

Research of the Mobile Medical Architecture for Health Care in Hypertensive Disorders

Yu-Huei Cheng*, *Member*

Abstract—The irregular schedules make the prevention and treatment of hypertension is difficult to pay attention and control. In the developed generation for mobile technology, mobile application (App) as medical care has achieved called “mobile medical”. To help the public for daily health care in hypertension, we propose supposed mobile medical app architecture for health care and describe the functionalities as the suggestions to assist the developers to develop available mobile medical App. We apply the concept of personal cloud library of medical management of blood pressure (BP) to accomplish a series of operation for BP in measurement, analysis, records, management, family care, and hypertension knowledge acquirement as well as physician diagnosis.

Index Terms—hypertension, mobile medical, mobile application (App), health care, cloud library.

I. INTRODUCTION

BLOOD pressure (BP) is the force of blood pressing the artery wall sent from the heart, that is, the artery is under pressure. Look to international standards, as long as the systolic is more than 140mmHg and diastolic is more than 90mmHg, we call it hypertension. Hypertension is one of modern health killer. As a result of modern, busy lives, tension, and excessive emotional stress, lack of express ways, coupled with irregular schedules, stay up late and eating disorders which cause hypertension unconsciously obtained. Serious complications such as coronary thrombosis, myocardial infarction, thrombotic stroke, eye vein occlusion, retinal detachment, kidney failure, damage to the brain, eyes, heart and kidney and other organs can be occurred for long-term high BP. It may lead to hemiplegia or organ function loss for mild condition and it will result in life-threatening for severe condition.

The rapid development of mobile technology, the popularity of smartphones, the convenience and circulation of mobile application (App) already have changed our life way. App for the demands of health care gradually are taken seriously, there are a growing number of health and medical related App shelves circulation in the iTunes App Store. The FDA (Food and Drug Administration) in September 2013 announced the official Mobile Medical Application Final

Guidance. Mobile medical App on development has begun to have a preliminary specification to follow, but also contribute to the development of mobile medical App. FDA report pointed out that, the world will have 5 billion smartphone users access to healthcare APP by 2015 [1]. Global profit on mobile medical health care market will reach \$ 23 billion, of which the content and App providers profit is expected to reach \$ 2.6 billion by 2017 [2].

Because the increasing mobile medical App for the demands of health care, currently on the market has emerged in many hypertension-related App, such as "hypertension FAQ" [3], "Hypertension 2.0", and "Blood Pressure (BP) IMPACT" [4] and so on. Many associated with hypertension App only provide most of introduction to etiology of hypertension, hypertension prevention, complications of hypertension, and treatment methods for high BP. For more advanced App can provide users to enter their own BP record, or drugs treatment record to reach self-tracking. All in all, for existing hypertension App, their lack of functions for integration of automatic analysis and family care as well as physician diagnosis to the actual health care, therefore, those are not yet complete for the mobile medical on healthcare, can only be one kind of record software. Since the mobile medical App demands more and more for health care, we proposes the use of mobile medical concept to present supposed mobile medical app architecture for health care.

II. MATERIALS AND METHODS

The proposed schematic diagram for mobile medical architecture for health care in hypertension is shown in Figure 1. Users can operate BP measuring device using a wireless connection / a wired connection to their smartphone or tablet, or other mobile devices in combination. Simultaneously, they can use mobile medical app to accomplish a series of operation for BP in measurement, analysis, records, management, family care, and hypertension knowledge acquirement as well as physician diagnosis. BP related information will be stored in the user's personal cloud library of medical management of BP. In addition to recording and management that can be used anytime and anywhere, but can still combine the personal or family physician for further diagnosis or treatment function.

Architecture proposed in this study is divided into two parts: 1. terminal user side and 2. physician's side as described as follows:

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Y.-H. Cheng is with the Department of Information and Communication Engineering, Chaoyang University of Technology, Taichung, Taiwan (e-mail: yuhuei.cheng@gmail.com).

