Home Exam of eHealth

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1 Technical approach and system solution

The purpose of this task is to propose a system solution supporting remote management of chronic heart failure (CHF) for elderly patients. The profiles of these patients are: (1) more than 75 years old with CHF, (2) they are able to read and send messages through phones, (3) they have limited skills to operate software on smartphones. The solution needs to meet several requirements, such as easy to use and not expensive for users. Based on the limitation, a system solution is proposed as shown in Figure 1, which is inspired from the reference [1].

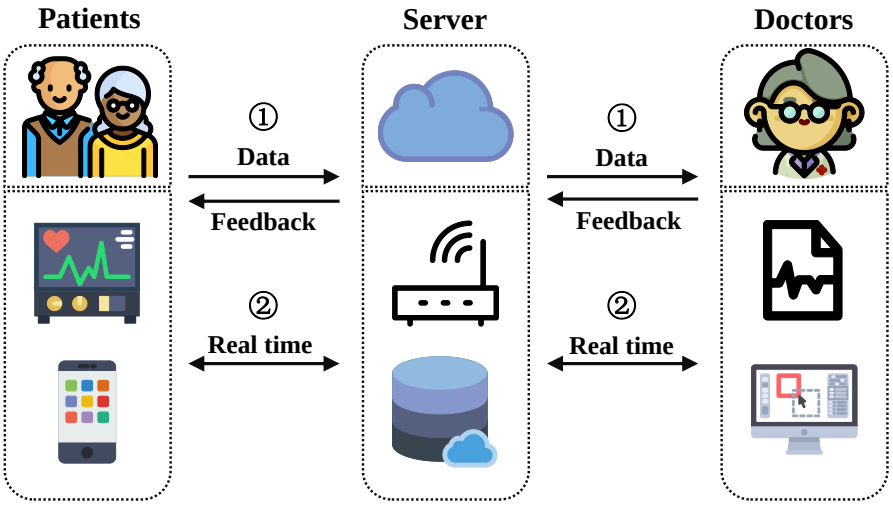

Figure 1: A system for remote monitoring CHF patients.

The system has two respective terminals for patients and doctors (or research nurse and other health-care providers), and a server that connects two ends through Internet. In other word, the system can be divided into three components, consisting of information collection, data transmission and storage, and data analysis. In patient's end, a program is installed in the patient's phone. The application provides basic functions to gather information and communicate with doctors. Compared with the web application, a phone program has more approaches to collect data from additional portable equipment, and also it can offer better user experience. The other end for doctor possesses a computer program that helps doctor to make regular diagnosis, and it can be used as a tool to communicate with patients online. The server is a system that integrates communication service and database technology to effectively transmit and stably store the data from one end to another.

Two modes are applied in this system solution. First one is the regular diagnosis on patient's data. All daily measurements are uploaded and stored in the server. The data is organized and visualized in doctor's computer when doctor reviews patient's condition. Another mode allows patient to make appointment with doctor by text messaging, carrying out a real-time video consultation according to measurements stored in server.

2 Design and implementation

Three aspects need to be considered when designing and implementing the solution as listed in Figure 2. First, in patient's terminal, the mobile app should have high usability for elderly people to obtain information and send them to the server. To simplify the data collection, a well-designed questionnaire can be applied to acquire information which is unquantified, such as tiredness, mood state and subjective feelings. The questionnaire also investigates items that can be easily quantified, for instance daily weight and input dose of medication. Some biotic data, heart rate and blood pressure, is able to be detected by the wearable device which is easy to use and inexpensive. Furthermore, electrocardiograph (ECG) can be captured if a portable monitor is applied, but increasing the cost and obtaining the signal without high-precision. Ideally, an integrated implanted sensor will provide a truly real-time monitoring, avoiding interference from external environment. This technology is fairly frontier in a limited scope with high cost. It is probably used in more applications in the near future because of the increasing demand for it.

