to improve the outcomes and productivity of healthcare. One of the most obvious benefits of these apps is that they provide ready access to information related to drug reference, medical textbook, disease diagnosis, and medical calculations, which should improve decision-making and support evidence-based medicine by practicing clinicians, medical and nursing students. Pharmacists are assisted in a similar manner via instant access to multiple drug information sources and other medical references (Ventola, 2014).

Compared to traditional paper-based methods of documentation, these apps lead to improved accuracy and efficiency of patient documentation by having more diagnostic coding, more frequent documentation of side effects, and increased medication safety through reduced medical errors. There is evidence that these apps lead to more complete records, more rapid access to new information, and improved workflow patterns (Mickan et al., 2013).

Research has indicated a remarkable increase in the productivity of health care professionals associated with using the apps. For example, one study found a significant increase in the average rate of electronic prescribing, from 52% to 64% ($P = 0.03$) (Mickan et al., 2013). In addition, such apps allow important drug information to be checked quickly, leading to more rapid processing of prescriptions by pharmacists (Ventola, 2014).

2-4: Challenges and Opportunities

Despite the great promise of M-healthcare, there are nonetheless many challenges facing the developers of these applications. The technological development and the rapid adoption of the modern healthcare applications has led to some novel difficulties for both clinicians and patients. Therefore, a brand-new application has to include the ability to make useful, simple, unique, and guidance for the application. In addition, some of the main challenges relate to the need to guarantee the safety or data security of these applications and to establish their cost-effectiveness. There are also challenges related to engaging users and integrating them into this new type of system, which can be especially challenging with populations (e.g., the elderly) that are not familiar with similar technologies.

While no system or application is free of challenges and weaknesses, it is nonetheless important to understand the specific concerns related to M-healthcare applications. Some of these concerns relate to the threats of malignancy exist, proneness for accidents, behavior problems, loneliness, web dependence and depression, and the possibility of hacking (Kulkarni et al., 2013, p. 690). One concern related to is the potential to lead to misinformation and patients' interpretation of available online content. On the same token, “optimizing the user experience is paramount to launching an app that people will come back to again and again” (Konschak & Davaloor, 2011, p. 4).

Interoperability is another critical issue for m-Healthcare. Simply, patients may have multiple clinical conditions at one time, and will therefore interact with health systems via multiple points, and with numerous providers and professionals. Therefore, it is very important that apps can integrate various processes, both within and across an

individual's relevant conditions. For example, a system sending texts to patients reminding them of their next appointment has the potential to serve multiple purposes within the broad scope of patient care if it can exchange information with other systems, like microscopy images taken using a mobile phone can be securely imported back into the electronic health record (Barbour et al., 2013).

The development and use of open standards available from coding platform can help solve the lack of interoperability between systems. Closed standards create a knowledge obstacle for systems developers in low- and middle-income countries. Also, closed standards mean that systems developers and policy makers cannot understand how systems or standards work, making it difficult to develop technical capacity and to decide for their country what systems they need to developed (and how) (Barbour et al., 2013).

The challenge of standardizing health care data and applications involves several components, as identified by Aspden et al. (2004):

- 1- Definition of data elements: determination of the data content to be collected and exchanged.
- 2- Data interchange formats: standard formats for electronically encoding the data elements and document architectures for structuring data elements.
- 3- Terminologies: the medical terms and concepts used to describe, classify, and code the data elements, and the data expression languages and syntax that describe the relationships among the terms/concepts.
- 4- Knowledge Representation: standard methods for electronically representing medical literature, clinical guidelines, and the like for decision support.

With respect to evaluation of these emerging technologies, high-quality trials are needed to provide a more rigorous evidence base to inform the scale-up of m-health applications related to interventions to improve health behaviors, improve disease self-management, and facilitate health-care delivery processes. This need for more trials is especially relevant in relatively understudied populations including low- and middle-income countries. Indeed, it is vital to understand the feasibility and efficacy of m-health across a variety of groups (Barbour et al., 2013).

2-5: The Way Forward

Going forward and trying to improve the contributions to healthcare made by these applications, it is vitally important that all groups – patients, doctors, and others – are provided with the skills necessary to efficiently and accurately make use of the technologies. It is also important to analyze how these apps are used in order to get a sense of how doctors and patients interact via these technologies; such information may inform the developing and fine-tuning of the apps. These concerns will only grow along with the market itself, which is expected to expand greatly during the next several years. Examples of technologies that are expected to spread rapidly include Cloud-Based Technologies. As pointed out by Elsevier Clinical Solutions (2015), “Healthcare Vaults and Portals give patients online access to their own health records and information. Individual doctors, groups of doctors, medical practices, and hospitals have portals that allow patients to see their medical records from that institution”

With increased prevalence and influence, there is no doubt that these emerging technologies will greatly affect the trajectory of the healthcare system itself, shaping

its approach via multiple devices connected together in order to provide reliable and secure services and to meet the needs of an aging population.

In this chapter, we have provided a thorough overview of the types of applications, including specific examples, in order to indicate their impact on patient care. In doing so, we demonstrated that the available options are useful and important to the modernization and development of healthcare services. We also highlighted some challenges facing systems developers for a brand-new applications, including interoperability, closed standards, and evaluation.

Chapter 3: A Review of Cardiovascular Health Awareness Program (CHAP)

3-1: A Review of Community-Based Programs

Community-based programs represent a valuable way to improve population health and to improve clinical and financial outcomes by managing diseases, cases, and demands. This strategy can help prevent numerous diseases that have common risk factors across a large number of people. Their aim is to shift the distribution of risk factors to lower levels across entire populations (Kaczorowski et al., 2013). These programs have the benefit of being able to reach people in specific settings such as schools, worksites, health care facilities and communities. They also give the participants opportunities to enhance and protect their own health and wellness by learning about important topics such as chronic diseases, injury and violence prevention, mental illness/behavioral health, unintended pregnancy, oral health, tobacco use, substance abuse, nutrition and obesity prevention, and physical activity (Educational and Community-Based Programs, 2013).

Hypertension is a prime example of a common disease for which risk can be reduced through proper community-based management. Not surprisingly, several community-based programs have been implemented in Canada to improve prevention and management of high BP, with four programs launched over the last few decades, besides the one we are working within:

- 1- Blood pressure assessment program of the Calgary Fire Department started in 1995.
- 2- Diabetes Risk Evaluation and Micro albuminuria (DREAM) studies started in 1998.

3- Airdrie Community Hypertension Awareness and Management Program (A-CHAMP) started in 2004.

4- Indo-Central Asian Cardiovascular Health and Management Program (ICA-CHAMP).

All these programs have been exhibited good visibility, promising results, and high evaluations (Kaczorowski et al., 2013). Also, according to one analysis (Pennant et al., 2010), there have been 36 community-based programs from 1970 to 2008 that have contributed to positive changes in mortality rate, although demonstrating effectiveness has been challenge facing these programs throughout their history. The main reason that it's difficult to evaluate the overall effect of such programs is that is that they differ so greatly from each other, often with dramatically different characteristics (length of follow-up time, response rate, matching intervention and control units, adjusting analysis for covariates, and the settings and populations under study).

3-2: Describe Cardiovascular Health Awareness Program (CHAP)

Cardiovascular Health Awareness Program (CHAP) is an innovated program in Ontario, Canada, that aims to improve management of cardiovascular diseases. This program started in 2000 and has given rise to a number of different projects in service of its overall mission. According to CHAP's implementation guide, the main concept of this program is a "community-based program that brings together local family physicians, pharmacists, volunteers, public health representatives & other organizations to promote and participate in the prevention and control of cardiovascular disease". Importantly, CHAP is free of charge to all older people in community residents.

The program was established at McMaster University in Hamilton by just four researchers; however, with success over the last decade plus, the program involves a large number of researchers at a number of different universities across Canada and involves a number of medical doctors.

CHAP can adopt over a period of 24 weeks in any community. The first 12 weeks are for tasks related to hiring, mobilizing the community, and recruiting the partners necessary to operate CHAP. The following 12 weeks are for operating the CHAP community-based sessions and completing CHAP reports.

For any community, there are three key players within CHAP:

- The CHAP regional manager covers several different CHAP communities and is responsible for overall planning and management, as well as preparing reports on activities across all CHAP communities.
- The local lead organization is a community organization such as a health-oriented agency, or a public health unit, which functions in managing the program files, databases, and information required for evaluation of CHAP in the community.
- The local CHAP coordinator is responsible for recruiting, retaining and coordinating the participation of all local physicians, pharmacists, and volunteer peer health educators, as well as assisting in the development and delivery of information sessions.

3-2-1: The Protocol of CHAP

CHAP offers many services to participants, including measuring multiple blood pressure readings and managing risk factors associated with cardiovascular diseases via promotion of healthy eating, physical activity, and smoking cessation. For success, it

is important to recruit a large number of family physicians and pharmacists, and to invite all of the patients who are at risk for cardiovascular diseases using several approaches including personal letters and community-wide advertising. Another important necessity is to assist volunteer peer health educators trained by community health nurses. For example, volunteers should know how to measure participants' blood pressure using an automated blood pressure measuring device and record this measure on a **Risk Profile Recording Form** (Figure 1).

Moreover, older adults should have the chance to attend weekly sessions in local pharmacies. In these sessions, participants will measure their blood pressures with a trained volunteer, fill out standardized CVD and stroke risk profile, take permissions, meet with a nurse in the of case abnormal BP, and undergo medication assessment to ensure the safe and appropriate use of all type of medication. Also, participants receive education materials related to specific risk factors. With the participants' permission, the blood pressure reading and the risk profile is forwarded to family physicians by fax. Also, a copy is given to each participant, to the participant's regular pharmacist and physicians. Thus, it is easy for physicians and pharmacists to communicate with each other and follow up with the patient, if necessary.



Figure 1: CHAP Risk Profile Recording Form

Session Pharmacy ID

□ □ : □ □

Risk Profile Recording Form

FAX TO: 1-800-xxx-xxxx

Participant Information - Please PRINT CLEARLY in CAPITALS.

Last Name, First Name, Family MD's Last Name

Sex, Postal Code, Date of Birth

Consent to Release Participant Information

Blood Pressure & Pulse Rate

Cardiovascular Disease & Stroke Risk Profile

- 1. Is this a repeat visit? (If Yes, please do not fill in questions 2-20)
2. In general, would you say your health is:
3. What is your height?
4. What is your weight?
5. Have you ever had a transient ischemic attack (TIA or mini-stroke)?
6. Have you ever had a stroke?
7. Have you ever had a heart attack?
8. Has your doctor told you that your cholesterol is high?
9. Has your doctor told you that you have diabetes?
10. Have you ever been diagnosed with high blood pressure by a doctor?
11. Are you currently taking prescription pills for high blood pressure?
12. If you currently use pills for high blood pressure, do you take them each day?
13. Do you currently smoke?
14. In a typical week, how many times do you eat high fat or fast foods?
15. Typically, do you drink 2 or more alcoholic drinks a day?
16. Do you eat 5 servings or more of fruits and vegetables a day?
17. How frequently do you add salt to foods during cooking or at the table?
18. In a typical week, how frequently do you feel overwhelmed or stressed?
19. Are you moderately physically active for 30 to 60 minutes, most days of the week?
20. Do you live alone?

Office Use Only (Print in CAPS) Today's Date, Pt's Birthdate, Family MD's ID, Regular Pharmacy's ID, First 4 letters of Pt's Last Name

Office Use Only (Solidly FILL squares like this ■, not like this □) Recommendations, Actions, Pt's Web Access ID

Session Pharmacy ID

Program copy -- white Pharmacy copy -- yellow Participant copy -- pink
2006-Jul-10, Copyright © 2006 CHAP and Clinforma Data Management, Fig.P Software Incorporated



Figure 1: Risk Profile Recording Form

3-2-2: Evaluation and the Possible Outcomes of CHAP

This section will provide an overview of studies that have evaluated CHAP. One such study (Kaczorowski et al., 2011) evaluated the effectiveness of community-based CHAP on morbidity from cardiovascular disease. Using 15889 unique participants, the study compared hospital admissions for acute myocardial infarction, stroke, and congestive heart failure between pre-intervention period (from September 2006 to August 2007) and post-intervention period (from September 2007 to August 2008). The results revealed that, for individuals with special characteristics (e.g., 65 and over), there were 3.02 fewer annual hospital admissions for cardiovascular disease per 1000 people than communities were control with CHAP not offered. Similarly, hospital admissions for acute myocardial infarction and congestive heart failure were significantly decreased by CHAP, although there was no change with respect to stroke.

Another study (Ye et al., 2013) evaluated the effect of the community-based CHAP on participants' blood pressure by monitoring blood pressure over an 18 month period in patients who attended more than two CHAP sessions. The researchers found that both components of blood pressure improved. Average SBP decreased from 123 to 102 mmHg over and average DBP is also decreased from 78 to 69 mmHg.

There is a study (Angeles et al., 2014). We must mention in our project the possible outcomes of CHAP, which fall into three categories, which were community, individual, mediating outcomes. The community outcomes were reductions in hospitalizations, decreased deaths rates due to stroke, myocardial infarction, and congestive heart failure and reductions in health care costs associated with cardiovascular illness. The individual outcomes were increased use of community health resources,

decreased occurrence of modifiable risk behaviors, and better BP control. The mediating outcomes were improved awareness of susceptibility, improved awareness of consequences of Risk Factors, awareness of the benefits of attending CHAP, and improved self-efficacy in management of Risk Factors.

3-2-3: CHAP Goals

Currently there are a number of programs that seek to build on the success and achievements of CHAP. For examples, the Community Health Assessment Program through Emergency Medical Services CHAP-EMS intends to develop and evaluate the feasibility and success of community-based program conducted by paramedics, for the promotion and prevention of chronic conditions, such as blood pressure and diabetes mellitus risk, characterized as low income, with a focus on older adults of multicultural backgrounds with frequent calls to Emergency Medical Services (Agarwal et al., 2015).

Similarly, the Canadian Chronic Disease Awareness and management program (C-CHAMP, Kaczorowski et al., 2015) is working to reach more people and add more services (Figure 2). As the primary goal of this project, C-CHAMP is doing so by adapting, implementing, and evaluating in large urban communities in Canada, and by targeting a younger population that is aged 40 years and over. Besides blood pressure assessment, this program includes diabetes risk assessment and screening for atrial fibrillation, both of which are associated with hypertension. According to the researchers, C-CHAMP has diverse expected outcomes from many aspects that include social and economic benefits, improved population health, capacity development, and advancing knowledge.

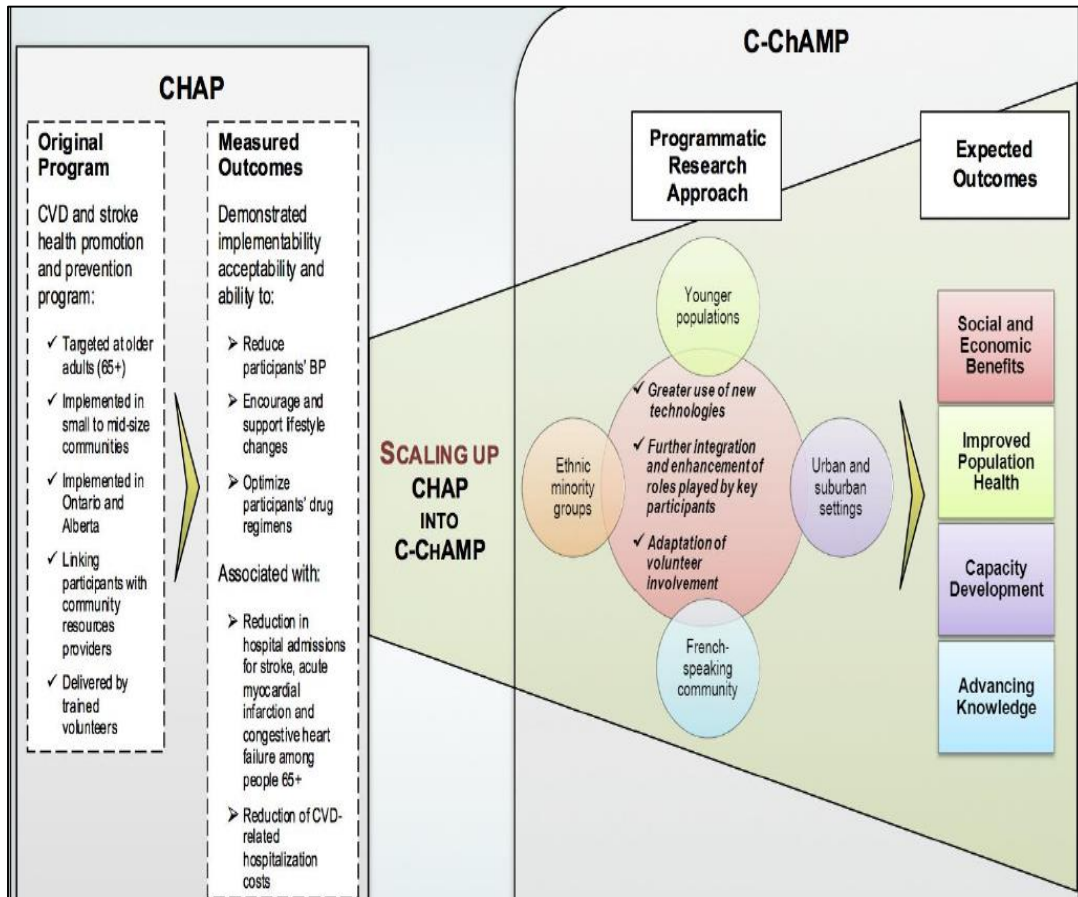


Figure 2: Scaling up CHAP into C-CHAMP

This chapter reviewed Cardiovascular Health Awareness Program (CHAP), addressing its structure, protocols, and evaluation, in order to understand why we chose this program to develop. With respect to the app developed in this study, the focus here was on the Canadian Chronic Disease Awareness and Management Program (C-CHAMP). Importantly, this program has focused on the younger population 40+ than CHAP population 65+.

Chapter 4: Design and Development of C-CHAMP Application

4-1: Overview of C-CHAMP App

C-CHAMP app provides a secure and reliable framework that accepts users' daily measurements, either at a medical center with the aid of a health professional or at home. It is able to sort and present the data in a cohesive format for viewing by pharmacists, nurses or family doctors, and also to automatically alert the user of possible risks as indicated by specific parameters. The app runs fully automatically without any major errors during its implementation and use, with a user-friendly outer layer to provide intuitive input and viewing of critical information. The primary objective for the C-CHAMP app is built on a successful community-based program by creating a chronic disease management app.

4-1-1: App Requirements

For now, this app is only available on the iOS apps store and in English. The most recent version is 1.1.2. The app can be found by searching the app store using keywords such as the following: CHAMP, health, blood pressure, BMI, BMI calculator. It requires iOS 7.1 or later and is compatible with iPhone, iPad, and iPod touch.

