The Research of Mobile Emergency Healthcare Information System in Taiwan

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ABSTRACT

Nowadays the quality of healthcare has been improved gradually. However, the processing time of healthcare is too long, and causes a lot of regrets about pre-hospital emergency. The minimization of time required for providing primary care and important consultation to patients is one of the crucial factors when trying to improve the healthcare delivery in emergency situations. The purpose of the study is the development of a Mobile Emergency Healthcare Information System (MEHIS). A Standard Operation Procedure of Emergency Healthcare (SOPEH) is first planned. Then, the system is developed for EMT or families of patients to communicate with physicians in hospitals when accident happens. Users can use their 3G mobile phone to transfer symptoms and information of the situation to JSP server. Therefore, the system delivers information quickly and provides proper emergency care in the first time. Meanwhile, MEHIS can short emergency healthcare time, and enhance quality of emergency healthcare.

1: INTRODUCTIONS

The quality of pre-hospital healthcare is needed to be improved in the emergency healthcare system of Taiwan. Resources of emergency healthcare are not allocated evenly and pre-hospitals healthcare needed to be re-planed. Meanwhile, index of pre-hospital healthcare quality is not unified, and Standard Operation Procedure of Emergency Healthcare (SOPEH) is not well developed to concern efficiency and whole quality with whole procedure. (Pao Chu, 2005).

The minimization of time required for providing primary care and important consultation to patients is one of the crucial factors when trying to improve the healthcare delivery in emergency situations. In general, an ambulance has to respond to an emergency call, administer first aid and the send the patient to an emergency ward in a close by hospital. The golden time for emergency rescue will be wasted under the situation of non-medical treatment. Therefore, any research about development of SOPEH and system will be a great help to improve crucial time of SOPEH. Therefore, if there is any Emergency Healthcare Information System to help patients or EMT to interaction with physicians or a consultant in hospitals, they can make right first aids immediately and hospitals can arrange necessary medical resource in advance. Eventually, the rescue rate could be improved.

The current Standard Operation Procedure of Emergency Healthcare in Taiwan is re-planned in the current research. Then, a Mobile Emergency Healthcare Information System (MEHIS) is developed based on the Third Generation (3G) communication technology..

2: Related work

2.1: Emergency Healthcare in Taiwan

The emergency treatment department provides emergency medical service. Emergency medical service (EMS) is to do suitable treatment when accidents happen. The medical healthcare system of Taiwan was established since 1968 (Roger, 1983). Although the emergency treatment system of Taiwan was improved in last 30 years, some researchers thought that it is not matured. However, emergency treatment is an important category in medical service. Efficiency of the system and quality of emergency treatment procedure are urgent topics for improving cure rate. The current emergency ambulance delivery and treatment process of Taiwan is shown in Figure 1 (Department of Health, Taiwan, 2006). Most of the time, patients are not adequately treated in the ambulance and they still need to wait for the arrangement of medical resource or emergency treatment when ambulance arrived the hospital.

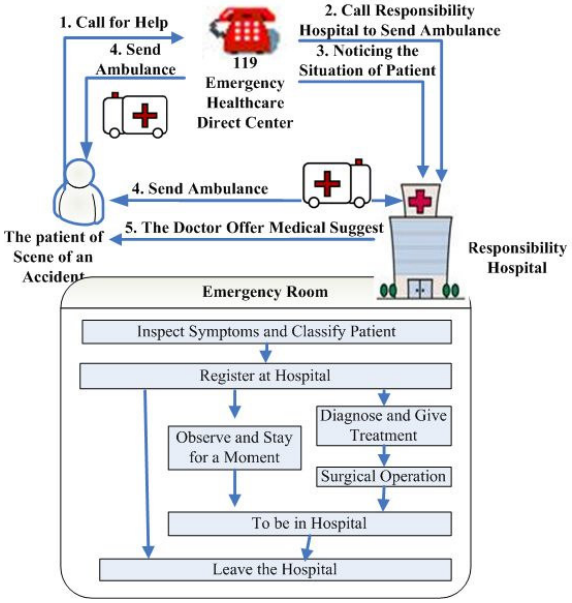

Fig. 1. SOPEH in Taiwan. (Department of Health in Taiwan, 2003)

Slack and Slack (1972) believe that in an integrated basic medical treatment system, the function of the department of emergency treatment must include providing specialized service to estimate, hand accident. The operation of medical instruments is getting more and more complex and diversification. Therefore, hospitals should pay more attention to manage these instruments for providing high quality and safe patient environment (Bhatti and Khursheed-Ul-Hasnain, 2002).

