A Self-administered Healthcare Warning Mechanism Based on Internet of Things

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Abstract. In view of today's society of advanced medical technology and popularity of social networking, remote home care will become the new stream of health care services. In this paper, the medical resources and information technology were combined to set up a self-administered healthcare warning mechanism. Through wireless transmission, patients' psychological status can be monitored at home. Under the event-driven mode, appropriate professional medical advice and response measures were proposed so that the subjects could safely and effectively engage self-care at home under the support of information technology. Depending on individuals' needs, information technology can reduce the care costs and enhance the medical service quality, thereby achieving the goal of seamless integration of the health care system both inside and outside the hospital.

Keywords: Home care · Electrocardiogram (EKG) · Vital sign
Internet of Things

1 Introduction

In the rapidly changing information society, the pace of life has rapidly accelerated. Long-term negligence of health is likely to lead to the happen of Cardiovascular diseases 0. In order to ensure a seamless integration of health care system for post-operative patients with cardiovascular disease and hospital care, doctors will recommend a healthcare mode outside the hospital based on the evaluation of patients' conditions. Subacute care is a comprehensive inpatient care and is designed for patients with acute illness, injuries, or aggravated diseases. It is a type of target-oriented treatment aimed at assisting patients through the stage of disease to recovery. Patients can return home or be admitted to nursing home when their conditions are stabilized.

Accompanied by the rising needs of mobile hospital and home nursing, the concept of telecare arises. The origin of this concept can be traced back to the term of eHealth that is defined as the application of Internet and other related technologies in the

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healthcare industry to improve the quality of clinical process [2]. Nowadays, equipments used in telecare adopt wireless sensor that enables users to collect vital signs including heart beat, pulse, glucose, and blood pressure and to transmit these information through mobile devices to medical institutions where doctors can grasp patients' current condition based on received information 00. Through the hard device to receiving the vital sign of patient, we develop an intelligent platform with the module of self-administered healthcare warning mechanism to warnings users when their health condition appears abnormal phenomenon and inform them their health require extra attention.

This paper is organized as follows. Section 2 describes the entire self-administered healthcare warning mechanism in detail. In Sect. 3, we describe the result of our simulation experiment. Discussion and conclusion are in Sect. 4.

2 Methodology

In order to monitor the condition of Cardiovascular diseases patient effective and abiding and offer the appropriate nursing process promptly. The application of information technology will be the most important part in this study.

This section will be distributed into three parts. The selection of hard device and the method of vital sign measurement and recording function will describe in Sect. 2.1. Section 2.2 will be the boundary of warning mechanism and the process will describe in Sect. 2.3.

2.1 Vital Sign Measurement and Recording Function

This research has applied the wireless vital sign receiver to grasp the condition of patient and transmit to the platform through the wireless. After measuring and uploading the vital signs, the user can self-inspect his health status. As shown in Fig. 1, if any figures were out of boundary, the system will show up the warning message below. After measuring the vital signs, the results were uploaded to the medical

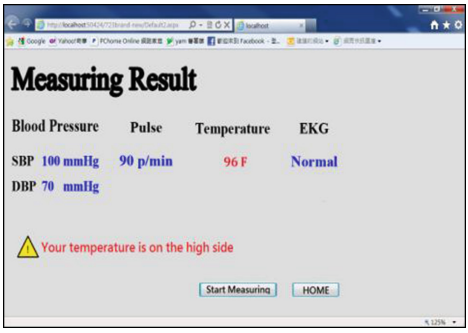

Fig. 1. Vital sign measuring and recording function – measuring result

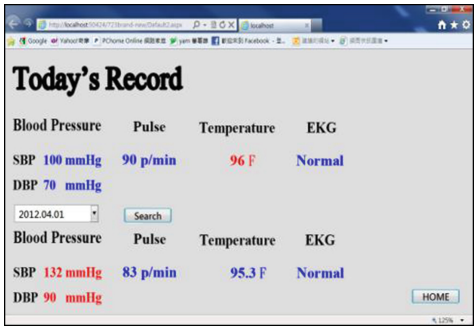

Fig. 2. Vital sign measuring and recording function – health record

database in hospital, and the health record in the system was updated. As shown in Fig. 2. The user may also search the measurement records of the previous days through the system.