The app requires the user to fill out a registration form. The screens that follow feature with parameters related to personal information, blood pressure, risk profile evaluation, health record, calculate BMI. The user has the option to update their information from all the tabs. Once all the information is added, it is saved; whenever the user wants to see their info, they need to open their profile and check the reports.

4-1-2: Specific Functions and Features

Within the framework described above, the C-CHAMP app contains a number of specific functions:

- For security, users can easily authenticate themselves with a login process that should take one to two steps; this process is both easy for the user and provides ample protection against tampering.
- The CHAP protocol is followed, with data storage and transmission secured in local server.
- The user interfaces are simple, intuitive to use, and structured so that the most important information is displayed right away; nonetheless, all information is easy to access.
- It is able to represent blood pressure readings in terms of both numerical definition and stage (Table 2).

Systolic	Diastolic	Stage
<90	<60	Low
90-129	60-79	Normal
130-139	80-89	High Normal
140-159	90-99	Stage 1 –Mild
160-179	100-109	Stage 2 –Moderate
180-209	110-119	Stage 3 –Severe
210+	120+	Stage 4 -Very Severe

Table 2: Blood Pressure Measurements with Corresponding Stages of Severity. “The table shows the measure blood pressure with two numbers, such as 120/80 mmHG. The first number is systolic pressure, and occurs when you heart contracts to pump blood. Diastolic pressure is the second and lower number and occurs when your heart relaxes. These measures help doctors to identify the level of care for patient”

- It represents past blood pressure readings over a defined time interval in a cohesive manner, using calendar visualization.
- It allows for easy completion of the Risk Profile Evaluation and displays it in an intuitive manner.
- It is able to measure body mass index (BMI).
- It provides user push-notifications as reminders related to health records.

4-2: Data Input / Output

The context diagram in Figure 3 shows the relationship between the application and the five external entities, participant, volunteer peer health educator, physician, pharmacist, and administrator. Some of the key aspects of the relationships among these entities are highlighted below.

- Participants can input data on their own or with support from volunteer peer health educators, who can help users to register, measure their blood pressure, and fill out the Risk Profile Evaluation.
- Participants, physicians, and pharmacists can review participants' information in two different ways: by viewing (and possibly printing) Health Record and via the Calendar function, which can show multiple entries of blood pressure readings.
- With consent of the participant, these reports can be sent back to family physicians and pharmacists for appropriate care via the database (administrator works)
- The administrator: is responsible for managing the application, accessing the database through the website (PHP), upgrading the application, and giving authorizations to health providers to access the database or send the data to them.

The data flow diagram in Figure 4 illustrates the two initial processes in the application, registering and signing in. This diagram also shows how the data transfers from the user to the database. First, the user will enter user details and press to register that information, so the application will store the data in tbl_user in the database. Then, the user need to sign in, by entering their user name or email in the first field and password in the second field. If those match the data in the database, the user will enter into the main interface, which contains 7 processes, as shown in Figure 5.

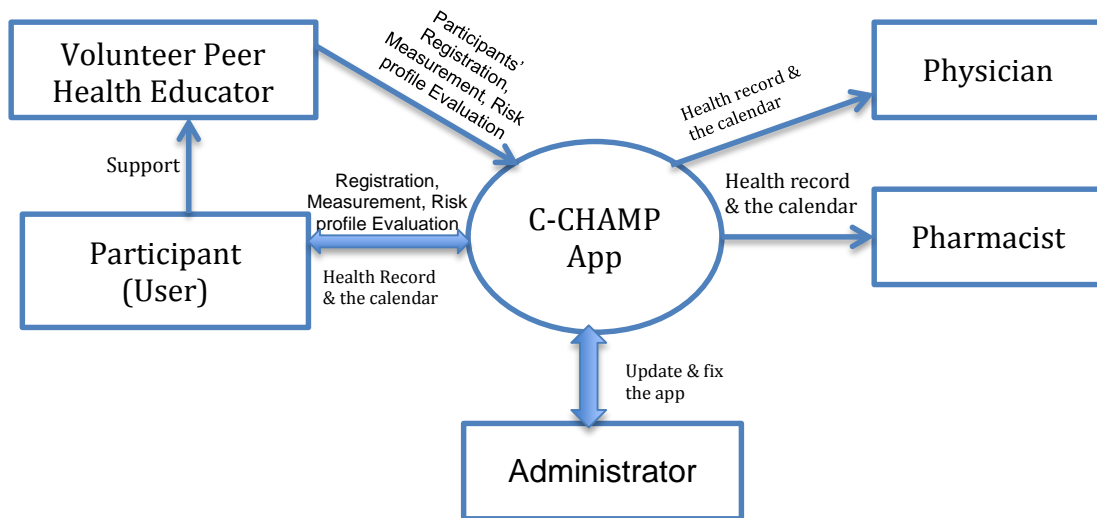


Figure 3: Context Diagram

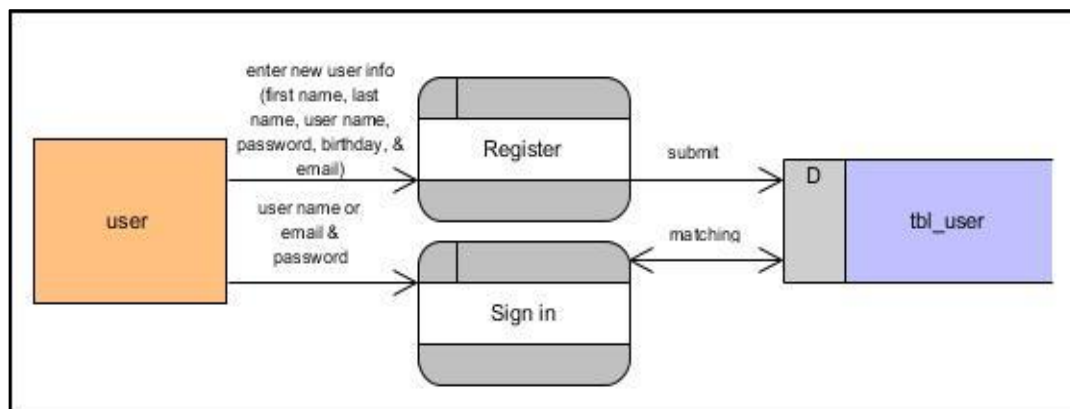


Figure 4: Data Flow Diagram level 0

Data Flow Diagram level 1 in Figure 5 illustrates the interactions between the user, the processes of the application, and the data store tables. There are seven different processes that the user can apply in the application: show and update personal information, enter BP reading, answer 15 questions about risk profile evaluation, calculate & display BMI, display Health Record, and display multiple BP readings in the Calendar,. All these data are stored within four tables in the database (tbl_user, tbl_bp, tbl_questions, tbl_bmi).

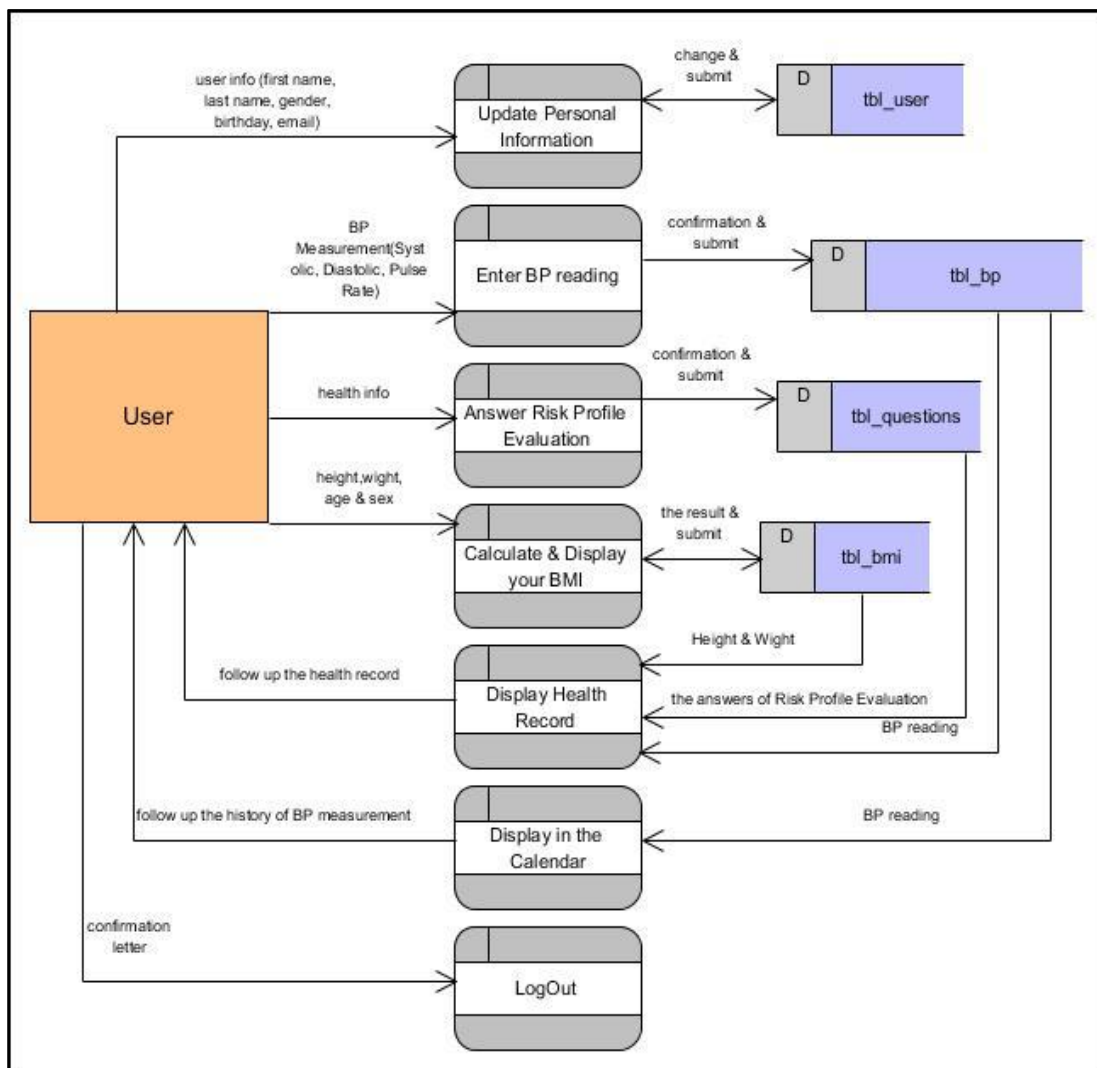


Figure 5: Data Flow Diagram level 1

4-3: User interfaces (UI)

For registration: user needs to enter the following required information first name, last name, username, password, sex, birthday, and email address.

In the main interface (Figure 6), there are eight main options:

1- Personal Information: shows information related to registration and provides the ability to update them when the user wants.

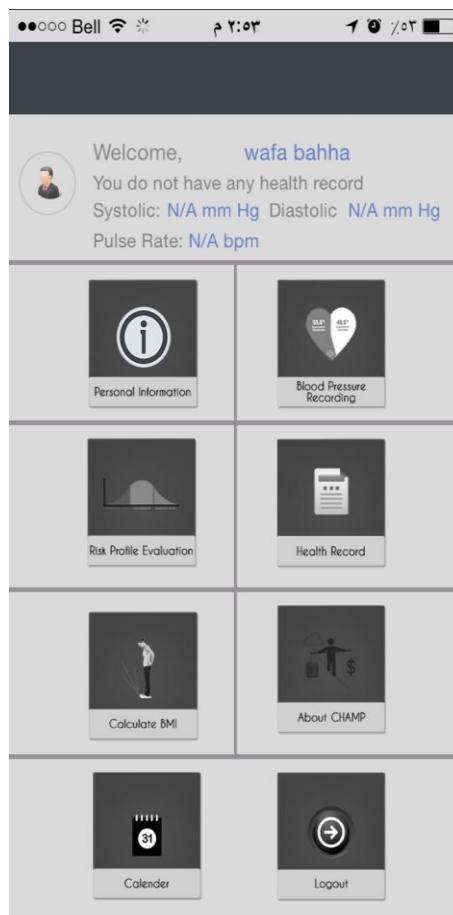


Figure 6: Main UI

2- Blood Pressure Recording (Figure 7): contains fields for the following information: systolic, diastolic, and pulse. This may be updated weekly, or when users meet their family physician, pharmacist, or volunteers.

3- Risk Profile Evaluation (Figure 8): contains fifteen simple and basic questions taken from **Risk Profile Recording Form (Figure 1)**, each question has its own interface:

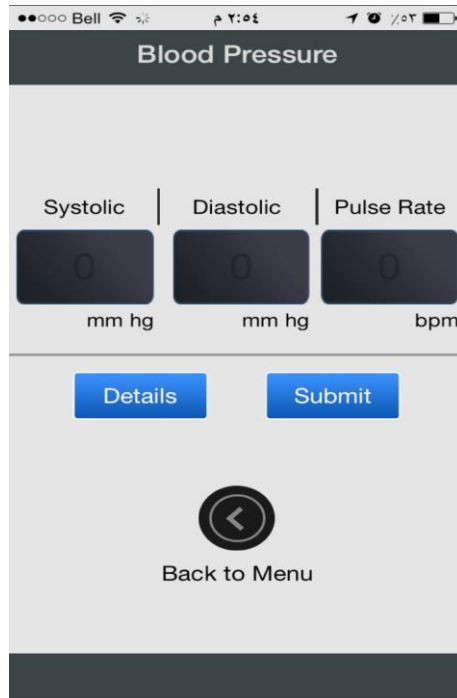


Figure 7: Blood Pressure Recording UI

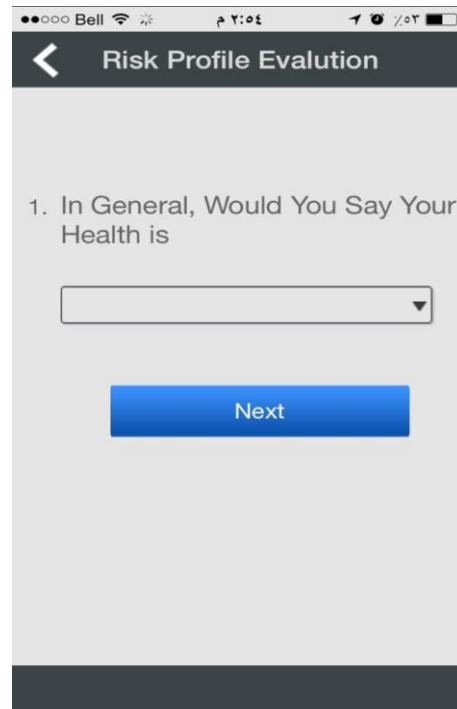


Figure 8: Question One UI

- 1- In general, would you say your health is: [very good], [good], [fair], [poor].
- 2- What is your height? [CM].
- 3- What is your weight? [Kg.] or [lbs.].
- 4- Have you ever had a transient ischemic attack (TIA or mini stroke)? [Yes] or [No].
- 5- Have you ever had a stroke? [Yes] or [No].
- 6- Have you ever had a heart attack? [Yes] or [No].
- 7- Has your doctor told you that your cholesterol is high? [Yes] or [No].
- 8- Has your doctor told you that you have diabetes? [Yes] or [No].
- 9- Are you currently taking prescription pills for high blood pressure? [Yes] or [No].
- 10- Do you currently smoke? [Never Smoked], [Not Anymore] or [Yes I do].
- 11- Typically, do you drink 2 or more alcoholic drinks a day? [Yes] or [No].
- 12- In a typical week, how many times do you eat high fat or fast foods? [Zero], [1-2] or [3 or more].
- 13- In a typical week, how frequently do you feel overwhelmed or stressed? [Rarely], [Sometimes] or [Often].
- 14- Have you ever been diagnosed with atrial fibrillation by a doctor? [Yes] or [No].
- 15- Are you currently taking prescription pills for atrial fibrillation? [Yes] or [No].

4- Heath Record (Figure 9): Once the user answers the previous questions, the system will save the data; this information, as well as the most recent blood pressure reading, can be viewed in the Health Record.

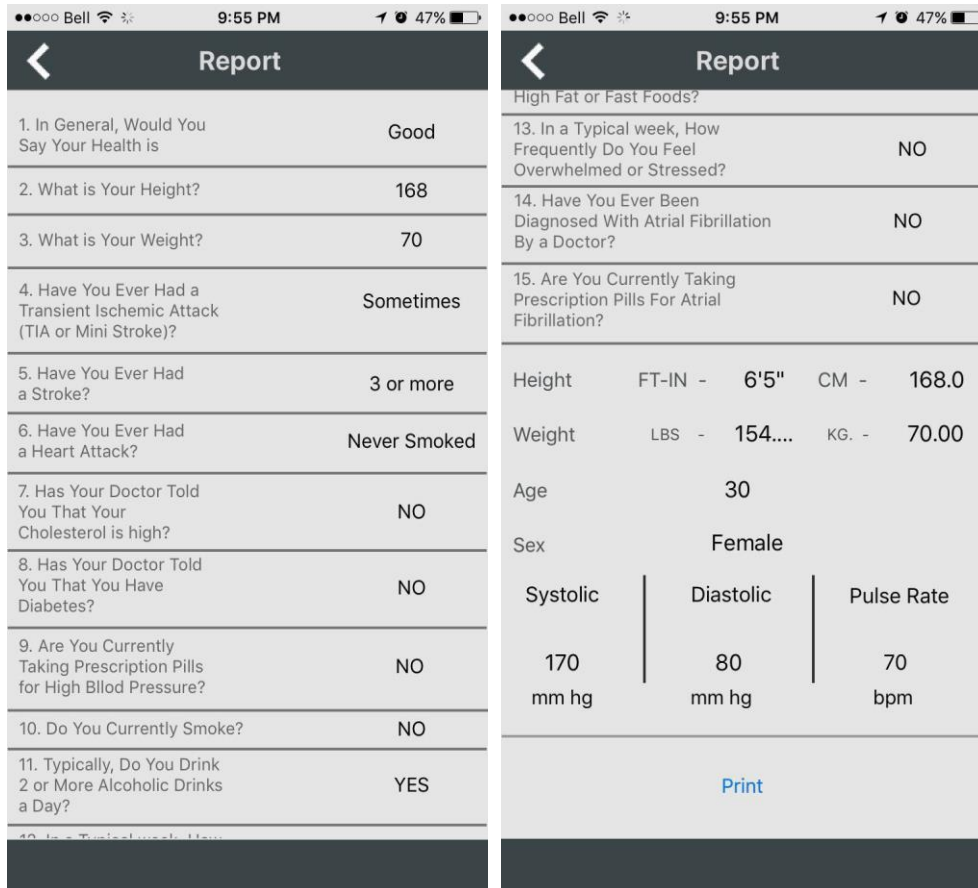


Figure 9: Health Report UIs

5- BMI: Body mass index (BMI) measures body fat in terms of height and weight that applies to adult men and women. Enter your weight and height using standard or metric measures (National Institutes of Health, 2014). For calculation of BMI, the user needs to enter height, weight, age, and gender.