Nowadays, many hospitals in Taiwan are planning to develop medical information system including information technology administration, electric patient record, online registration and remote treatment; however, there are still many problems existing on emergency medical treatment, such as the disproportionate distribution and ambiguous of medical resource. Therefore, patients usually found that the resource is not enough when they reach hospital, and then they took a lot of time to transfer to other hospitals. Meanwhile, physicians can not prepare specific medical instruments of resource until patients arrive at the hospital. However, an Ambulance can be changed into a moving emergency room by the wireless communication technology for improve these situations. Slack and Slack (1972) proposed that there are three characteristics of utilizing wireless communication on emergency treatment, including mobile ability, simplification and active.

2.2: Mobile communication and emergency mobile healthcare system

Digitalized communication and Time Division Multiple Access (TDMA) technique are adopted in second-generation (2G) mobile phone system. Usability of radio wave was dramatically improved and the number of mobile phones is propagated in late 1990s. Personal Digital Cellular (PDC) and Global System for Mobile Communications (GSM) are two major types of 2G communication systems; PDC is mostly used in Japan and GSM is widely used in European countries. However, the second generation mobile phone system is limited to a speed of 9.6 Kbps. Having just this bandwidth available, only low resolution static images and text-like patient data could be sent over the air.

In 1998, Code Division Multiple Access (CDMA) technique was used to provide mobile phone service, which was called 2.5G mobile phone service. Many European mobile phone carriers started General Packet Radio Service (GPRS) for providing high-speed transmission at about 115 kbps in the network of GSM system. This service permits data transmission rather than communication (Banitsas et al., 2004).

Third-generation (3G) mobile phone system is a digital mobile phone which utilizes the Universal Mobile Telecommunication Services (UMTS) technology. Because of the high operating flexibility and ability to provide a wide range of applications, it is a significant innovation over 2G and 2.5G systems. Nowadays, it generally extends the services provided to fixed networks users to mobile customers. UMTS provides bit rates up to 2 Mbps. Since the CDMA system is adopted in 3G phone system, noise and cutoff in communication is reduced. Meanwhile, high-speed data transmission can be done at the rate of 384 kbps at the most which was not acquired in 2G mobile phones (Muratore, 2001). Because the number of 3G cells is lower than those of 2.5G, a communication will have to fallback into GPRS speed, until it regains a 3G signal. Therefore, it results in considerable delays in communication and data transfer.

With the emergence of cellular networks, a number of systems used cellular phones to transfer electrocardiogram (ECG) and heart rate (Johnson et. al., 2001). Istepanian et al (2001a) utilized 2G Communications networks to address the ECG transmission issues. Recently, several researches have been conducted to develop GSM based mobile health and wireless tele-medical systems for remote diagnosis in mobile and hardly accessible environments (Istepanian et al (2001b). The European Union's Ambulance and its successive projects were able to transmit patients' biosignals or image sequences using available GSM phone lines (Kyriacou, 2003). The results show that their image transmission rate is one image (size of 2.5–3 kB) every 3–5s and the percentage of ECG transmission interruption reaches 27%. An Ambulance can be changed into a moving emergency room by the wireless communication technology (Lee, 2003). Istepanian et al (2006) presented a comprehensive review of wireless telemedicine applications and the latest advances on mobile health systems. However, 2G mobile phone systems lack the necessary resources to transmit bandwidth-demanding real-time (RT) medical data. On the contrary, 3G mobile phone system overcomes the limitations.

3: Service analysis and system design

3.1: Research Processes

The process of the research is shown in Figure 2. Literatures about emergency healthcare system, mobile communication technologies and emergency healthcare in Taiwan were first explored. Then the process of improved mobile version of SOPEH and the service model of emergency healthcare system were developed. Finally, the system was developed and evaluated.