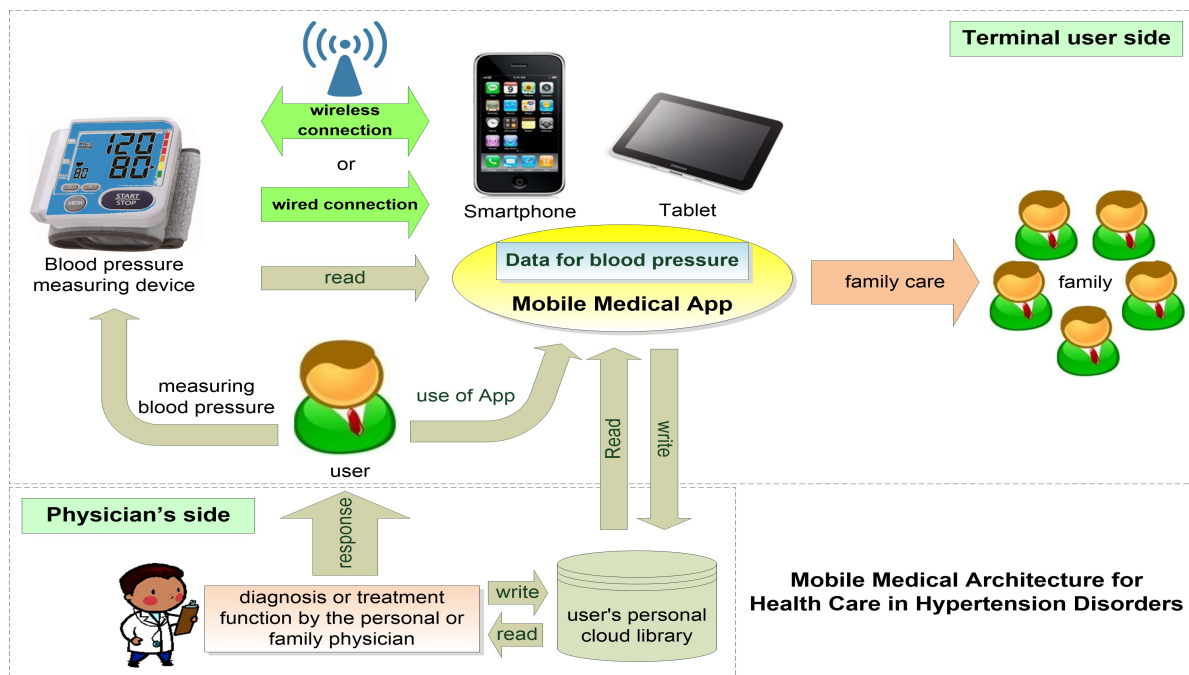


Fig. 1. Schematic diagram of mobile medical architecture for health care in hypertension.

A. Infrastructure of functions of mobile medical App for health care operations in hypertension - terminal user side

Basic functional architecture according to the functional requirements is presented in the present study. The details are described below.

a. measurement of BP

The main planning for measurement of BP is described below:

(1) posture correction when measuring BP

When measuring BP due to poor posture can affect BP resulting in misreading, and different BP may lead to drug policy change.

(2) bedtime measured reminder

Before going to bed every night to timing measure BP can help strengthen the reference value of BP measurement data.

(3) wake up measured reminder

After getting up every morning and regularly measure BP, it can also help to strengthen the reference value for BP measurement data.

(4) timing measured reminder

Since taking into consideration the user can not measure BP every day before going to sleep at night and wake up the morning after, so doctors have recommended a fixed time every day can enhance the value of the reference BP measurement data.

(5) BP measuring device setup

IoT (Internet of Things) quickly spring up, taking into consideration future BP measuring device will be combined with mobile device to achieve personal medical purposes.

b. analysis of BP

In terms of BP analysis, they are described as follows:

(1) BP recording chart trend analysis

BP recording chart trend analysis is a visual way to help users quickly control the trend of BP.