6- About CHAP: this provides a definition of CHAP, lists CHAP's sponsors, and provides contact information.

7- Calendar (as shown in Figure 10): this represents all the blood pressure readings ranked in the calendar day by day with different colors (Table 3).

8- Logout: this is enables the user to exit the application.

(For more User Interfaces, see Appendix A)

Definition	Systolic (mm Hg)	Diastolic (mm Hg)
Low	<90	<60
Normal	<130	<85
High Normal	130-139	85-89
Stage 1 - Mild	140-159	90-99
Stage 2 - Moderate	160-179	100-109
Stage 3 - Severe	180-209	110-119
Stage 4 - very Severe	≥210	≥120

Table 3: Colors with BP Measurements Table

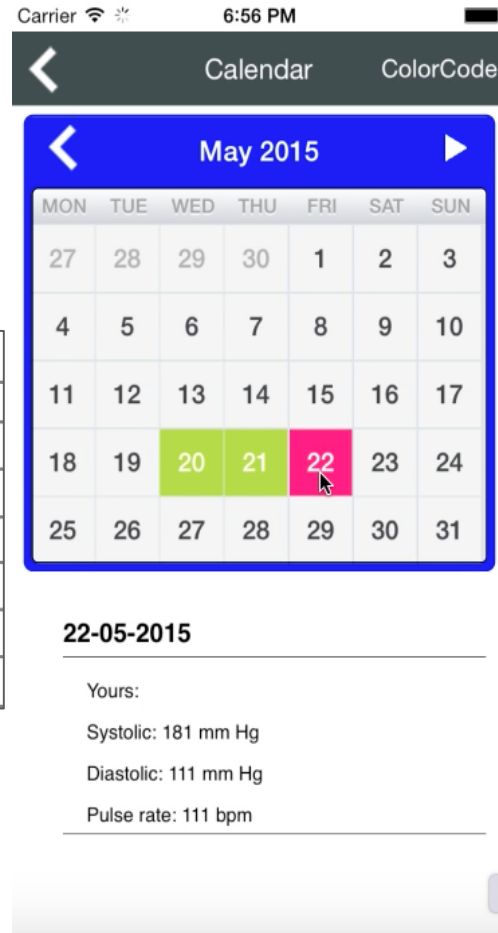


Figure 10: Calendar UI

4-4: Implementation Tools and Services:

4-4-1 XCode6

Coding, interface design, testing, and debugging were unified into a single workflow using Objective-C language programming (Figure 11).

(For some of the Objective-C source code for the app, see Appendix B)

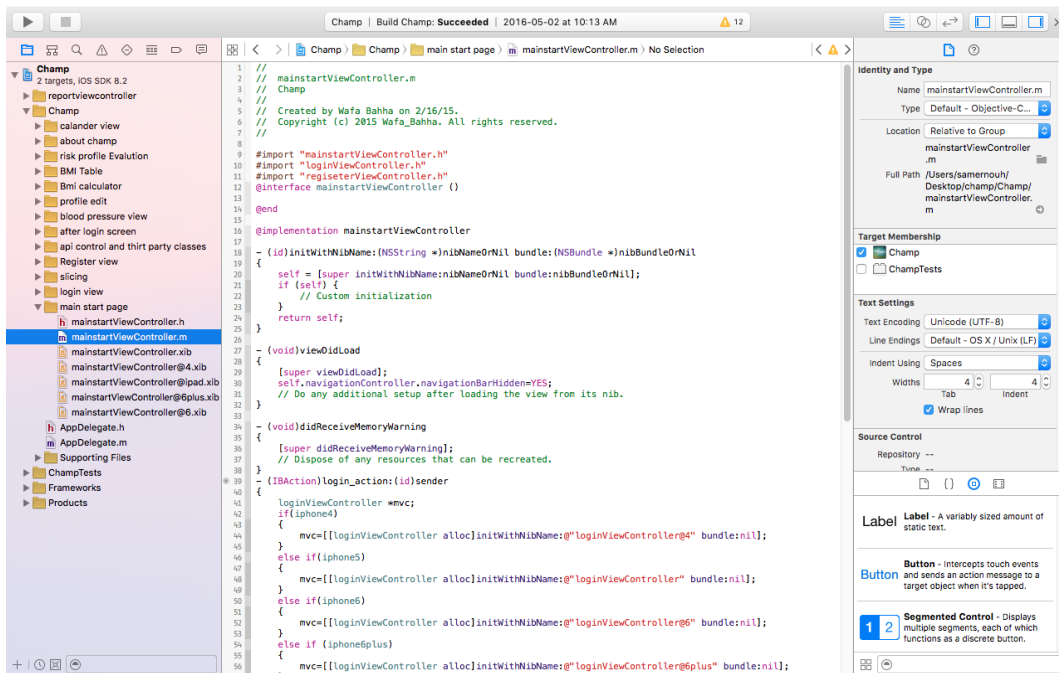


Figure 11: XCode6

4-4-2: Siteground.com

To manage the PHP files and MYSQL database, we used Site Ground, a web hosting company and domain name registrar (Figure 12). It offers a comprehensive set of

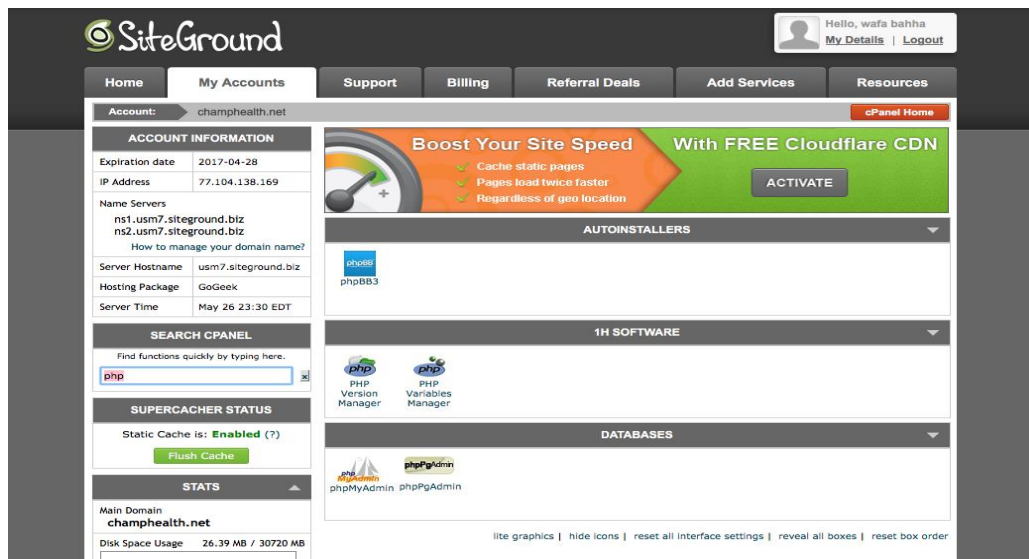


Figure 12: the server & the domain

website building tools, and offers the GoGeek plan, which is suitable for heavily visited or resource-intensive websites. For the website, we chose the domain **champhealth.net**

4-4-3: PHP Files Manger

Using a PHP files manger (Figure 13) in this application in order to connect a remote MySQL database to an iPhone/iPad device. PHP is a general-purpose scripting language used for web development. We used the PHP script to pass the request to the database and then return the response to C-CHAMP app.

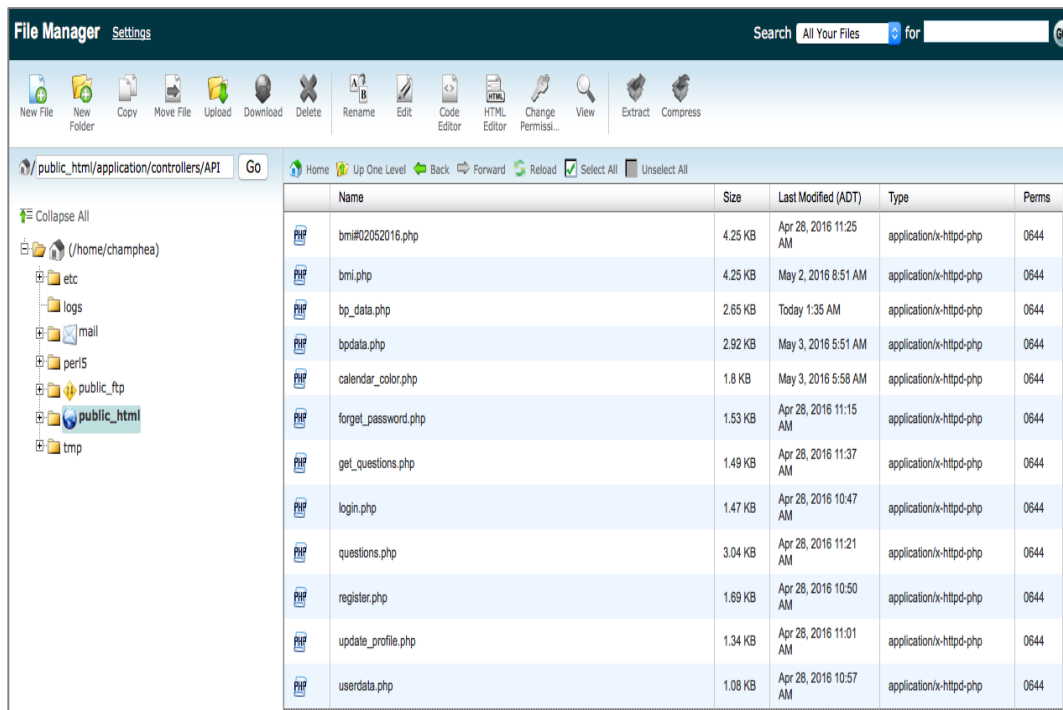


Figure 13: PHP files manager

(For some of the PHP source code, see Appendix C)

4-4-4: MySQL Database

MySQL is a server to collect and store data, an open source relational database management system (RDBMS) based on Structured Query Language (SQL). SQL is the language for adding, accessing and managing tables or content in a database. MySQL server is the best choice of database for use in web sites, personal computer applications, and smartphone applications, because it offers a lot of free MySQL tools and has strong technical support (What is MySQL, 2016). Consequently, MySQL is used for low cost practice management and clinical healthcare solutions for thousands of installations and tens of thousands of users; such applications include Practice Management Solutions, Electronic Medical Records (EMR) / Electronic Health Records (EHR), Monitoring Equipment, and Digital Imaging Systems (MySQL in Healthcare, 2016).

For storing data in the app, we created a MYSQL database; Table 4 represents this database's six tables, which are collectively referred to as champhea_champhealth. Two tables (ci_cookies – ci_sessions) are used to manage the system and the other four tables (tbl_user, tbl_bp, tbl_questions, & tbl_bmi) are used to store user data.

Table	Action	Rows	Type	Collation	Size	Overhead
ci_cookies	Browse Structure Search Insert Empty Drop	-0	InnoDB	latin1_swedish_ci	16 K1B	-
ci_sessions	Browse Structure Search Insert Empty Drop	6	MyISAM	latin1_swedish_ci	8.3 K1B	2.5K1B
tbl_bmi	Browse Structure Search Insert Empty Drop	-5	InnoDB	latin1_swedish_ci	16 K1B	-
tbl_bp	Browse Structure Search Insert Empty Drop	-0	InnoDB	latin1_swedish_ci	16 K1B	-
tbl_questions	Browse Structure Search Insert Empty Drop	-1	InnoDB	latin1_swedish_ci	16 K1B	-
tbl_user	Browse Structure Search Insert Empty Drop	-9	InnoDB	latin1_swedish_ci	16 K1B	-
6 tables	Sum	21	InnoDB	utf8_general_ci	88.3 K1B	2.5 K1B

Table 4: Database Tables

Table 5 (tbl_user) contains nine columns for personal information, such as first name, last name, password, and so on. user_id is the primary key that connects all the database tables.

#	Name	Type	Collation	Attributes	Null	Default	Extra	Action
1	user_id	int(11)			No	None	AUTO_INCREMENT	Change Drop Primary Unique Index More
2	user_name	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
3	first_name	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
4	last_name	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
5	email	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
6	pass	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
7	gender	varchar(11)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
8	birthday	datetime			No	None		Change Drop Primary Unique Index More
9	createdOn	datetime			No	None		Change Drop Primary Unique Index More

Table 5: User Table

Table 6 (tbl_bp) contains 11 columns to store the blood pressure measures such as systolic, diastolic, pulse-rate, etc. bp_id is the primary key in this table.

#	Name	Type	Collation	Attributes	Null	Default	Extra	Action
1	bp_id	int(11)			No	None	AUTO_INCREMENT	Change Drop Primary Unique Index More
2	user_id	int(11)			No	None		Change Drop Primary Unique Index More
3	systolic	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
4	diastolic	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
5	pulse_rate	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
6	height	varchar(222)	latin1_swedish_ci		Yes	NULL		Change Drop Primary Unique Index More
7	weight	varchar(222)	latin1_swedish_ci		Yes	NULL		Change Drop Primary Unique Index More
8	age	varchar(222)	latin1_swedish_ci		Yes	NULL		Change Drop Primary Unique Index More
9	sex	varchar(222)	latin1_swedish_ci		Yes	NULL		Change Drop Primary Unique Index More
10	createdOn	datetime			No	None		Change Drop Primary Unique Index More
11	time	datetime			No	None		Change Drop Primary Unique Index More

Table 6: Blood Pressure Recording Table

Table 7 (tbl_bmi) contains 11 columns to store information required to calculate BMI, such as height, weight, age, etc. bmi_id is the primary key in this table.

#	Name	Type	Collation	Attributes	Null	Default	Extra	Action
1	bmi_id	int(11)			No	None	AUTO_INCREMENT	Change Drop Primary Unique Index More
2	user_id	int(11)			No	None		Change Drop Primary Unique Index More
3	h_foot	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
4	h_inch	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
5	h_cm	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
6	w_kg	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
7	w_lbs	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
8	age	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
9	sex	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
10	bmi	varchar(22)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
11	createdOn	datetime			No	None		Change Drop Primary Unique Index More

Table 7: BMI Table

Finally, Table 8 (tbl_questions) contains 18 columns to store the answers of Risk Profile Recording questions. Each answer has one column, and que_id is the primary key in this table.

#	Name	Type	Collation	Attributes	Null	Default	Extra	Action
1	que_id	int(11)			No	None	AUTO_INCREMENT	Change Drop Primary Unique Index More
2	user_id	int(11)			No	None		Change Drop Primary Unique Index More
3	q1	varchar(222)	latin1_swedish_ci		Yes	NULL		Change Drop Primary Unique Index More
4	q2	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
5	q3	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
6	q4	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
7	q5	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
8	q6	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
9	q7	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
10	q8	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
11	q9	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
12	q10	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
13	q11	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
14	q12	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
15	q13	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
16	q14	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
17	q15	varchar(222)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
18	createdOn	datetime			No	None		Change Drop Primary Unique Index More

Table 8: Risk Profile Recording Table

In this chapter, we discussed the design and development of the C-CHAMP iPhone/iPad application to manage cardiovascular diseases using protocols defined by CHAP. In addition, we illustrated the user requirements, the specific functions and features for the app, and the data input-output. App development began with designing MYSQL database tables, and then connecting these tables into interfaces, creating the iPhone/iPad application itself. We designed these interfaces using XCode 6 to be very simple and clear, such that older individuals who may lack technological experience could nonetheless navigate the app. To connect the database table with the interfaces, we created PHP files manager. These files and the database are managed through a server and domain.

Chapter 5: Evaluation Plan and Analysis for C-CHAMP App

5-1: Overview of Evaluation Plan and Develop Evaluation Plan for C-CHAMP App

Developing evaluation plans for mobile-health applications is important for many reasons: collecting information about the app, comparing different app types, measuring the app's effectiveness or contribution, demonstrate the app's value, improving it, and meeting funding requirements.

According to the U.S. Department of Health and Human Services Centers for Disease Control and Prevention (2011), there are three types of evaluations: Implementation/Process evaluations, Effectiveness/Outcome evaluations, and Causal Attribution evaluations. Since the goal of our evaluation was to understand the effectiveness of our app from the user's perspective, in hopes of improving its functions and processes, we used Effectiveness/Outcome evaluations. Specifically, we first developed a logic model that incorporates the process used for describing the effectiveness of their programs in the interest of determining the best evaluation focus. This model describes logical linkages among program resources, activities, outputs, audiences, and short-, intermediate-, and long-term outcomes related to a specific problem or situation.

We next consider evaluation criteria. M-Health care service evaluation criteria are often too general, complex, or specific for the particular health domain in question (Stoyanov, 2015). Studies vary substantially in terms of criteria used. For example, a study by Handel (2011) evaluated 35 m-health apps based on user ratings of ease of use, reliability, quality, scope of information, and aesthetics. Another study (Khoja et al, 2013) developed a matrix of evaluation criteria, divided into seven themes for each of the four stages of e-health life cycle (development, implementation, integration, and

sustained operation). In general, the above evaluations tend to focus on appropriateness, relevance, use, safety, and effectiveness of the technology. Yasini (2015) used a simpler approach, measuring just the usability score of health apps because calculation and attribution of usability scores to health apps could be used to identify apps with better medical quality. Following Yasini (2015) and (Khoja et al, 2013), we focused our evaluation on the usability of C-CHAMP app, both in general and with respect to the app's component functions. The evaluation also focused on assessing the short-term goals associated with using the app, which will represent in the logic model for the app (Figure 14).

In developing an evaluation plan, we followed A Guide to Planning and Conducting Program Evaluation (the Michael Smith Foundation for Health Research, 2009). To develop the evaluation plan, the key components were:

- (1) Identification of the stakeholders
- (2) Program description (development of a Logic Model)
- (3) Identify evaluator (Develop and select evaluation questions)
- (4) Results and analyses
- (5) Discussion
- (6) Limitations.

5-2: Evaluation Methods

5-2-1: Stakeholders

Stakeholders were divided into three groups:

- The CHAP working group & program staff, including the regional manager, local lead organization, local CHAP coordinators, administrators, and programmers.
- Individuals served or affected by the program, including patients and community members.
- Health professionals, including pharmacists, nurses, and -family doctors.

5-2-2: Logic Model for C-CHAMP App

The logic model used for evaluation of the app is shown in Figure 14.