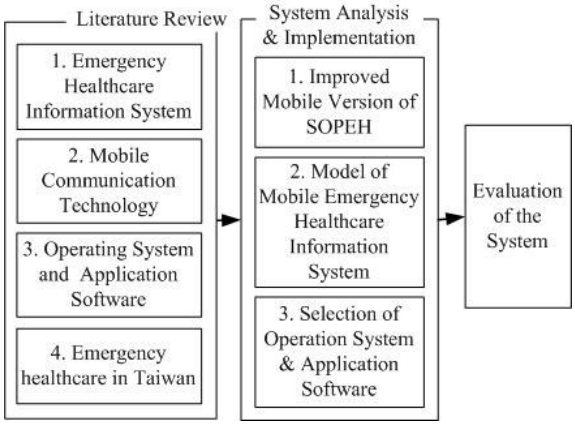

Fig. 2. Research Processes

3.2: Improved mobile version of SOPEH

The current emergency ambulance delivery and treatment process of Taiwan is modified and the improved mobile version of SOPEH is shown in figure 3. In Figure 3, step3.1 and step 3.2 and 3.3 are carried on at the same time when patient is delivering to the hospital by ambulance. Meanwhile, step 5.1 and step 5.2 are executed at the same time. Eventually, physicians can transfer emergency advice to the ambulance and prepare treatment needs in the hospital in advance. For emergency patients, it is an important issue to avoid wasting golden time on sudden outbreak and medical mistakes. Therefore, valuable treatment time of patients could be saved and cure rate will be improved by the mobile version of SOPEH.

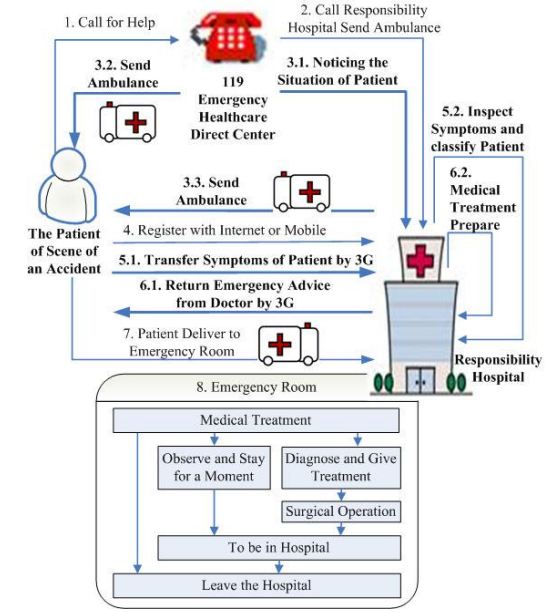

Fig. 3. Improved mobile version of SOPEH in Taiwan.

3.3: System Architecture

The Mobile Emergency Healthcare Information System (MEHIS) includes two parts, user side terminal and hospital side terminal as shown in Figure 4.

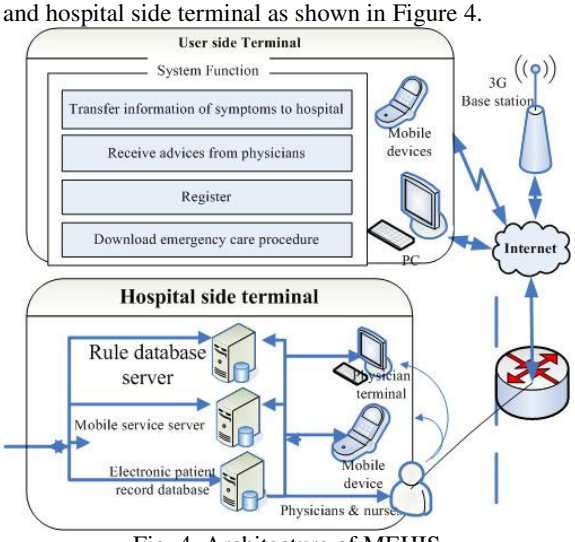

Fig. 4. Architecture of MEHIS

Mobile device can be used to transfer information of patients' symptoms to the responsibility hospital, receive advices from physicians, register, and download emergency care procedure through Mobile Emergency Healthcare System during the delivering process to the hospital. Meanwhile, patients can use desktop computer to register through Internet. 3G communication technology is utilized to transfer information. On the other side, physicians or nurses in the hospital can access patients' electronic record via mobile phone or PC to arrange healthcare equipments or advise emergency care for patients in the ambulance. The hospital side terminal contains rule database server, mobile service server, and electronic patient record database server. They response for controlling request of users, physicians, and nurses.

3.4: System Functions

The functions of MEHIS developed in the research are shown in Figure 5. Registration, transfer of symptoms, advice, and maintenance are major functions of the system. Server and component layer are developed to support functions for providing more convenient and comfortable usage of emergency healthcare service. Patients or their family can register by mobile devices and situations will be sent back by mobile device in case of accident happened. Then, physicians' advice is sent to patients' site as soon as they receive patient's situation. Therefore, urgent treatment could be applied according to physician's advice. Application server is response for providing patients' medical records, required medical instruments and medicine. Rules of medical treatments and transforming components for agent of medicine were designed to make decision and decrease the compute load from application server.