2.2 Critical Value Warning Function

In general, in addition to EKG monitoring, the postoperative home care patients' other vital signs such as: respiration, temperature, pulse, blood pressure, and blood oxygen should be measured. The vital signs are subject to changes due to the human health status and amount of activity and these vital signs are correlated. For instance, if a person experiences shortness of breath, this person's blood flow and oxygen supply capacity will be changed, resulting in the blood pressure and blood oxygen volume are not in the standard ranges. Therefore, to assess whether or not a person's physiological function is normal and healthy, depending on one type of vital sign value is not enough to make the right judgments. Clinically, multiple vital sign data is used to perform diagnosis. However, based on a person's physiological status, past medical history, and family medical history, the vital sign health standards and critical value ranges differed for every individual, no single standard value is sufficient for the respective monitors to determine whether the health of the patient is in "safe" or "critical" condition.

In view of this, the threshold values of the vital signs adopted for patient's discharge assessment on this platform are the warning threshold values for the previous month and based on the doctor's judgment after comparing the assessment setting values at the time of discharge and user's vital signs measured during the first month, patient's vital sign health standards were reset or adjusted. In the phase of system initialization, an emergency contact person was set and patient and contact person were notified of the possible conditions and disposal in consideration to the warning degree. The warning mechanism is divided into three degrees: abnormal, critical, and urgent. The "abnormal" warning tones sent out by the system is when patient's vital signs have not been received yet. It acts as a reminder for patients to measure their vital signs. The "critical" warning tones sent out by the system is when the patient's health status becomes severe, which may jeopardize patient's life if an immediate disposal is not done. Therefore, the critical warning degree is further divided into critical and urgent, the former is when the doctor deems it necessary for the patient to return to the hospital for checkup before the next scheduled appointment while the latter is when the patient's condition is extremely critical and requires immediate medical attention. The warning strategy is illustrated in Table 1.

Table 1. Warning levels and strategies

Warning levels	Strategy
Abnormal	A reminder for user to collect vital sign
Critical	The scheduled next-visit appointment shifted to an early date based on doctor's diagnosis
Urgent	Requiring immediate medical attention based on doctor's diagnosis

2.3 The Process of Warning Mechanism

The flowchart of warning mechanism process is shown in Fig. 3. If the system does not receive daily vital sign values, the receiving device hold by user will send out two short waning sounds that each lasts for three seconds to remind patient to measure vital signs. After receiving the measured data, the system will record the message received. If the data is not received within 15 min, the system will send SMS to the emergency contact person whom will be requested to check the patient's condition and confirm whether the patient has experienced severe physical discomfort or to further assist the patient in eliminating obstacles during the measurement, uploading data, or sending notification for emergency rescue. In case of severe physical discomfort, the healthcare system will immediately send SMS and transmit patient's medical records to the attending physician who will then determine if the patient required immediate medical attention and engaged in follow-up rescue. If the patient does not require immediate medical attention, the doctor will then make a decision based on the patient's condition to see if the patient needs an early next-visit or engage in simple emergency disposal at home.