<p>Program: C-CHAMP (Canadian Chronic Disease Awareness and Management Program) app.</p> <p>Target population: community-wide orientation with a view to reaching all people in the community with cardiovascular diseases.</p>
<p>Inputs:</p> <ul style="list-style-type: none"> - Use of a validated and accurate blood pressure measuring device. - Volunteers trained to measure blood pressure accurately. - Health providers: family physicians, nurse practitioners, and pharmacists involved to the program. - Installed C-CHAMP app on participants' cell phone.
<p>Activities:</p> <ul style="list-style-type: none"> - Organize sessions weekly held in community pharmacies -Register participants in the app. - Enter blood pressure readings on the application. - Fill the Risk Profile Evaluation on the application. - Measure participants' BMI.

Outputs:

- Follow up the BP readings in the Calendar.
- Follow up the Health Record.
- Received feedback of patients' results to their family physician or regular pharmacist.

Short-term Outcomes:

- Improved the management of health information.
- Flexible & appropriate app interfaces.
- Better blood pressure control for participants
- Increased awareness of cardiovascular disease and risk factors.
- Improved communication between patient and health care professionals.
- Improved making decision.
- Improved work life or the protocol of CHAP, by using less papers.
- Reduced effort.
- Reduced time.

Long-term Outcomes

- Increased accurate, by having a confirmation letter in the application, and by support volunteers trained enters each blood pressure reading.
- Increased the number of blood pressure readings, without missing any reading
- Reduce costs
- Facilitated the process of counting outputs.

Figure 14: Logic Model for C-CHAMP app

5-2-3: Identification of Evaluator

For the data collection, we constructed distinct five-minute surveys that catered to three types of stakeholders. In particular, surveys were administered to 57 users (20-60 years old- Canadian-diploma or Bachelor's degrees, master's degrees or higher), six health professionals, and two CHAP working program groups. The three surveys are discussed below.

1- Users

The questionnaire for the users evaluated the short-term outcomes for the app. It was composed of 17 statements regarding the app, for which they could indicate level of agreement or satisfaction; for these, there was a seven point scale ranging from “strongly disagree” to “strongly agree” (or “very dissatisfied” to “very satisfied”). There was also one multiple choice question.

2- Health Professionals

The questionnaire to evaluate the app from doctors', nurses', and pharmacists' perspectives featured seven statements regarding C-CHAMP app, with professionals asked to indicate agreement or satisfaction using the same seven-point scales used above. In addition, there were three short answer questions

3- CHAP Working Program Group

The questionnaire to evaluate the app from CHAP manger' perspectives determined the degree to which the app improves the protocol and work life of CHAP, and reduces effort and time. This survey contained ten short answer questions about work climate, comparison of technologies with the original CHAP, and the outputs and information management.

5-3: Results and Analyses:

5-3-1: The Users

The evaluation aspects	Negative	Neutral	Positive
1- C-CHAMP app is easy to use in overall.	3.57%	3.75%	92.86%
2- C-CHAMP app is helpful	0.0%	3.51%	96.49%
3- C-CHAMP app is reliable	5,36%	8.93%	85.71%
On the functionally of the app:			
4-Registering your personal information	7.15%	8.93%	83.92%
5-Entering the blood pressure readings with the confirmation letter.	3.51%	7.02%	89.47%
6- Answering Risk Profile Evaluation questions.	1.75%	7.02%	91.23%
7-Follow up your health records.	21.05%	1.75%	77.19%
8-Calculate your BMI.	0.00%	3.51%	96.49%
9- Follow up your past BP readings.	3.50%	1.75%	94.74%
On the goals of the app			
10- The app improves your health condition in overall.	3.50%	3.51%	92.98%
11- C-CHAMP makes you more empowered to make your decisions about what to do next.	3.51%	5.26%	91.23%

The evaluation aspects	Negative	Neutral	Positive
12- C-CHAMP helps you to manage your blood pressure.	1.75%	1.75%	96.49%
13- C-CHAMP helps you to describe your condition better.	3.51%	1.75%	94.74%
On the Risk Profile Evaluation service			
14- Risk Profile Evaluation service is helpful.	1.75%	3,51%	94.74%
15- You are comfortable to put your information.	5.25%	15.79%	78.95%
16- It helps you to collect more and save information about your health.	3.5%	5.26%	91.23%
17- It has improved self-efficacy in the management of risk factors.	3.50%	5.26%	91.22%

Table 9: Results of users' survey

Most users (59.65%) reported using the app once a week, while the rest reported using it either every day (15.79%) or several days a week (24.56%). Overall, the vast majority of users found the app helpful (96.49% of users), easy to use (92.86%), and reliable (85.71%) (Table 9).

Users also rated the functionality of the app highly, with positive ratings by the vast majority of users for most functions (calculating BMI, entering personal

information, etc.) (Table 9). The lowest-rated aspect of functionality was following up health records, for which 21.05% of users gave a negative rating. The app was very highly rated in terms of its goals. On questions related to improvement of overall health, decision-making, describing one’s condition, and managing BP, over 90% of users rated the app highly (Table 9). Similarly, over 90% of users ranked the app highly for most questions related to the risk profile evaluation service; the only exception was the question exploring user comfort for entering personal information, for which 78.95% of users gave a positive rating (Table 9).

5-3-2: Health Professionals

The evaluation aspects	Negative	Neutral	Positive
About the diagnoses and patients’ needs			
1- Having better diagnoses	1	0	5
2- The app improves your practice overall	0	1	5
3- The app is a way to reaching patients’ needs	0	1	5
About the technology			
4- Safety	1	0	5
5- Reliability	0	2	4
6- Saving time	0	0	6
7- Accuracy, and efficiency	1	2	3

Table 10: Results of Health Professionals’ Survey

Health professionals ranked the app highly with respect to diagnosis and meeting users' needs (Table 10). For example, five of the six professionals agreed that the app improves their practice, and the app meets patients' needs. The only negative rating for these questions was by one professional with regard to the app having better diagnoses. The professionals also rated the app positively with respect to its technological aspects (Table 10). Saving time was the most highly rated of these aspects, with all six professionals giving positive ratings.

We also asked the health professionals three short answer questions. The first inquired about the general impacts of the apps on patient care. The answers to this question were positive, noting the role of the app in facilitating life for patients by given them the best tools for managing their health and the data analytics are making it easier for healthcare professionals to deliver the appropriate care possible, without relying exclusively on high-cost facilities such as hospitals and doctors' offices. Also, it is a way to improve workflow and productivities and to manage complex health conditions by tying patients directly to their healthcare providers via mobile phones.

The second question explored the possibility of other chronic diseases that we could manage them by this approach. The diseases suggested by the professionals included diabetes, thyroid diseases, mental health issues such as schizophrenia, and Alzheimer's disease.

In response to the third question, which asked for any other comments, questions, or concerns, professionals recommended adding an education tool, which would provide diagnostic and treatment recommendations for blood pressure diseases, as well as

information about blood pressure medications, including indications and contraindications.

5-3-3: CHAP Working Program Group:

The evaluation aspects	Negative	Positive
About a work climate		
1- Improve workflow of the protocol of CHAP	0	2
2- Reduce effort	0	2
In the area of technologies comparing with the original CHAP		
3- Reduce time	0	2
4- Easy to use	0	2
5- Safety	1	1
6- Reliability	0	2
7- Accuracy	1	1
8- Efficiency	2	0
9- Follow up the outputs	0	2

Table 11: CHAP Group Survey Results

The CHAP groups both rated the app positively with respect to its improvement of workflow/protocols and its reduction of effort (Table 11). Responses regarding particular aspects of the technology were mixed. While both groups ranked the app positively with respect to time reduction, ease of use, reliability, and follow up of

outputs, they were split on safety and accuracy. Both groups rated the app negatively with respect to efficiency (Table 11).

5-4: Discussion

From our survey, it was clear that users find the C-CHAMP app easy to use and feel that it improves the management of health information. User opinions indicated that most of the app's functions work well, although results suggest that the Health Records function need to be improved. According to users, the app fulfills its goals related to awareness and disease management.

The perspectives of health professionals suggested that the app succeeds in improving communications between patient and health care professionals by enhancing their overall practice and making it easier to meet patient needs. In addition, the app contributes to improvements in diagnoses and decision making. Health professionals indicated that, in terms of technology, the app saves time and is more reliable in comparison to using paper.

The CHAP working program groups indicated that the app leads to improved workflow/protocols and reduced effort. Compared to using paper, they identifying the app as being quicker and more reliable. Overall, the strong positive results demonstrated by the evaluation justify the usefulness of the app.

5-5: Limitations

While the study produced fairly consistent results in terms of evaluation of the newly developed app, there are some limitations that should be noted. For example, we

just focused only on usability and some short-term outcomes goals in evaluating the app. According to Khoja et al (2013), we can evaluate the app with respect to numerous other factors, including health services outcomes, economic outcomes, behavioral and social outcomes, ethics outcomes, readiness and change outcomes, and policy outcomes. Compared to the outcomes evaluated here, such outcomes are longer-term and therefore outside of the current scope of this project and service providers did not play a real role in this project yet. Thus, we were limited to evaluating technology outcomes related to the software, hardware, and connectivity infrastructure used to implement and sustain any e-health solution, including the app being evaluated here. Therefore, we evaluated preliminary quality assurance via these aspects: interoperability, user-friendliness/usability, appropriate in a variety of conditions, relevance to existing and growing needs, flexibility, efficiency/error rates, and accuracy.

Chapter 6: Conclusion & Future Work

In this thesis, we designed and developed the Canadian Chronic Disease Awareness and management program (C-CHAMP) iPhone/iPad application to manage cardiovascular diseases using protocols defined by the Cardiovascular Health Awareness Program (CHAP), an innovative program started in Ontario.

Specifically, we have reviewed the mobile healthcare applications industry with respect to the various types. The impact of these apps on patient care are wide ranging and include improved decision-making and supporting evidence-based medicine, improved accuracy and efficiency of patient documentation, and increased in the productivity of health care professional. Nonetheless, there are some important challenges facing developers, Future work with the app examined here, as well as all M-healthcare apps, should consider these factors when developing mobile technologies.

This study, and development of the app examined here, exist in the context of the Cardiovascular Health Awareness Program (CHAP), which has established protocols related to measuring multiple blood pressure readings, managing the risk factors of cardiovascular diseases by organize weekly sessions in local pharmacy, measuring BP with trained volunteers to avoid any error occur, completing Risk Profile Recording Forms, meeting with a nurse in the case abnormal BP, assessing medication in order to ensure the safe and appropriate use of all types of medication, and getting permission to forward info to family physicians. Moreover, this thesis reviewed some evaluation studies that test the effectiveness of the community based CHAP

For C-CHAMP app, this thesis details the development and operation of the app's main functions, which are registration, ability to represent current blood pressure

readings in numerical definition, able to represent past blood pressure readings in the calendar, able to fill out and display Risk Profile Evaluation easily and obviously, able to measure the body mass index all these with user interfaces are simplistic and intuitive to use. Also, it illustrated the implementation tools and services.

We have illustrated technology outcomes evaluation plan and analysis for C-CHAMP app, which include the usability, reliability, and on the functionality of the app. By follow these steps: determine the stakeholders, develop a Logic Model, evaluation methods and identify evaluator, results, analysis, and limitations. And there is strong evidence showing the C-CHAMP App has positive impact on all the stakeholders involved.

In future work, we will improve the app by developing a function by which healthcare professionals can send feedback regarding patients' results to their family physician immediately through the app. Also, we will develop an education tool for providing information related to blood pressure diseases, including recommendations and medication. In addition, we will create a version of the C-CHAMP app for Android platforms using Java programming language. We will also integrate the app with CHAP into community with the support of service health providers that we hope will adopt the app in Halifax. In terms of evaluation, we need to evaluate the app with respect to many other aspects including health, social, and economic outcomes.

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Appendix A: The Rest of C-CHAMP App User Interfaces