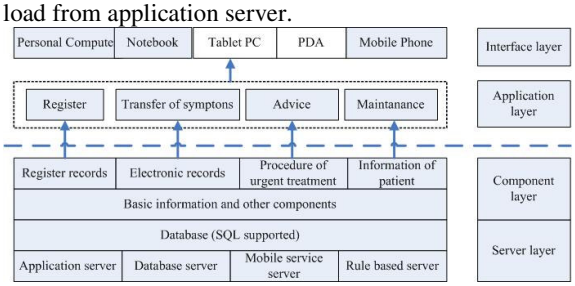

Fig. 5. Functions of Mobile Emergency Healthcare System.

4: Implementation

The system was developed by java language, including Java2 mobile edition, Java Server page. At the same time, MS SQL server was adapted as database server and the other J2EE server was setup based on it. It is in charge of controlling the rule base and receiving the information from client whether it is a PC or a mobile device. No matter what the platform of the client is, it supports to surfer the Internet. The system consists of two main user terminals, the hospital side and user side. Users report symptoms by the interface of user side terminal. The hospital side terminal provides an interface for physicians to review patients' electronic medical record, and they can key in advice for urgent treatment.

Then, advices are sent to mobile devices in the accident site. Meanwhile, the information is stored in the database for future proof reference. An example of hospital side interface is shown in Figure 6.

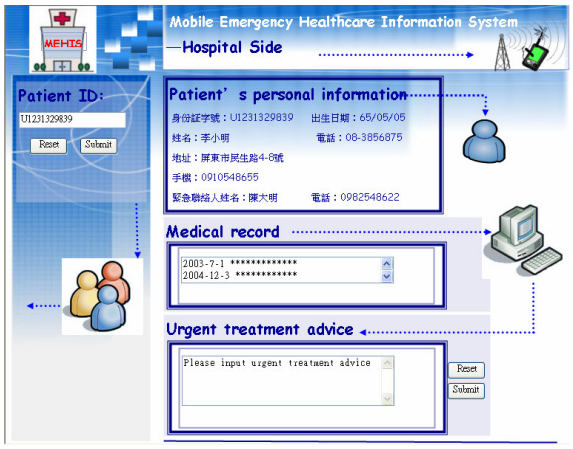

Fig. 6. An example of interface of hospital site.

The interface of user site of using 3G mobile phones is shown in Figure 7. The system includes four main functions, login, transfer symptom, register, and download emergency treatment advice. Figure 7(a) shows that users can select the menu to login the system. Figure 7(b), (c), (d), (e), (f), and (g) shows the process of how users report the symptoms of patients. Figure 7(h), (i), (j), (k), and (l) shows the process of how users download emergency treatment advice.

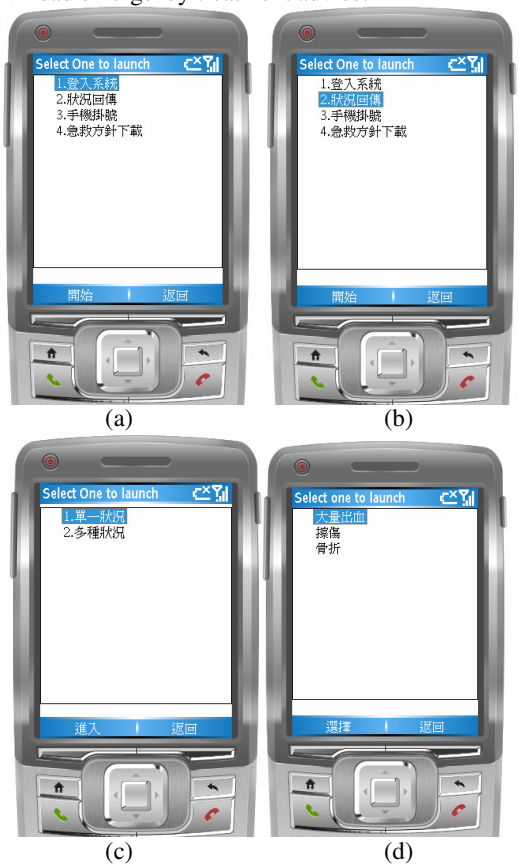

Fig. 7. An example of interface of user side terminal.

5: Conclusions

The improved mobile version of SOPEH can improve the procedure of emergency care and the development of the MEHIS can be used in ambulance to transfer symptoms back immediately. Meanwhile, the responsibility hospital can continue classified trauma of patients, and ambulance can receive physicians' emergency advice beforehand. Therefore, the emergency healthcare can reduce many paraphernalia. The most important thing is that it enhances rescue rate of patients by mobile SOPEH and MEHIS.

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