(2) built-in BP threshold assessment analysis

Users can enter a custom BP using a preset threshold or standard BP threshold, through the measurement of BP compared with each other to analyze the current BP is above or below a custom or standard BP, as prevention hypertension of reference.

(3) real-time diagnostic analysis of BP

Real-time diagnostic analysis can get "live" diagnostic analysis carried out the wisdom of BP through user's personal cloud library of BP management.

(4) long-term diagnostic analysis of BP

Long-term diagnostic analysis uses knowledge analysis for "long-term" diagnostic data through user's personal cloud library of BP management and medical doctors' semantic repository.

c. records of BP

Planning in BP record functions are shown below:

(1) the pathogenesis record of symptoms of hypertension

Patients with hypertension can always record pathogenesis time, location and symptoms of circumstances to facilitate follow-up observation and physician diagnosis of hypertension. To record pathogenesis information from anytime and anywhere for discomfort with suspected symptoms in hypertension pathogenesis.

(2) the diagnosis record of a physician

Physicians can record the diagnosis and drug information directly to users' personal cloud library

through the function of "Diagnosis edit" in "Diagnosis or treatment".

(3) the historical record of BP

Historical records over time provide users with the ever measured and effective BP information, thereby providing clinic reference for physicians. Users or physicians can query the past record of BP by pathogenesis records, date, and so on.

(4) immediate measurement record

Users can store currently BP value measuring via BP measuring device by manually add information and automatically fill in information.

d. management of BP

For the function of management of BP, they are presented as follows:

(1) physician diagnosis records management

Users can manage the diagnostic records of physicians for different physician-diagnosed results and check "the diagnosis record of a physician" in "Records of BP" described above, and may delete these records. Cloud library assists the recovery of deleted diagnostic records.

(2) BP records management

To set account of cloud BP management database can help the measured BP data stored in the user's personal cloud library to avoid loss of BP data. Furthermore, it also help for personalize medical work.

(3) family connection management

Users can input the account of mobile medical App by the input interface of family connection management for family care.

(4) physicians connection management

User can authorize the physician of a hospital or clinic for diagnosis and treatment function.

e. family care

In family care functions, they are introduced below:

(1) list of family BP

The family via the connection consent can observe the situations of the BP in family by list of family BP. Especially in hypertension patients, we can concern for our family anytime and anywhere as a remote family care.

(2) hypertension warning reminders

When hypertension patients have the measured BP is too high, through a warning to remind family agreed by family connection to allow them get the information, and seek further treatment or physician assistance to control BP for hypertension patients.

(3) hypertension treatment reminders

Through physician recommended treatment processes and timely control manner, it can alert patients with hypertension, and remind family members agreed by family connection to be urged for hypertension patients and thus achieve the purpose of treatment and control of hypertension.

(4) SMS and emergency contact phone

When measured BP is higher or is abnormal for patients with hypertension, the App can automatically send an emergency text message to family through patient phone or press a key to make an emergency contact telephone to his/her family.

(5) Whereabouts and secure GPS positioning

Family can get the location of the patient by GPS location directly and rush immediately beside the patient to provide assistance where necessary or urgent medical care processing.

f. hypertension-related knowledge

This part covers the functions of related knowledge and hypertension prevention and treatment, including A) definition of hypertension, B) symptoms of hypertension, C) hypertension and diet, D) prevention of hypertension, and E) treatment of hypertension. In addition to providing knowledge beyond words, developers can also design to interact with the user's game to provide knowledge about hypertension, to initiate the interest of users, help users understand hypertension.

B. the function for a physician diagnosis - physician's side

This part is the access and use of personal cloud to physicians via the user's database of medical management of BP shown as follows:

(1) List of patients' BP

The agreed hospital or clinic by physicians connection management, the physicians can perform the track work for hypertension patients. The physicians can browse the status for all hypertension patients by the function of list of patients' BP combined with user's personal cloud library of medical management of BP.