Figure 15: C-Champ app Icon

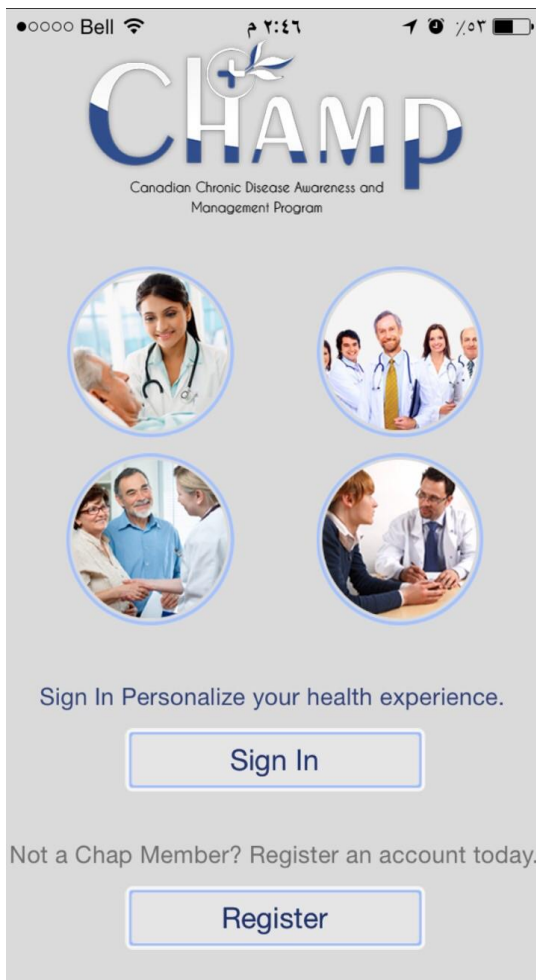


Figure 16: Main Start UI

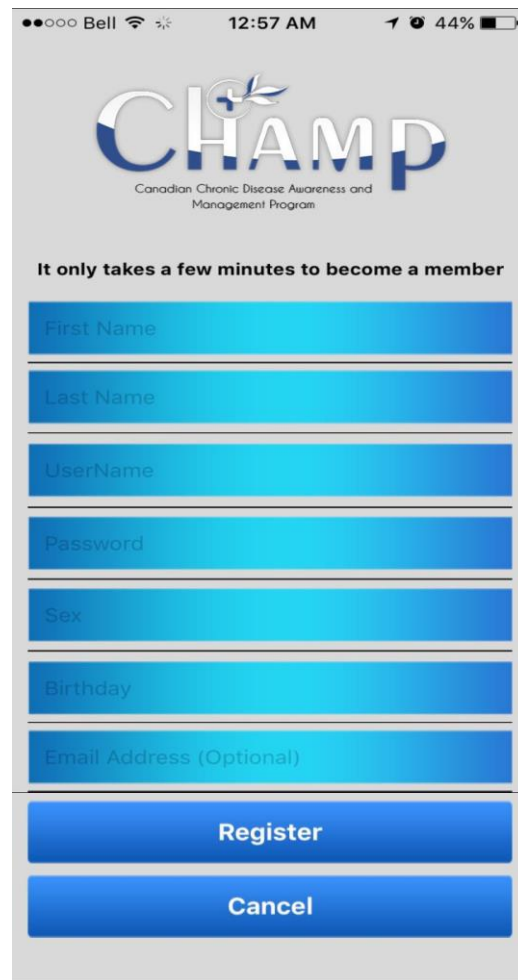


Figure 17: Register UI

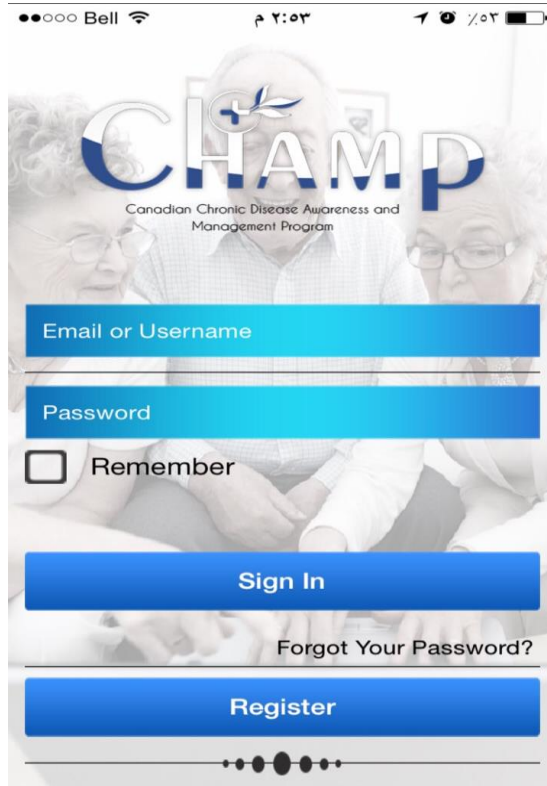


Figure 18: Login UI

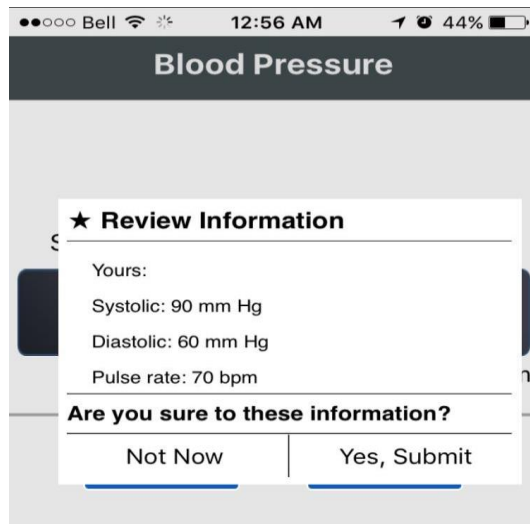


Figure 19: Confirmation Letter for BP Recoding



Figure 20: Question Two UI

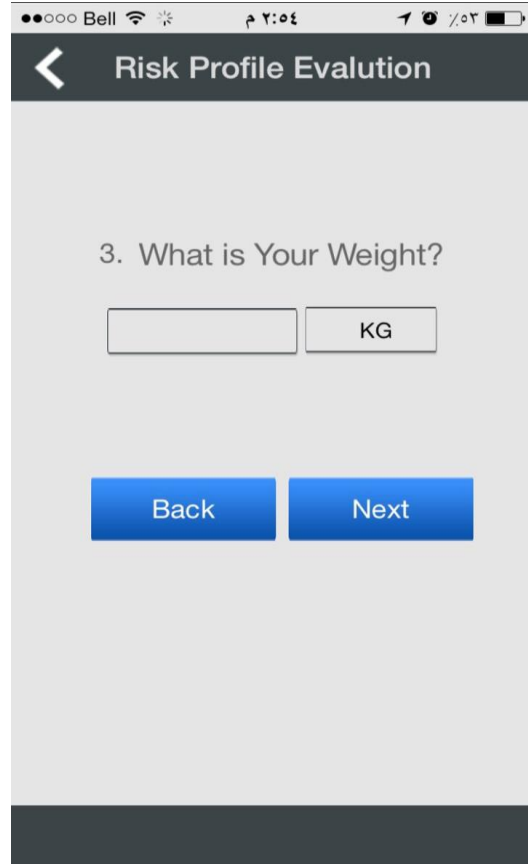


Figure 21: Question Three UI

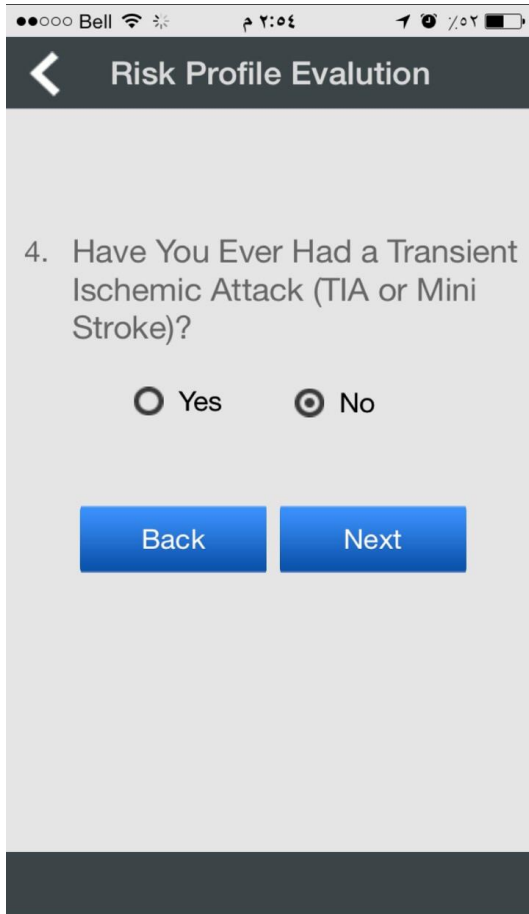


Figure 22: Question Four UI



Figure 23: Question Five UI

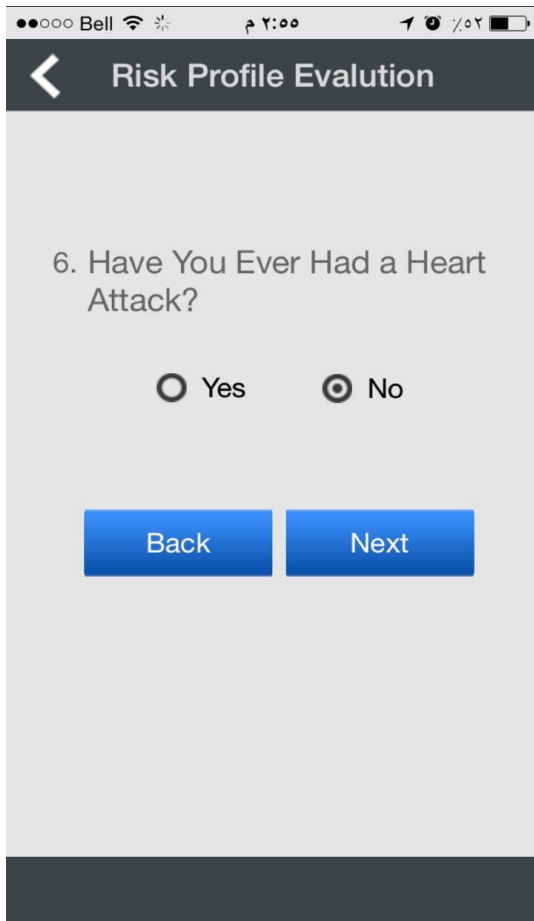


Figure 24: Question Six UI

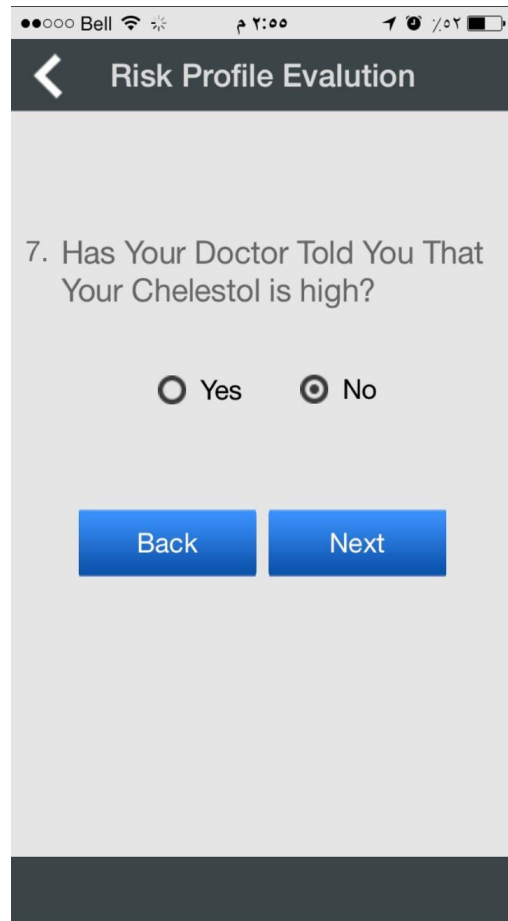


Figure 25: Question Seven UI

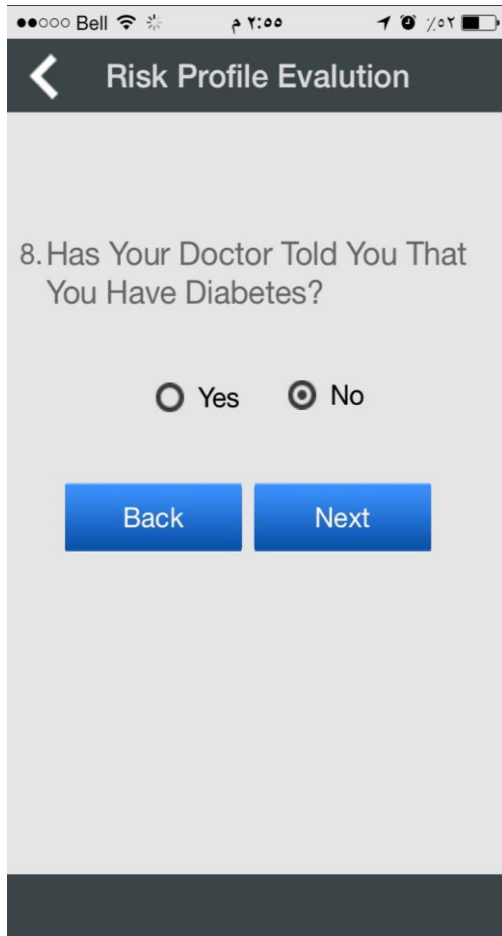


Figure 26: Question Eight UI

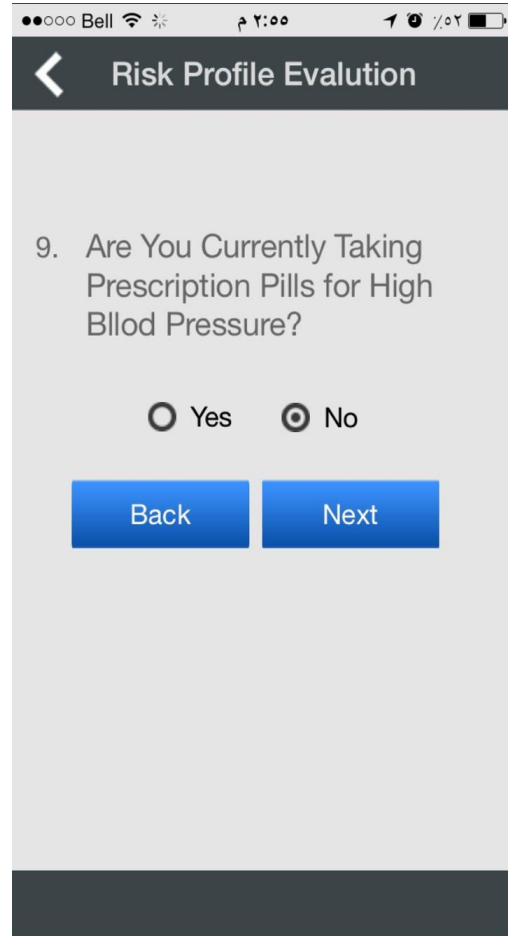


Figure 27: Question Nine UI

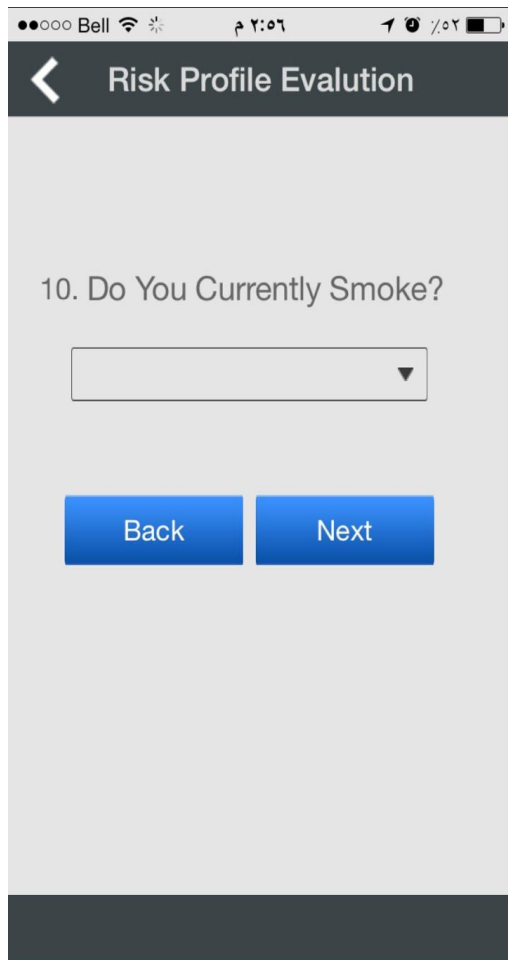


Figure 28: Question Ten UI

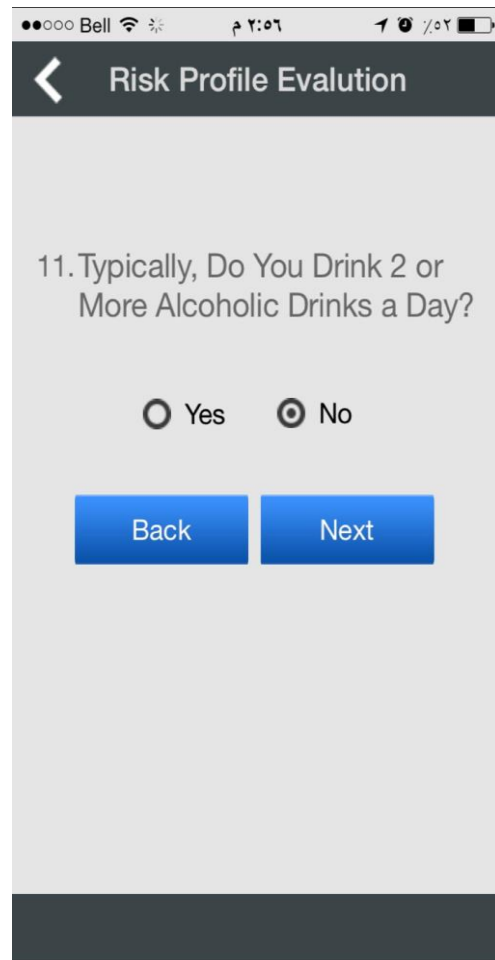


Figure 29: Question Eleven UI

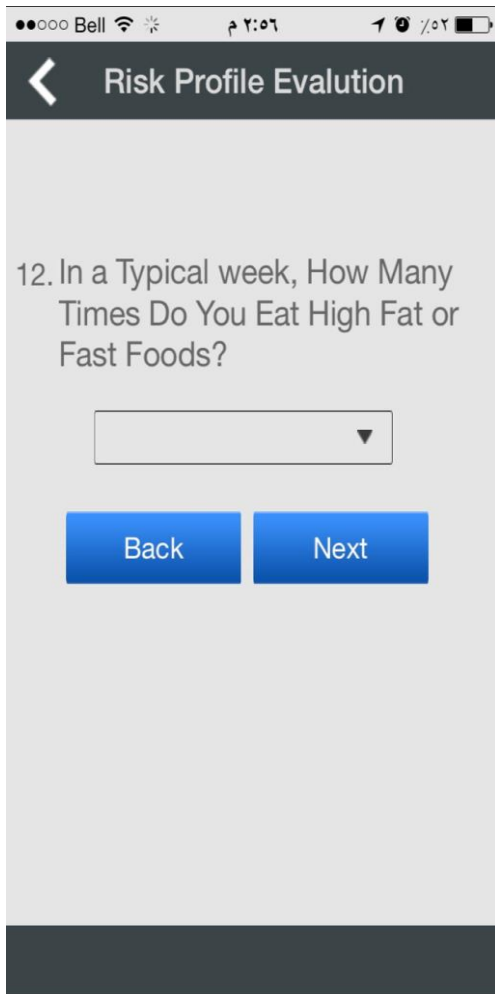


Figure 30: Question Twenty UI

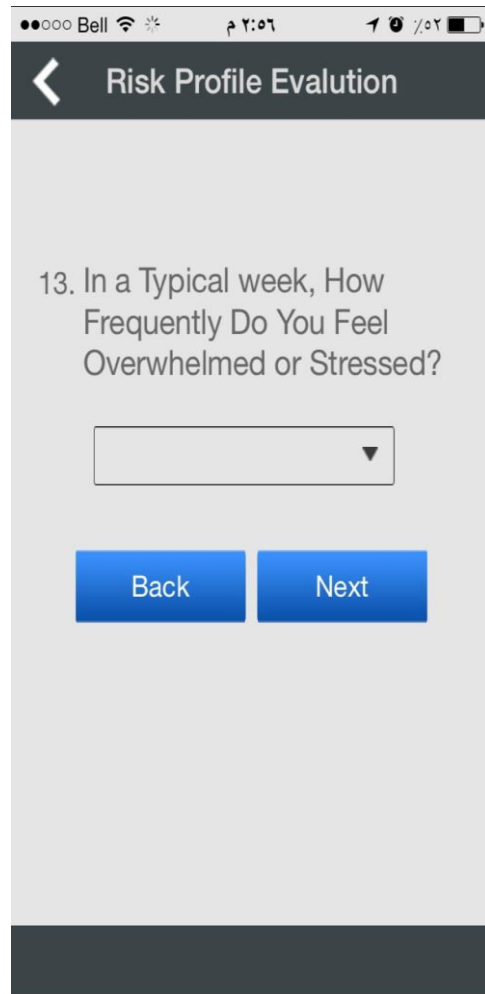


Figure 31: Question Thirteen UI

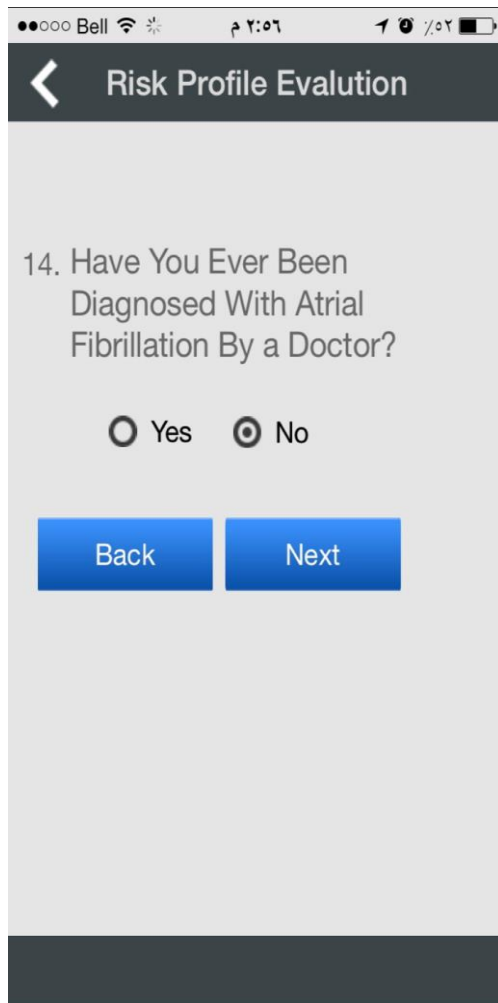


Figure 32: Question Fourteen UI

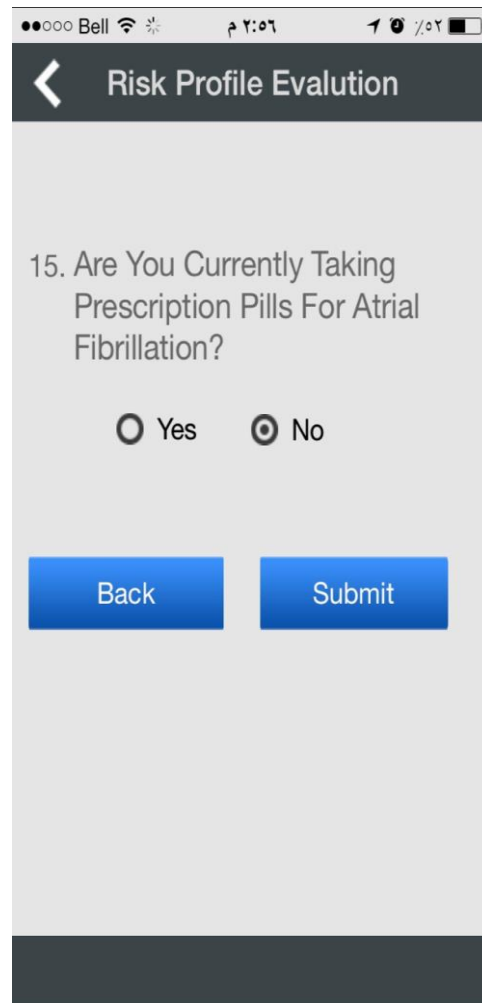


Figure 33: Question Fifteen UI

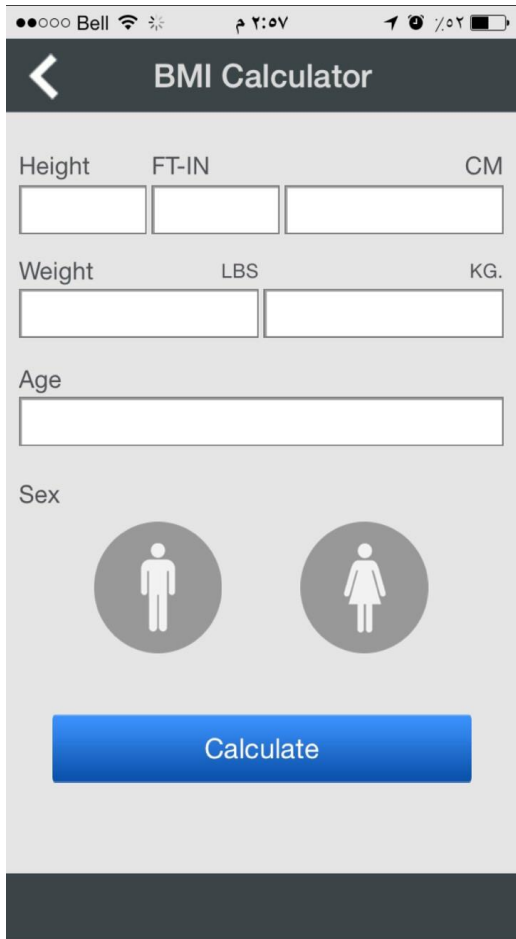


Figure 34: BMI Inputs UI

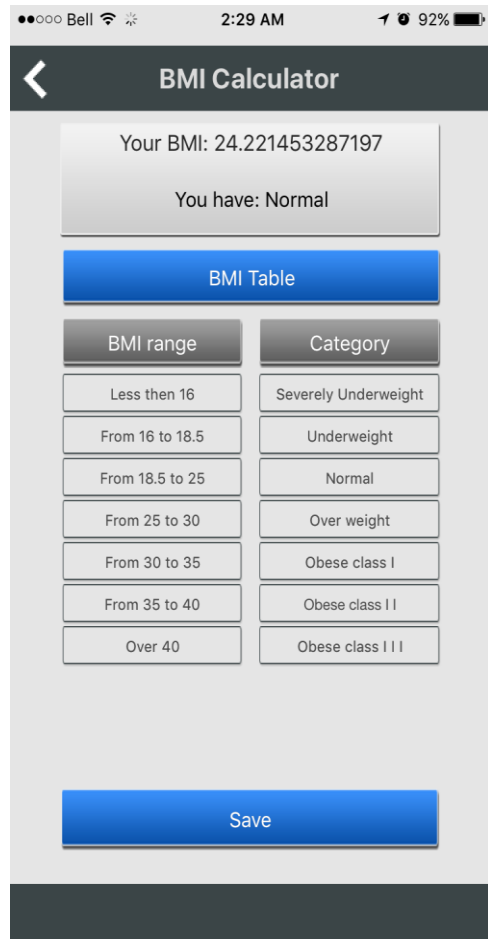


Figure 35: BMI Outputs UI

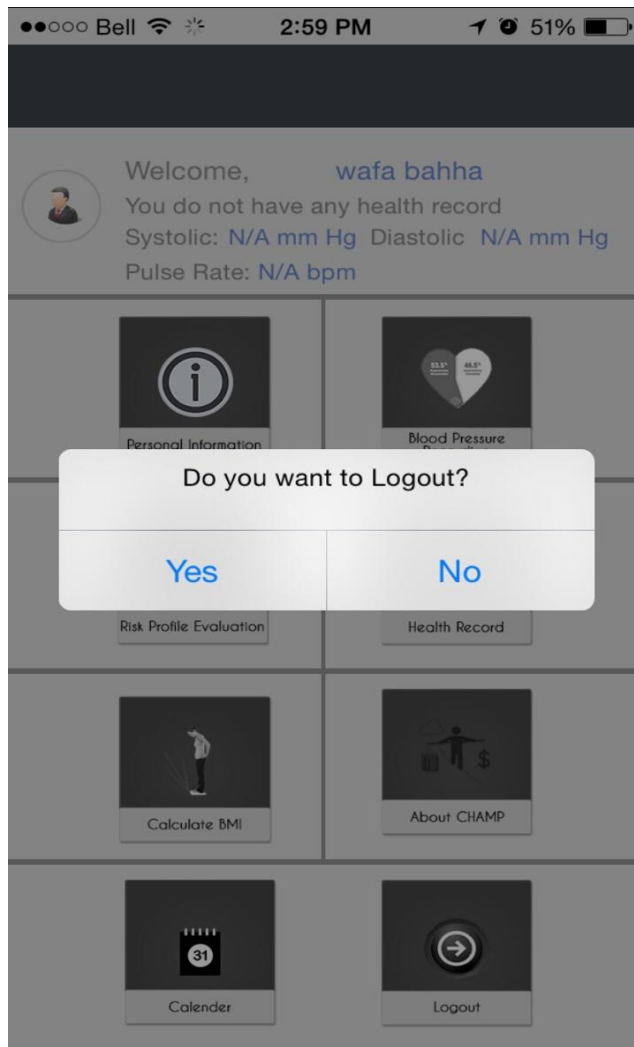


Figure 36: Logout letter

Appendix B: Some of the source code by using Objective C Programming Language

```
// mainstartViewController.h
// Champ
// Created by Wafa Bahha on 2/16/15.
// Copyright (c) 2015 Wafa_Bahha. All rights reserved.
//
#import <UIKit/UIKit.h>
@interface mainstartViewController : UIViewController
- (IBAction)login_action:(id)sender;
- (IBAction)register_action:(id)sender;
@end
// mainstartViewController.m
// Champ
// Created by Wafa Bahha on 2/16/15.
// Copyright (c) 2015 Wafa_Bahha. All rights reserved.
//
#import "mainstartViewController.h"
#import "loginViewController.h"
#import "regiseterViewController.h"
@interface mainstartViewController ()
@end
@implementation mainstartViewController

- (id)initWithNibName:(NSString *)nibNameOrNil bundle:(NSBundle *)nibBundleOrNil
{
    self = [super initWithNibName:nibNameOrNil bundle:nibBundleOrNil];
    if (self) {
        // Custom initialization
    }
    return self;
}

- (void)viewDidLoad
{
    [super viewDidLoad];
    self.navigationController.navigationBarHidden=YES;
    // Do any additional setup after loading the view from its nib.
}

- (void)didReceiveMemoryWarning
{
    [super didReceiveMemoryWarning];
    // Dispose of any resources that can be recreated.
}

- (IBAction)login_action:(id)sender
{
    loginViewController *mvc;
    if(iphone4)
    {
        mvc=[[loginViewController alloc]initWithNibName:@"loginViewController@4"
bundle:nil];
    }
}
```

```

        else if(iphone5)
        {
            mvc=[[loginViewController alloc] initWithNibName:@"loginViewController"
bundle:nil];
        }
        else if(iphone6)
        {
            mvc=[[loginViewController alloc] initWithNibName:@"loginViewController@6"
bundle:nil];
        }
        else if (iphone6plus)
        {
            mvc=[[loginViewController alloc] initWithNibName:@"loginViewController@6plus"
bundle:nil];
        }
        else
        {
            mvc=[[loginViewController alloc] initWithNibName:@"loginViewController@ipad"
bundle:nil];
        }
        [self.navigationController pushViewController:mvc animated:YES];
    }
- (IBAction)register_action:(id)sender
{
    regiseterViewController *mvc;
    mvc=[[regiseterViewController alloc] initWithNibName:@"regiseterViewController"
bundle:nil];

    [self.navigationController pushViewController:mvc animated:YES];
}
@end
//
// regiseterViewController.h
// Champ
// Created by Wafa Bahha on 2/16/15.
// Copyright (c) 2015 Wafa_Bahha. All rights reserved.
//
#import <UIKit/UIKit.h>
@interface regiseterViewController : UIViewController
{
    IBOutlet UITextField *firstname_feild;
    IBOutlet UITextField *plastname_feild;
    IBOutlet UITextField *username_feild;
    IBOutlet UITextField *email_feild;
    IBOutlet UITextField *pass_feild;
    IBOutlet UITextField *sex_feild;
    IBOutlet UITextField *birthday_feild;
    IBOutlet UIScrollView *scr;
}
- (IBAction)register_action:(id)sender;
- (IBAction)back_action:(id)sender;

```



```

@end
//
// regiseterViewController.m
// Champ
// Created by Wafa Bahha on 2/16/15.
// Copyright (c) 2015 Wafa_Bahha. All rights reserved.
//
#import "regiseterViewController.h"
#import "APIViewController.h"
#import "MBProgressHUD.h"
@interface regiseterViewController ()
{
    UIDatePicker *datePicker;
    UIView *popupscreen,*dateview;
    APIViewController *api_obj;
    MBProgressHUD *HUD;
    NSMutableArray *suggestedmem;
}
@end
@implementation regiseterViewController
- (id)initWithNibName:(NSString *)nibNameOrNil bundle:(NSBundle *)nibBundleOrNil
{
    self = [super initWithNibName:nibNameOrNil bundle:nibBundleOrNil];
    if (self) {
        // Custom initialization
    }
    return self;
}
- (void)doneClicked2:(id)sender
{
    NSLog(@"Done Clicked.");
    [self.view endEditing:YES];
    [UIView beginAnimations:@"animate" context:nil];
    [UIView setAnimationDuration:0.35f];
    [UIView setAnimationBeginsFromCurrentState:NO];
    self.view.frame = CGRectMake(self.view.frame.origin.x, 0, self.view.frame.size.width,
self.view.frame.size.height);
    [UIView commitAnimations];
}
- (void)viewDidLoad
{
    UIToolbar* keyboardDoneButtonView = [[UIToolbar alloc] init];
    [keyboardDoneButtonView sizeToFit];
    UIBarButtonItem* doneButton = [[UIBarButtonItem alloc] initWithTitle:@"Done"
style:UIBarButtonItemStyleBordered target:self
action:@selector(doneClicked2:)];
    [keyboardDoneButtonView setItems:[NSArray arrayWithObjects:doneButton, nil]];
    username_feild.inputAccessoryView = keyboardDoneButtonView;
    firstname_feild.inputAccessoryView = keyboardDoneButtonView;
    plastname_feild.inputAccessoryView = keyboardDoneButtonView;
    pass_feild.inputAccessoryView = keyboardDoneButtonView;
}

```

```

    email_feild.inputAccessoryView = keyboardDoneButtonView;
    [super viewDidLoad];
    scrv.contentSize=CGSizeMake(300, 600);
    // Do any additional setup after loading the view from its nib.
}
- (void)didReceiveMemoryWarning
{
    [super didReceiveMemoryWarning];
    // Dispose of any resources that can be recreated.
}
- (IBAction)register_action:(id)sender
{
    //registerNewUser
    NSString *emailid = email_feild.text;
    NSString *emailRegex = @"[A-Z0-9a-z._%+-]+@[A-Za-z0-9.-]+\.[A-Za-z]{2,4}";
    NSPredicate *emailTest =[NSPredicate predicateWithFormat:@"SELF MATCHES
%@", emailRegex];
    BOOL myStringMatchesRegEx=[emailTest evaluateWithObject:emailid];
    if([username_feild.text isEqual:@""] || [firstname_feild.text isEqual:@""]||