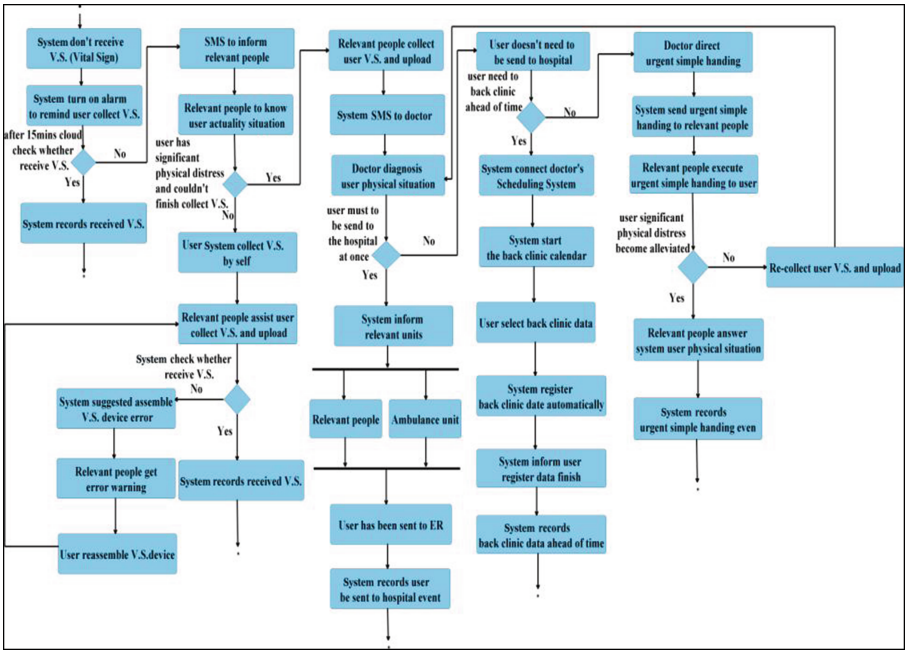

Fig. 3. The flowchart of warning mechanism process

3 Simulation

This section will simulate the situation when the system received an abnormal figure and triggered the process of warning mechanism. Also, we assumed the user's condition is not available to measuring the vital sign by themselves.

After 15 min system triggered the first time warning to patient and still don't receive the update figures. System will send a message to the relevant people. When relevant people upload the newest vital sign, the system will sent an order request to the attending physician to decide whether the patient should sent to the hospital at once. As shown as Fig. 4. Suppose the decision of physician is unnecessary, but the patient have to back to clinic ahead of the next appointment. System will check the appointment of physician and send the recommended schedule for patient to register. As shown as Fig. 5.

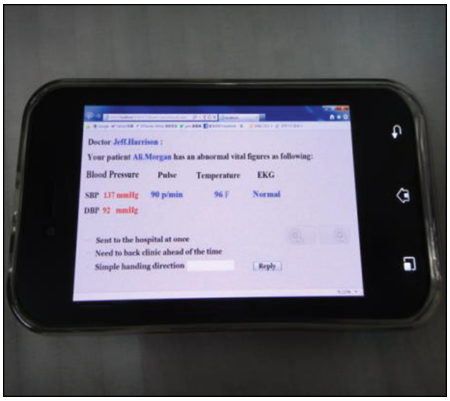

Fig. 4. An order request to the attending physician

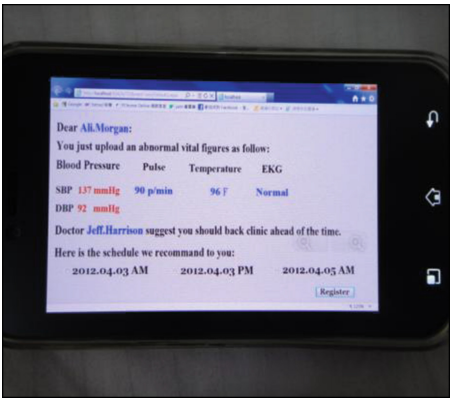

Fig. 5. Patient registration

4 Conclusions

After discharge from the hospital, postoperative patients with cardiovascular disease can resume their daily life activities if they can continue monitoring their health condition. Our research team devote themselves on developing a user-centered self-administrative healthcare mechanism involving professional medical staff and patients themselves. As to the design of risk warning, self-administrative healthcare mechanism for homecare patients establishes a personalized warning, reminder, and precaution function based on individual differed health status and can recommend proper measures. Regarding the warning setting strategy, we divide warnings into abnormal, critical, and urgent degree and dispatch follow-up works based on the degree of emergency. With the advanced technology, a new generation of the application of

healthcare platform is engaged to perform remote care, to reduce the cost of medical resources, and to enhance the quality of medical care.

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