(2) real-time diagnosis for patients' BP

The physician may be through the number in medical records of patients with hypertension to check the patient's medical records and medication information as reference for the immediate diagnosis, and to provide patients with hypertension-related drugs, or to reply for diagnostic results to the patients.

(3) drug administration

Because different symptoms are happened for different patients with hypertension, the way in medication are not the same. Thus, it has corresponding drugs for different patients with hypertension, and the physician can prescribe the right medicine, and send the drug information to patients with hypertension. The drug information will be presented in the user's physician-diagnosed history.

(4) diagnostic editing

The physicians agreed by physicians connection management, has completed the trace analysis of BP in patients with hypertension and aim at the BP information available for patients to provide the diagnostic reference to patients.

III. RESULTS

According to our research known the current study in the field of hypertension-related mobile medical is not yet mature. However, there are numerous medical studies of hypertension. Recently, Fedullo et al. review the indications, outcomes, and approach to treatment with medical therapy for chronic thromboembolic pulmonary hypertension (CTEPH) [5]. Yoon et al. describe trends in the awareness, treatment, and control of hypertension; mean BP; and the classification of BP among US adults 2003 to 2012 [6]. Böhm et al. assess the safety and effectiveness of renal denervation using the Symplicity system in real-world patients with uncontrolled hypertension [7]. Whelton et al. present findings of an ad hoc working group assembled by the National Heart, Lung, and Blood Institute (NHLBI) to assess research needs to improve prevention, treatment, and control of hypertension among African Americans [8]. Cushman et al. present the SPRINT Trial Results. The results of SPRINT are likely to have a major impact on the treatment of hypertension. But there are many important lessons to be learned from SPRINT to apply the results in a safe and effective manner [9].

For the mobile medical aspects, Logan proposed mobile health (mHealth) technology circumvents the technical challenges of electronic health systems and provides a more flexible platform to enhance patient self-care. The author's group studies in hypertension and other chronic conditions have shown improved health outcomes using mHealth applications that have undergone rigorous usability testing [10]. Kaplan et al. review the role of mobile technologies in the assessment of health-related behaviors, physiological responses, and self-reports [11]. Steinhubl et al. present the important of mHealth. US Secretary of Health and Human Services Kathleen Sebelius referred to mHealth as "the biggest technology breakthrough of our time" in 2011 [12]. Aungst et al. define existing market factors relevant to selection of medical applications and describe a framework to empower clinicians to identify, assess and utilise mobile medical applications in their own practice [13].

This study gives mobile technology to help people fast and easy to achieve the effectiveness of self-health management. In order to further apply the concept of mobile medical in hypertension with health care, we have proposed supposed mobile medical app architecture for health care and describe for the functionalities as the suggestions to assist the developers to develop available mobile medical App. Interaction with the health care operations of the mobile medical App is demanded for users. Mobile medical Apps must offers users the convenience and easy user interface, so that they are look of the prohibitive. For a mobile medical App with non-reminder, non-feedback and also complex to use makes users over time forgot its existence. Because the generation of developed mobile technology, used in various needs Apps abound, how to increase sticky for a mobile medical App and allow users to sustained health care is one of the evaluations for the developers. The follow-up have to rely on the professional advice of doctors and experts in the public back to be expanded and revised so that hypertension in medical health cares to be more complete and comprehensive.

IV. CONCLUSION

This study puts forward the hypothesis of mobile medical App architecture for health care in hypertension and describes for the functionalities based on the popularity of today's wisdom mobile devices. Terminal user side and physician's side are proposed and combined with users' personal cloud library of medical management of BP in mobile medical App for a series of operations including measurement, analysis, records, management, family care, and hypertension knowledge acquirement as well as physician diagnosis. The proposed architecture can be further implemented, improved and assessed to help the global people using mobile devices to facilitate health care of hypertension. People will have regular daily measurements of BP, prevention and treatment to avoid or ameliorate the occurrence of hypertension. People can come from anytime and anywhere with healthcare through mobile medical App the day is not far off.

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