[plastname_feild.text isEqual:@""] || [pass_feild.text isEqual:@""] || [sex_feild.text
isEqual:@""] || [birthday_feild.text isEqual:@""])
    {
        UIAlertView *alert = [[UIAlertView alloc] initWithTitle:@" " message:@"Please enter
all of the fields" delegate:nil cancelButtonTitle:@"OK" otherButtonTitles:nil];
        [alert show];
        return;
    }
    else if(!myStringMatchesRegEx)
    {
        UIAlertView *al=[[UIAlertView alloc]initWithTitle:@" " message:@" This email
address is invalid. " delegate:self cancelButtonTitle:@"OK" otherButtonTitles: nil];
        [al show];
    }
    else
    {
        api_obj=[[APIViewController alloc]init];
        [api_obj registerNewUser:@selector(registerresult:) tempTarget:self :
username_feild.text :firstname_feild.text :plastname_feild.text :email_feild.text
:pass_feild.text :sex_feild.text :birthday_feild.text ];
        HUD=[MBProgressHUD showHUDAddedTo:self.view animated:YES];
        HUD.labelXText=[NSString stringWithFormat:@"Register %@",username_feild.text];
    }
}
- (void)registerresult:(NSDictionary*)dict_Response
{
    [HUD hide:YES];
    NSLog(@"%@",dict_Response);
    if (dict_Response==NULL)
    {
        UIAlertView *alert = [[UIAlertView alloc] initWithTitle:@" " message:@"Server Error"
delegate:nil cancelButtonTitle:@"OK" otherButtonTitles:nil];

```

```

        [alert show];
    }
    else
    {
NSString *loginStatusStr = [NSString stringWithFormat:@"%@", [[dict_Response
objectForKey:@"response"]valueForKey:@"status" ]];
        if([loginStatusStr isEqualToString:@"true"]){
            userid=[[dict_Response objectForKey:@"response" valueForKey:@"id"];;
            NSUserDefaults *userDefaults = [NSUserDefaults standardUserDefaults];
            [userDefaults setObject:userid forKey:@"userid"];
            [userDefaults synchronize];
            [[NSUserDefaults standardUserDefaults] setObject:userid forKey:@"id"];
            [self.navigationController popViewControllerAnimated:YES];
        }
        else
        {
            if([[[dict_Response objectForKey:@"response" valueForKey:@"message"]][0]
isEqualToString:@"user name not available"])
            {
                suggestedmem=[[NSMutableArray alloc]init];
                suggestedmem=[[dict_Response objectForKey:@"response"
valueForKey:@"suggest_name"];
                UIAlertView *alert = [[UIAlertView alloc] initWithTitle:@""
message:@"Username is already exists!" delegate:self cancelButtonTitle:nil
otherButtonTitles:nil];
                alert.tag=1212;
                [alert addButtonWithTitle:@"OK"];
                [alert addButtonWithTitle:@"Option for UserName"];
                [alert show];
            }
            else
            {
                UIAlertView *alert = [[UIAlertView alloc] initWithTitle:@"" message:@"Email is
already registered" delegate:nil cancelButtonTitle:@"OK" otherButtonTitles:nil];
                [alert show];
            }
        }
    }
}
- (IBAction)back_action:(id)sender
{
    [self.navigationController popViewControllerAnimated:NO];
}
#pragma mark- text feild deligate
- (BOOL)textFieldShouldBeginEditing:(UITextField *)textField
{
    if(textField.tag==33)
    {
        dateview=[[UIView alloc]initWithFrame:CGRectMake(0, 0, 320,
self.view.frame.size.height)];
        dateview.backgroundColor=[UIColor grayColor];
    }
}

```

```

dateview.alpha=1.0;

UIView *tape=[[UIView alloc]initWithFrame:CGRectMake(0, 200, 320, 50)];
tape.backgroundColor=[UIColor blackColor];
UIButton *button31 = [UIButton buttonWithType:UIButtonTypeRoundedRect];
[button31 addTarget:self action:@selector(doneClicked:)
forControlEvents:UIControlEventTouchUpInside];
[button31 setTitle:@"Done" forState:UIControlStateNormal];
button31.frame = CGRectMake(30, 10, 90, 30);
button31.titleLabel.font = [UIFont systemFontOfSize:16];
button31.backgroundColor=[UIColor clearColor];
[button31 setTitleColor:[UIColor whiteColor] forState:UIControlStateNormal];
[tape addSubview:button31];
datePicker = [[UIDatePicker alloc] initWithFrame:CGRectMake(0, 250, 320, 300)];
datePicker.datePickerMode = UIDatePickerModeDate;
datePicker.hidden = NO;
datePicker.date = [NSDate date];

[datePicker addTarget:self
                action:@selector(LabelChange:)
                forControlEvents:UIControlEventValueChanged];
[dateview addSubview:datePicker];
[dateview addSubview:tape];
[self.view addSubview:dateview];
return NO;
}
else if(textField.tag==234)
{

    dateview=[[UIView alloc]initWithFrame:CGRectMake(0, 0,
self.view.frame.size.width,self.view.frame.size.height)];
    dateview.backgroundColor=[UIColor clearColor];
    UIView *popview1=[[UIView alloc]initWithFrame:CGRectMake(15, 325, 285,70)];
    popview1.backgroundColor=[UIColor blueColor];

    UIButton *uim=[[UIButton alloc]initWithFrame:CGRectMake(30, 20, 40, 40)];
    uim.tag=235;
    [uim setBackgroundImage:[UIImage imageNamed:@"male.png"]
forState:UIControlStateNormal];
    [uim addTarget:self action:@selector(buttonclick:)
forControlEvents:UIControlEventTouchUpInside];
    UIButton *uim1=[[UIButton alloc]initWithFrame:CGRectMake(210, 20, 40, 40)];
    uim1.tag=236;
    [uim1 setBackgroundImage:[UIImage imageNamed:@"female.png"]
forState:UIControlStateNormal];
    [uim1 addTarget:self action:@selector(buttonclick:)
forControlEvents:UIControlEventTouchUpInside];
    [popview1 addSubview:uim];
    [popview1 addSubview:uim1];
    [dateview addSubview:popview1];
    [self.view addSubview:dateview];

```

```

        return NO;
    }

    else
    {
        [textField resignFirstResponder];
        [UIView beginAnimations:nil context:NULL];
        [UIView setAnimationDuration:0.35f];
        CGRect frame = self.view.frame;
        frame.origin.y = -150;
        [self.view setFrame:frame];
        [UIView commitAnimations];
        return YES;
    }
}

- (BOOL)textFieldShouldReturn:(UITextField *)textField
{
    [textField resignFirstResponder];

    [UIView beginAnimations:nil context:NULL];
    [UIView setAnimationDuration:0.35f];
    CGRect frame = self.view.frame;
    frame.origin.y = 0;
    [self.view setFrame:frame];
    [UIView commitAnimations];
    return YES;
}

- (void)LabelChange:(id)sender{
    NSDateFormatter *df = [[NSDateFormatter alloc] init];
    [df setDateFormat:@"yyyy-MM-dd"];

    birthday_feild.text = [df stringFromDate:datePicker.date];
}

- (void)doneClicked:(id)sender
{
    NSLog(@"Done Clicked.");
    [self.view endEditing:YES];
    if([birthday_feild.text isEqualToString:@""])
    {
        NSDate *currDate = [NSDate date];
        NSDateFormatter *df = [[NSDateFormatter alloc] init];
        [df setDateFormat:@"yyyy-MM-dd"];
        birthday_feild.text = [df stringFromDate:currDate];
    }
    [dateview removeFromSuperview];
    [UIView beginAnimations:nil context:NULL];
    [UIView setAnimationDuration:0.35f];
    CGRect frame = self.view.frame;
    frame.origin.y = 0;