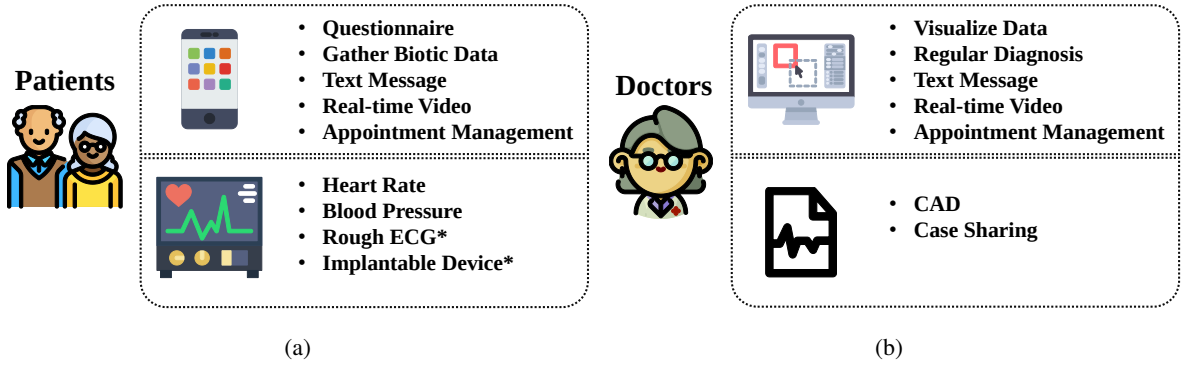

Figure 2: Detials of design and implementation of the system solution.

Second aspect is how to effectively analyze data and utilize information in relative clinical application. Basically, gathered data in timing sequence should be visualized in well-mannered organization, providing the deep connection between different type of information to doctors for making diagnosis and evaluation. These data, if it is collected by many patients in a long term, can be formed into a valuable CHF case database with vast numbers and text, which is referred to as "Big Data". It is capable to facilitate the development of algorithms for computer aided diagnosis (CAD) combining with artificial intelligence technique. Another scenario these information can be applied in is the pretreatment in an ambulance as shown in Figure 3. If a patient who is the user of this system, unfortunately, requires emergency treatment, the diagnostic records of him/her are extracted from database, being analyzed quickly for preparing medication and equipment in an ambulance. Meanwhile, the records are also displayed to doctors who will plan the therapy for coming patient.

Third aspect but the same important as previous factors is the usage of information and communication technology (ICT) and data storage strategy in databases. Convenient communication between CHF patients and their doctors ensures to smoothly exchange key messages. The application in this system solution provides two modes mentioned in previous section, which are text message and real-time video. Doctors can give suggestions or alerts to patients according to the review on a durative data through text message. A real-time video consultation allows users in both terminals to have a session about the current situation of the patient, also provides opportunities for patient's families or other experts at CHF to join the meeting. The database should be managed with well-designed table structure, indicating clear relationship among tables to improve the efficiency of data access and storage.

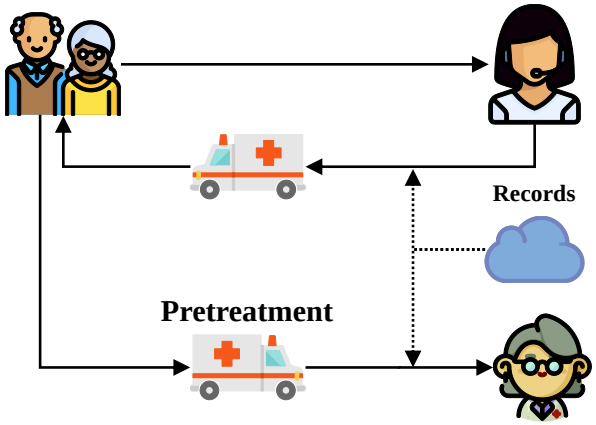

Figure 3: Use records to suggest a pretreatment on ambulance and assist doctor to plan therapy.

3 Safety & privacy issues

There are mainly two aspects need to be considered when implementing this system solution in practice, which are physical safety and information security. Several electronic devices are mentioned above, such as portable medical equipment measuring blood pressure, heart rate and ECG, are in low risk to injure human body. As to implanted devices, the potential damage maybe caused by inadequate testing. As defined in the guidance by the Swedish Medical Product Agency, it is obligatory to fulfill a series standard of information safety, including confidentiality, accuracy and access of private data [2]. Complete gathered information from both two terminals should be transmitted, data loss or delay resulted from the poor access could arouse confusion. Patient's information without high accurate may lead to misunderstanding by doctors who is more likely to make an incorrect diagnosis and improper decision for therapy. The confidentiality issue stands a chance to trigger some legal and ethical problems. The prevention of data leakage is required to guarantee that the information of patients can only be approached by those who have qualified access. Any other usage of user's information, except for diagnostic purpose in certain conditions, is no doubt to be well informed to all relevant stakeholders, and data can be accessed only under their permissions.

References

[1] Gund A., Sjöqvist B.A., and Lindecrantz K. A generic web based ehealth system for long term out-of-hospital care., 2013.

[2] Swedish Medical Product Agency. Medical information systems, guidance for qualification and classification of standalone software with a medical purpose., 2012.