```

```

    [self.view setFrame:frame];
    [UIView commitAnimations];
}
-(void)buttonclick:(UIButton*)but
{
    if(but.tag==235)
    {
        sex_feild.text=@"Male";
        [dateview removeFromSuperview];
    }
    else if(but.tag==236)
    {
        sex_feild.text=@"Female";
        [dateview removeFromSuperview];
    }
}
- (void)alertView:(UIAlertView *)alertView clickedButtonAtIndex:(NSInteger)buttonIndex
{
    if (alertView.tag==1212)
    {
        if(buttonIndex==0)
        {
        }
        else
        {
            UIAlertView *alert = [[UIAlertView alloc] initWithTitle:@"Choose
One" delegate:self cancelButtonTitle:nil otherButtonTitles:nil];
            alert.tag=12121;
            for(int i=0;i<suggestedmem.count;i++)
            {
                [alert addButtonWithTitle:suggestedmem[i]];
            }
            [alert addButtonWithTitle:@"Cancel"];
            [alert show];
        }
    }
    if (alertView.tag==12121)
    {
        if(buttonIndex==suggestedmem.count+1)
        {
        }
        else
            username_feild.text=suggestedmem[buttonIndex];
    }
    else
    {
    }
}
@end

```

```
// loginViewController.h
```

```

// Champ
// Created by Wafa Bahha on 2/16/15.
// Copyright (c) 2015 Wafa_Bahha. All rights reserved.
//
#import <UIKit/UIKit.h>
#import "regiseterViewController.h"
@interface loginViewController : UIViewController
{
    IBOutlet UITextField *email_feild;
    IBOutlet UITextField *pass_feild;
    IBOutlet UIButton *rememberbtn;
}
- (IBAction)login_action:(id)sender;
- (IBAction)remember:(id)sender;
- (IBAction)register_action:(id)sender;
- (IBAction)forgot_action:(id)sender;
@end
//
// loginViewController.m
// Champ
// Created by Wafa Bahha on 2/16/15.
// Copyright (c) 2015 Wafa_Bahha. All rights reserved.
//
#import "loginViewController.h"
#import "MBProgressHUD.h"
#import "APIViewController.h"
#import "afterloginViewController.h"

@interface loginViewController ()
{
    APIViewController *api_obj;
   MBProgressHUD *HUD;
    NSString *emailid123;
    int q;
}
@end
@implementation loginViewController
- (id)initWithNibName:(NSString *)nibNameOrNil bundle:(NSBundle *)nibBundleOrNil
{
    self = [super initWithNibName:nibNameOrNil bundle:nibBundleOrNil];
    if (self) {
        // Custom initialization
    }
    return self;
}
- (void)viewDidLoad
{
    if (remmbr==YES) {
        email_feild.text=rnbrusername;
        pass_feild.text=rnbrpassword;
    }
}

```

```

        [rememberbtn setImage:[UIImage imageNamed:@"remember_selected.png"]
forState:UIControlStateNormal];
        q=1;
    }
    else {
        email_feild.text=@"";
        pass_feild.text=@"";
        [rememberbtn setImage:[UIImage imageNamed:@"remr.png"]
forState:UIControlStateNormal];
        q=0;
    }
UIToolbar* keyboardDoneButtonView = [[UIToolbar alloc] init];
[keyboardDoneButtonView sizeToFit];
UIBarButtonItem* doneButton = [[UIBarButtonItem alloc] initWithTitle:@"Done"
style:UIBarButtonItemStyleBordered target:self
action:@selector(doneClicked:)];
[keyboardDoneButtonView setItems:[NSArray arrayWithObjects:doneButton, nil]];
email_feild.inputAccessoryView = keyboardDoneButtonView;
pass_feild.inputAccessoryView = keyboardDoneButtonView;
[super viewDidLoad];
self.navigationController.navigationBarHidden=YES;
UIColor *color = [UIColor whiteColor];
email_feild.attributedStringPlaceholder = [[NSAttributedString alloc] initWithString:@"Email
or Username" attributes:@{NSForegroundColorAttributeName: color}];
pass_feild.attributedStringPlaceholder = [[NSAttributedString alloc]
initWithString:@"Password" attributes:@{NSForegroundColorAttributeName: color}];
// Do any additional setup after loading the view from its nib.
}
-(void)viewWillAppear:(BOOL)animated
{
    if (remmbr==YES)
    {
        email_feild.text=rnbrusername;
        pass_feild.text=rnbrpassword;
        [rememberbtn setImage:[UIImage imageNamed:@"remember_selected.png"]
forState:UIControlStateNormal];
        q=1;
    }
    else {
        email_feild.text=@"";
        pass_feild.text=@"";
        [rememberbtn setImage:[UIImage imageNamed:@"remr.png"]
forState:UIControlStateNormal];
        q=0;
    }
}
- (void)doneClicked:(id)sender
{
    NSLog(@"Done Clicked.");
    [self.view endEditing:YES];
    [UIView beginAnimations:@"animate" context:nil];

```



```

[UIView setAnimationDuration:0.35f];
[UIView setAnimationBeginsFromCurrentState: NO];
self.view.frame = CGRectMake(self.view.frame.origin.x, 0 , self.view.frame.size.width,
self.view.frame.size.height);
[UIView commitAnimations];
}
- (void)didReceiveMemoryWarning
{
    [super didReceiveMemoryWarning];
    // Dispose of any resources that can be recreated.
}
- (IBAction)login_action:(id)sender
{
    if([email_feild.text isEqualToString:@""] || [pass_feild.text isEqualToString:@""])
    {
        UIAlertView *alert = [[UIAlertView alloc] initWithTitle:@"" message:@"Please fill
required fields" delegate:nil cancelButtonTitle:@"OK" otherButtonTitles:nil];
        [alert show];
        return;
    }
    else
    {
        rmbusername=email_feild.text;

        rmbpassword=pass_feild.text;
        api_obj=[[APIViewController alloc]init];
        [ api_obj login:@selector(loginresult:) tempTarget:self : email_feild.text :
pass_feild.text];
        HUD=[MBProgressHUD showHUDAddedTo:self.view animated:YES];
        HUD.labelText=@"Logging In";
    }
}
- (void)loginresult:(NSDictionary *)dict_Response
{
    [HUD hide:YES];
    NSLog(@"%@",dict_Response);
    NSLog(@"%@",[[dict_Response
objectForKey:@"response"]valueForKey:@"status"]);
    NSString *result=[NSString stringWithFormat:@"%@",[[dict_Response
objectForKey:@"response"]valueForKey:@"status"]][0];

    if (dict_Response==NULL)
    {
        UIAlertView *alert = [[UIAlertView alloc] initWithTitle:@"" message:@"Server Error"
delegate:nil cancelButtonTitle:@"OK" otherButtonTitles:nil];
        [alert show];
    }
    else
    {
        if([result isEqualToString:@"true"])
        {

```

```

        userid=[[dict_Response objectForKey:@"response"] valueForKey:@"id"][0];
        username=[[NSString stringWithFormat:@"%@" "%@",[[dict_Response
objectForKey:@"response"] valueForKey:@"first_name"][0],[[dict_Response
objectForKey:@"response"] valueForKey:@"last_name"][0]];

        afterloginViewController *mvc;
        if(iphone4)
        {
            mvc=[[afterloginViewController
alloc]initWithNibName:@"afterloginViewController@4" bundle:nil];
        }
        else if(iphone5)
        {
            mvc=[[afterloginViewController
alloc]initWithNibName:@"afterloginViewController" bundle:nil];
        }
        else if(iphone6)
        {
            mvc=[[afterloginViewController
alloc]initWithNibName:@"afterloginViewController@6" bundle:nil];
        }
        else if (iphone6plus)
        {
            mvc=[[afterloginViewController
alloc]initWithNibName:@"afterloginViewController@6plus" bundle:nil];
        }
        else
        {
            mvc=[[afterloginViewController
alloc]initWithNibName:@"afterloginViewController@ipad" bundle:nil];
        }
        [self.navigationController pushViewController:mvc animated:YES];
    }
    else
    {
        UIAlertView *alert = [[UIAlertView alloc] initWithTitle:@"The
Username or Password you entered is incorrect." delegate:nil cancelButtonTitle:@"OK"
otherButtonTitles:nil];
        [alert show];
    }
}
- (IBAction)remember:(id)sender
{
    if (q==0)
    {
        [rememberbtn setImage:[UIImage imageNamed:@"remember_selected.png"]
forState:UIControlStateNormal];
        q=1;
        remmbr=YES;
    }
}

```

```

    }
    else if(q==1)
    {
        [rememberbtn setImage:[UIImage imageNamed:@"remr.png"]
forState:UIControlStateNormal];
        q=0;
        remmbr=NO;
    }
}
- (IBAction)register_action:(id)sender
{
    regiseterViewController *mvc;
    mvc=[[regiseterViewController alloc] initWithNibName:@"regiseterViewController"
bundle:nil];
    [self.navigationController pushViewController:mvc animated:YES];
}
- (IBAction)forgot_action:(id)sender
{
    UIAlertView* alert1 = [[UIAlertView alloc] init];
    [alert1 setDelegate:self];
    [alert1 setTitle:@"Enter valid Email"];
    [alert1 setMessage:@" "];
    [alert1 addButtonWithTitle:@"Send"];
    [alert1 addButtonWithTitle:@"Cancel"];
    alert1.tag=1;
    alert1.alertViewStyle = UIAlertViewStylePlainTextInput;
    [alert1 show];
}
- (void)alertView:(UIAlertView *)alertView clickedButtonAtIndex:(NSInteger)buttonIndex
{
    if(alertView.tag==1)
    {
        if(buttonIndex==0)
        {
            {
                if([[alertView textFieldAtIndex:0].text isEqual:@""])
                {
                    [self forgot_action:0];
                }
                else
                {
                    emailid123 = [alertView textFieldAtIndex:0].text;
                    NSString *emailRegex = @"[A-Z0-9a-z._%+-]+@[A-Za-z0-9.-]+\.[A-Za-
z]{2,4}";
                    NSPredicate *emailTest =[NSPredicate predicateWithFormat:@"SELF
MATCHES %@", emailRegex];
                    BOOL myStringMatchesRegex=[emailTest evaluateWithObject:emailid123];
                    if(!myStringMatchesRegex)
                    {
                        UIAlertView *al=[[UIAlertView alloc] initWithTitle:@" " message:@"Incorrect
email, please enter valid email" delegate:self cancelButtonTitle:@"OK"

```

```

otherButtonTitles: nil];
    al.tag=2;
    [al show];
}
else
{
    NSLog(@"forgot password webservice");
    api_obj=[[APIViewController alloc]init];
    [ api_obj forgotpass:@selector(forgotresult:) tempTarget:self :emailid123];
    HUD=[MBProgressHUD showHUDAddedTo:self.view animated:YES];
    HUD.labelText=@"In Progress";
}
}
}
else if(buttonIndex==1)
{
    NSLog(@"string123");
}
}
else if (alertView.tag==1212)
{
    if(buttonIndex==0)
    {

    }

}
}
-(void)forgotresult:(NSDictionary*)dict_Response
{
    [HUD hide:YES];
    NSLog(@"%@",dict_Response);
    if (dict_Response==NULL)
    {
        UIAlertView *alert = [[UIAlertView alloc] initWithTitle:@"" message:@"Server Error"
delegate:nil cancelButtonTitle:@"OK" otherButtonTitles:nil];
        [alert show];
    }
    else
    {
        if([[NSString stringWithFormat:@"%@", [[dict_Response
objectForKey:@"response"] valueForKey:@"status"][0]] isEqualToString:@"true"]){
            UIAlertView *alert = [[UIAlertView alloc] initWithTitle:@"Please check email"
message:@"Password reset link sent to your email" delegate:nil
cancelButtonTitle:@"OK" otherButtonTitles:nil];
            [alert show];
        }
        else
        {
            UIAlertView *alert = [[UIAlertView alloc] initWithTitle:@"" message:@"Email Id
did not exist" delegate:nil cancelButtonTitle:@"OK" otherButtonTitles:nil];
            [alert show];
        }
    }
}
}

```

```

    }
}
#pragma mark- text feild deligate
- (BOOL)textFieldShouldBeginEditing:(UITextField *)textField
{
    [textField resignFirstResponder];
    [UIView beginAnimations:nil context:NULL];
    [UIView setAnimationDuration:0.35f];
    CGRect frame = self.view.frame;
    frame.origin.y = -100;
    [self.view setFrame:frame];
    [UIView commitAnimations];
    return YES;
}
- (BOOL)textFieldShouldReturn:(UITextField *)textField
{
    [textField resignFirstResponder];
    [UIView beginAnimations:nil context:NULL];
    [UIView setAnimationDuration:0.35f];
    CGRect frame = self.view.frame;
    frame.origin.y = 0;
    [self.view setFrame:frame];
    [UIView commitAnimations];
    return YES;
}
@end

// afterloginViewController.h
// Champ
// Created by Wafa Bahha on 2/16/15.
// Copyright (c) 2015 Wafa_Bahha. All rights reserved.
//
#import <UIKit/UIKit.h>
@interface afterloginViewController : UIViewController
{
    IBOutlet UILabel *username_lbl;
    IBOutlet UILabel *systolic_lbl;
    IBOutlet UILabel *diastolic_lbl;
    IBOutlet UILabel *pulserate_lbl;
    IBOutlet UILabel *welcome_lbl;
}
- (IBAction)bp_action:(id)sender;
- (IBAction)bmicalculate_action:(id)sender;
- (IBAction)profile_action:(id)sender;
- (IBAction)logout_action:(id)sender;
- (IBAction)risk_avelution_action:(id)sender;
- (IBAction)report_action:(id)sender;
- (IBAction)calander_action:(id)sender;
@property (strong, nonatomic) IBOutlet UIButton *aboutBtn;
- (IBAction)about:(id)sender;
@end

```

```

// afterloginViewController.m
// Champ
// Created by Wafa Bahha on 2/16/15.
// Copyright (c) 2015 Wafa_Bahha. All rights reserved.
//
#import "afterloginViewController.h"
#import "bloodprViewController.h"
#import "profileViewController.h"
#import "bmiccalculatorView.h"
#import "mainstartViewController.h"
#import "MBProgressHUD.h"
#import "APIViewController.h"
#import "riskevelutionViewController.h"
#import "reportViewController.h"
#import "aboutViewController.h"
#import "calanderViewController.h"
@interface afterloginViewController ()
{
    APIViewController *api_obj;
    MBProgressHUD *HUD;
    NSString *dateforcalander1;
    NSString *colorforcalendar1;
    NSMutableArray *dates;
}
@end
@implementation afterloginViewController
- (id)initWithNibName:(NSString *)nibNameOrNil bundle:(NSBundle *)nibBundleOrNil
{
    self = [super initWithNibName:nibNameOrNil bundle:nibBundleOrNil];
    if (self) {
        // Custom initialization
    }
    return self;
}
-(void)viewWillAppear:(BOOL)animated
{
    api_obj=[[APIViewController alloc]init];
    [ api_obj bpdatabasetagetresult:@selector(bpdatabasetagetresult:) tempTarget:self ];
    HUD=[MBProgressHUD showHUDAddedTo:self.view animated:YES];
    HUD.labelText=@"Please wait..";
}
- (void)viewDidLoad
{
    [super viewDidLoad];
    username_lbl.text=username;
// Do any additional setup after loading the view from its nib.
}
-(void)bpdatabasetagetresult:(NSDictionary*)dict_Response
{
    [HUD hide:YES];
}

```

```

NSLog(@"%@",dict_Response);
if (dict_Response==NULL)
{
    UIAlertView *alert = [[UIAlertView alloc] initWithTitle:@" " message:@"Server Error"
delegate:nil cancelButtonTitle:@"OK" otherButtonTitles:nil];
    [alert show];
}
else
{
    if([[NSString stringWithFormat:@"%@", [[dict_Response
objectForKey:@"response"] valueForKey:@"status"]] isEqualToString:@"true"])
    {
        welcome_lbl.text=@"Welcome Back,";
        systolic_lbl.text=[NSString stringWithFormat:@"%@ mm Hg",[[dict_Response
objectForKey:@"response"] valueForKey:@"systolic"]];
        diastolic_lbl.text=[NSString stringWithFormat:@"%@ mm Hg",[[dict_Response
objectForKey:@"response"] valueForKey:@"diastolic"]];
        pulserate_lbl.text=[NSString stringWithFormat:@"%@ bpm",[[dict_Response
objectForKey:@"response"] valueForKey:@"pulse_rate"]];
    }
    else
    {
        welcome_lbl.text=@"Welcome,";
    }
}
}
- (void)didReceiveMemoryWarning
{
    [super didReceiveMemoryWarning];
    // Dispose of any resources that can be recreated.
}
- (IBAction)bp_action:(id)sender
{
    bloodprViewController *mvc;
    if(iphone4)
    {
        mvc=[[bloodprViewController alloc]initWithNibName:@"bloodprViewController@4"
bundle:nil];
    }
    else if(iphone5)
    {
        mvc=[[bloodprViewController alloc]initWithNibName:@"bloodprViewController"
bundle:nil];
    }
    else if(iphone6)
    {
        mvc=[[bloodprViewController alloc]initWithNibName:@"bloodprViewController@6"
bundle:nil];
    }
    else if (iphone6plus)
    {

```

```

        mvc=[[bloodprViewController
alloc]initWithNibName:@"bloodprViewController@6plus" bundle:nil];
    }
    else
    { mvc=[[bloodprViewController
alloc]initWithNibName:@"bloodprViewController@ipad" bundle:nil];
    }
    [self.navigationController pushViewController:mvc animated:YES];
}
- (IBAction)profile_action:(id)sender
{
    profileViewController *mvc;
    mvc=[[profileViewController alloc]initWithNibName:@"profileViewController"
bundle:nil];
    [self.navigationController pushViewController:mvc animated:YES];
}
- (IBAction)about:(id)sender
{
    aboutViewController *mvc;
    if(iphone4)
    {
        mvc=[[aboutViewController alloc]initWithNibName:@"aboutViewController@4"
bundle:nil];
    }
    else if(iphone5)
    {
        mvc=[[aboutViewController alloc]initWithNibName:@"aboutViewController"
bundle:nil];
    }
    else if(iphone6)
    {
        mvc=[[aboutViewController alloc]initWithNibName:@"aboutViewController@6"
bundle:nil];
    }
    else if(iphone6plus)
    {
        mvc=[[aboutViewController alloc]initWithNibName:@"aboutViewController@6plus"
bundle:nil];
    }
    else
    {
        mvc=[[aboutViewController alloc]initWithNibName:@"aboutViewController@ipad"
bundle:nil];
    }
    [self.navigationController pushViewController:mvc animated:YES];
}
- (IBAction)report_action:(id)sender
{
    reportViewController *mvc;
    mvc=[[reportViewController alloc]initWithNibName:@"reportViewController"
bundle:nil];
}

```



```

    [self.navigationController pushViewController:mvc animated:YES];
}
- (IBAction)bmicalculate_action:(id)sender
{
    bmicalculatorView *mvc;
    if(iphone4)
    {
        mvc=[[bmicalculatorView alloc]initWithNibName:@"bmicalculatorView@4"
bundle:nil];
    }
    else if(iphone5)
    {
        mvc=[[bmicalculatorView alloc]initWithNibName:@"bmicalculatorView" bundle:nil];
    }
    else if(iphone6)
    {
        mvc=[[bmicalculatorView alloc]initWithNibName:@"bmicalculatorView@6"
bundle:nil];
    }
    else if(iphone6plus)
    {
        mvc=[[bmicalculatorView alloc]initWithNibName:@"bmicalculatorView@6plus"
bundle:nil];
    }
    else
    {
        mvc=[[bmicalculatorView alloc]initWithNibName:@"bmicalculatorView@ipad"
bundle:nil];
    }
    [self.navigationController pushViewController:mvc animated:YES];
}
- (IBAction)risk_avelution_action:(id)sender
{
    riskevelutionViewController *mvc;
    mvc=[[riskevelutionViewController
alloc]initWithNibName:@"riskevelutionViewController" bundle:nil];
    [self.navigationController pushViewController:mvc animated:YES];
}
- (IBAction)calander_action:(id)sender
{
    calanderViewController *mvc;
    if(iphone4)
    {
        mvc=[[calanderViewController
alloc]initWithNibName:@"calanderViewController@4" bundle:nil];
    }
    else if(iphone5)
    {
        mvc=[[calanderViewController alloc]initWithNibName:@"calanderViewController"
bundle:nil];
    }
}

```

```

    else if(iphone6)
    {
        mvc=[[calanderViewController
alloc]initWithNibName:@"calanderViewController@6" bundle:nil];
    }
    else if(iphone6plus)
    {
        mvc=[[calanderViewController
alloc]initWithNibName:@"calanderViewController@6plus" bundle:nil];
    }
    else
    {
        mvc=[[calanderViewController
alloc]initWithNibName:@"calanderViewController@ipad" bundle:nil];
    }
    [self.navigationController pushViewController:mvc animated:YES];
}
- (IBAction)logout_action:(id)sender
{
    UIAlertView* alert1 = [[UIAlertView alloc] init];
    [alert1 setDelegate:self];
    [alert1 setTitle:@""];
    [alert1 setMessage:@"Do you want to Logout? "];
    [alert1 addButtonWithTitle:@"Yes"];
    [alert1 addButtonWithTitle:@"No"];
    alert1.tag=6;
    alert1.alertViewStyle = UIAlertViewStyleDefault;
    [alert1 show];
}
- (void)alertView:(UIAlertView *)alertView clickedButtonAtIndex:(NSInteger)buttonIndex
{
    if (alertView.tag==6)
    {
        if(buttonIndex==0)
        {
            NSHTTPCookieStorage *storage = [NSHTTPCookieStorage
sharedHTTPCookieStorage];
            NSArray *cookieJar = [storage cookies];

            for (NSHTTPCookie *cookie in cookieJar)
            {
                [storage deleteCookie:cookie];
            }
            NSUserDefaults *userDefaults = [NSUserDefaults standardUserDefaults];
            [userDefaults setObject:@"" forKey:@"userid"];
            [userDefaults synchronize];
            [self.navigationController popToRootViewControllerAnimated:YES];
        }
    }
}
@end

```

Appendix C: Some of the source code by using PHP programming Language

```
//login.php
<?php
error_reporting(0);
class login extends CI_Controller {

    public function __construct()
    {
        parent::__construct();
        $this->load->database();
        $this->load->helper('url');
        $this->load->library('email');
        $this->load->model('API/API_model', 'model_name');
    }

    function index()
    {
        $data['email'] = $_GET['email'];
        $data['pass'] = $_GET['pass'];

        $checkemailpassExists = $this->model_name->checkEmailPasswordExists($data);

        if(empty($checkemailpassExists))
        {
            $data_user1['message'] = ["Invalid Email or Password"];
            $data_user1['status'] = ["false"];
            $error = array("response"=>$data_user1);
            echo json_encode($error);
            exit;
        }
        else
        {
            $userId = $checkemailpassExists[0]['user_id'];
            $dataVal = $this->model_name->getUsersById($userId);

            if(!empty($dataVal))
            {
                $data_user['id'] = [$userId];
                $data_user['user_name'] = [$dataVal[0]['user_name']];

                $data_user['first_name'] = [$dataVal[0]['first_name']];
                $data_user['last_name'] = [$dataVal[0]['last_name']];
                $data_user['email'] = [$dataVal[0]['email']];
                $data_user['message'] = ["successfully Login"];
                $data_user['status'] = ["true"];
                $success = array('response'=>$data_user);
                echo json_encode($success);
                exit;
            }
        }
    }
}
```

```

    }
    else
    {
        $data_user['message'] = ["Invalid Email or Password"];
        $data_user['status'] = ["false"];
        $error = array("response"=>$$data_user);
        echo json_encode($error);
        exit;
    }
}
}
}
}
}

```

//register.php

?>

<?php

error_reporting(1);

class register extends CI_Controller {

public function __construct()

```

{
    parent::__construct();
    $this->load->database();
    $this->load->helper('url');
    $this->load->library('email');
    $this->load->model('API/API_model', 'model_name');
}

```

function index()

```

{
    /***** Value store Register table Start *****/
    $data['user_name']      = $_GET['user_name'];
    $data['first_name']    = $_GET['first_name'];
    $data['last_name']     = $_GET['last_name'];
    $data['email']         = $_GET['email'];
    $data['pass']          = $_GET['pass'];
    $data['gender']        = $_GET['gender']; //Male or Female
    $data['birthday']      = $_GET['birthday'];
    $data['createdOn']     = date('Y-m-d h:i:s');
}

```

\$checkemailExists = \$this->model_name->checkEmailExists(\$data['email']);

if(empty(\$checkemailExists))

```

{
    // user is not exist, Add in User table
    $result = $this->model_name->addUser($data);
}

```

if(!empty(\$result))

```

{
    $dataVal = $this->model_name-
}

```

```

>getUsersByEmail($data['email']);

        if(!empty($dataVal))
        {
            $data_user['id']      = $dataVal[0]['user_id'];
            $data_user['msg'] = "Insert Successfully";
            $data_user['status'] = "true";
            $succes = array('response'=>$data_user);
            echo json_encode($succes);
            exit;
        }
        else
        {
            $error = array('response'=>'Failed','msg'=>'Registration
Failed');
            echo json_encode($error);
            exit;
        }
    }
    else
    {
        $error = array('response'=>'Failed','msg'=>'Registration Failed');
        echo json_encode($error);
        exit;
    }
}
else
{
    $error = array('response'=>'Failed','msg'=>'Email Already Exists');
    echo json_encode($error);
    exit;
}
}
}
?>
//Blood_pressure_Data.php
<?php
error_reporting(0);
class bp_data extends CI_Controller {
    public function __construct()
    {
        parent::__construct();
        $this->load->database();
        $this->load->helper('url');
        $this->load->library('email');
        $this->load->model('API/API_model', 'model_name');
    }
    function index()
    {
        $data['user_id'] = $_GET['user_id'];

```

```

$dataVal = $this->model_name->getBpById($data['user_id']);
$dataVal1 = $this->model_name->getBmiById($data['user_id']);
if(!empty($dataVal))
{
    $data_user['systolic'] =
!empty($dataVal[0]['systolic'])?($dataVal[0]['systolic']):";
    $data_user['diastolic'] =
!empty($dataVal[0]['diastolic'])?($dataVal[0]['diastolic']):";
    $data_user['pulse_rate'] =
!empty($dataVal[0]['pulse_rate'])?($dataVal[0]['pulse_rate']):";
    if(!empty($dataVal1[0]['h_foot']))
    {
        $height = $dataVal1[0]['h_foot'];
    }
    if(!empty($dataVal1[0]['h_inch']))
    {
        $height .= ",".$dataVal1[0]['h_inch'].",";
    }
    if(!empty($dataVal1[0]['h_cm']) &&
(!empty($dataVal1[0]['h_foot'])))
    {
        $height .= $dataVal1[0]['h_cm'];
    }
    elseif(!empty($dataVal1[0]['h_cm']) &&
((empty($dataVal1[0]['h_foot']))))
    {
        $height = $dataVal1[0]['h_cm'];
    }
    else
    {
        $data_user['height'] = "";
    }
    $data_user['height'] = rtrim($height, ",");
    if(!empty($dataVal1[0]['w_kg']))
    {
        $weight = $dataVal1[0]['w_kg'].",";
    }
    if(!empty($dataVal1[0]['w_lbs']))
    {
        $weight .= $dataVal1[0]['w_lbs'].",";
    }
    else
    {
        $data_user['weight'] = "";
    }
    $data_user['weight'] = rtrim($weight, ",");
    if(!empty($dataVal1[0]['age'])) {
        $data_user['age'] = $dataVal1[0]['age'];
    }
    else

```

```

    {
        $data_user['age'] = "";
    }
    if(!empty($dataVal1[0]['sex'])) {
        $data_user['sex'] = $dataVal1[0]['sex'];
    }
    else
    {
        $data_user['sex'] = "";
    }
    $data_user['msg'] = "Success";
    $data_user['status'] = "true";
    $success = array('response'=>$data_user);
    echo json_encode($success);
    exit;
}
else
{
    $error = array("status"=>"false", "message"=>"Failed.");
    echo json_encode($error);
    exit;
}
}
}
?>

```

Appendix D: The Rest of Database Tables

Server: localhost:3306 » Database: champhea_champhealth » Table: ci_cookies

| # | Name | Type | Collation | Attributes | Null | Default | Extra | Action |
|---|----------------------------|--------------|-------------------|------------|------|---------|----------------|---------------------------------|
| 1 | <u>id</u> | int(11) | | | No | None | AUTO_INCREMENT | Change Drop Primary Unique More |
| 2 | <u>cookie_id</u> | varchar(255) | latin1_swedish_ci | | Yes | NULL | | Change Drop Primary Unique More |
| 3 | <u>netid</u> | varchar(255) | latin1_swedish_ci | | Yes | NULL | | Change Drop Primary Unique More |
| 4 | <u>ip_address</u> | varchar(255) | latin1_swedish_ci | | Yes | NULL | | Change Drop Primary Unique More |
| 5 | <u>user_agent</u> | varchar(255) | latin1_swedish_ci | | Yes | NULL | | Change Drop Primary Unique More |
| 6 | <u>orig_page_requested</u> | varchar(120) | latin1_swedish_ci | | Yes | NULL | | Change Drop Primary Unique More |
| 7 | <u>php_session_id</u> | varchar(40) | latin1_swedish_ci | | Yes | NULL | | Change Drop Primary Unique More |
| 8 | <u>created_at</u> | datetime | | | Yes | NULL | | Change Drop Primary Unique More |
| 9 | <u>updated_at</u> | datetime | | | Yes | NULL | | Change Drop Primary Unique More |

Table 12: ci_cookies Table

Server: localhost:3306 » Database: champhea_champhealth » Table: ci_sessions

| # | Name | Type | Collation | Attributes | Null | Default | Extra | Action |
|---|----------------------|--------------|-------------------|------------|------|---------|-------|---|
| 1 | <u>session_id</u> | varchar(40) | latin1_swedish_ci | | No | 0 | | Change Drop Primary Unique Index Spatial More |
| 2 | <u>ip_address</u> | varchar(45) | latin1_swedish_ci | | No | 0 | | Change Drop Primary Unique Index Spatial More |
| 3 | <u>user_agent</u> | varchar(120) | latin1_swedish_ci | | No | None | | Change Drop Primary Unique Index Spatial More |
| 4 | <u>last_activity</u> | int(10) | | UNSIGNED | No | 0 | | Change Drop Primary Unique Index Spatial More |
| 5 | <u>user_data</u> | text | latin1_swedish_ci | | No | None | | Change Drop Primary Unique Index Spatial More |

↑ Check All With selected: Browse Change Drop Primary Unique Index Spatial Fulltext

Table 13: ci_sessions Table

Appendix E: The Surveys Questions

Survey for C-CHAMP users

C-CHAMP (Canadian Chronic Disease Awareness and Management Program) is iPhone/iPad application that manages cardiovascular disease, which is the leading cause of death in Canada. It is a common factor to a wide range of diseases. High blood pressure (hypertension) increases your risk of getting heart disease, kidney disease, or Alzheimer's disease, and of having a stroke. Also, it has no warning signs or symptoms. Blood pressure is challenging to accurately measure because it is natural variability and measurement challenges.

How the app works: First, the user will register in the app. Then, the next screens is set with health record with different parameters like personal information, blood pressure, risk profile evaluation, health record, calculate BMI and Calendar. The user has the option to update their information from all the tabs. Once all the information is added, information is saved and whenever user wants to see their info they need to open their profile and check the reports. There is also a user push-notification reminder for health records.

The key goals of the application related to participants are to:

- Have better blood pressure control.
- Increase awareness of cardiovascular disease and risk factors.
- Create appropriate interfaces.
- Improve communication between patient and health care provider.

Thank you for taking time to participate in this survey to evaluate this application.

1. How often do you use C-CHAMP?

- Every day
- Once a week.
- Several days a week.

2. Do you agree with the statements below?

| Statements | strongly disagree | disagree | slightly disagree | neutral | slightly agree | agree | strongly agree |
|--|-------------------|----------|-------------------|---------|----------------|-------|----------------|
| - C-CHAMP app is easy to use in overall. | | | | | | | |
| - C-CHAMP app is helpful | | | | | | | |
| - C-CHAMP app is reliable | | | | | | | |

3- On the functionality of the APP, how satisfied are you with:

| Statements | very dissatisfied | dissatisfied | somewhat dissatisfied | neutral | somewhat satisfied | satisfied | very Satisfied |
|---|-------------------|--------------|-----------------------|---------|--------------------|-----------|----------------|
| - Registering your personal information | | | | | | | |
| - Entering the blood pressure readings with the confirmation letter | | | | | | | |
| - Answering the risk profile evaluation | | | | | | | |
| - Follow up your health records | | | | | | | |
| -Calculate your BMI | | | | | | | |
| - Follow up your past readings (Calendar) | | | | | | | |

4. On the goal of the APP, How satisfied are you with:

| Statements | very
dissatisfied | dissatisfied | somewhat
dissatisfied | neutral | somewhat
satisfied | satisfied | very
Satisfied |
|---|----------------------|--------------|--------------------------|---------|-----------------------|-----------|-------------------|
| - Your health condition in overall | | | | | | | |
| - CHAMP makes you more empowered to make your decisions about what to do next | | | | | | | |
| - CHAMP helps you to manage your blood pressure | | | | | | | |
| - CHAMP helps you to describe your condition better | | | | | | | |

5. On a Risk Profile Evaluation service, how satisfied are you with:

| Statements | very
dissatisfied | dissatisfied | somewhat
dissatisfied | neutral | somewhat
satisfied | satisfied | very
satisfied |
|--|----------------------|--------------|--------------------------|---------|-----------------------|-----------|-------------------|
| -This service is helpful. | | | | | | | |
| -You are comfortable to put your information. | | | | | | | |
| - It helps you to collect more and save information about your health. | | | | | | | |
| - It has improved self-efficacy in the management of risk factors. | | | | | | | |

Done

Survey for Health Professionals

This project is developed a C-CHAMP (Canadian Chronic Disease Awareness and Management Program) iPhone/iPad application to manage cardiovascular diseases using protocols defined by CHAP (Cardiovascular Health Awareness Program). CHAMP application is helping the users to manage their blood pressure readings by storing them and share with physicians to follow up the status of their patients if required. However, it is a community-based program, so we provide a volunteer peer health educators to measure and enter patient blood pressure reading in weekly sessions in a community. This survey is appropriate for physicians, pharmacists, and primary health care. The key goals of the application that related to you are to: - Have better diagnoses and reaching patients' needs.

- Improve communication between patient and health care provider.

- Have better blood pressure readings with accurate to save your time.

Thank you for taking a time to participate in this survey to discuss barriers, facilitators of implementation about CHAMP app.

1- On the diagnoses and patients' needs, do you agree with the statements below?

| Statements | strongly disagree | disagree | slightly disagree | neutral | slightly agree | agree | strongly agree |
|---|-------------------|----------|-------------------|---------|----------------|-------|----------------|
| 1- C-CHAMP app helps you to have better diagnoses | | | | | | | |
| 2- C-CHAMP app improves your practice in overall | | | | | | | |
| 3- C-CHAMP app is way to reaching patients' needs | | | | | | | |

2- On the technology, C-CHAMP app builds on the previous successful program CHAP, Which depends on using papers and fax to database technology, if you compare between original CHAP and C-CHAMP app, how satisfied are you with:

| Statements | very
dissatisfied | dissatisfied | somewhat
dissatisfied | neutral | somewhat
satisfied | satisfied | very
Satisfied |
|--|----------------------|--------------|--------------------------|---------|-----------------------|-----------|-------------------|
| 4-C-CHAMP app makes patient care safer | | | | | | | |
| 5- C-CHAMP app makes patient care more reliable | | | | | | | |
| 6- C-CHAMP app helping you to save your time | | | | | | | |
| 7- C-CHAMP app being more accurate and efficient | | | | | | | |

3- On the application services, are you aware of any impacts on these services?

[Please explain].

4- Do you have any idea about which other diseases we can manage them by this approach? [Please explain].

5- Do you have any other comments, questions, or concerns?

Done

Survey for CHAP Working Program Group

C-CHAMP (Canadian Chronic Disease Awareness and Management Program) is iPhone/iPad application that manages cardiovascular disease, which is the leading cause of death in Canada. This application is helping the users to manage their blood pressure readings by store them and share with physicians to follow up the status with patients if required. All these steps are requiring a working group to manage. This survey is for the key players of CHAP, which included Regional manager, local lead organization, and local CHAP coordinator. The key goals of the application that related to you are to:

- Reduce effort.
- Reduce time.
- Improve the quality of this service.

Thank you for taking time to participate in this survey to discuss barriers, facilitators of implementation about this application.

Part 1 - Questions about work climate: Based on your previous experience about CHAP:

- 1- What is the impact on work life of CHAP protocol?
- 2- Is the app led to decrease the effort or time?
- 3- Did the app reduce your operating costs?

Part 2 - Questions about the technology:

- As you know, C-CHAMP app builds on the previous successful program CHAP, Which depends on using papers and fax to database technology, If you compare between original CHAP and C-CHAMP application, Do you think that
- 4- C-CHAMP helps you to send BP readings in a more flexible way?

5- C-CHAMP led to reduce time?

6- C-CHAMP would increase the accuracy? How?

Part 3 - Question about the outputs and information management:

7- Do you think C-CHAMP helps you to examine the data?

Part 4 - Questions about user interfaces:

9- Are C-CHAMP interfaces easy to use?

10- Do you have any services want to add to the application?

Done