MEDINFO 2007
HISA Ltd Australia
© 2007 The authors. All rights reserved.

The Interface Software Design:Information System of Emergency Medical Care For Disaster In Indonesia

Agung Budi Sutiono [a,b], Toshizumi Ohta[a], Tri Wahyu Murni[b], Taufik Hasan[c]

[a]*Graduate School of Information Systems, The University of Electro-Communications, Tokyo, Japan*
[b]*Emergency Department, Hasan Sadikin Hospital, Bandung, Indonesia*
[c]*Research and Development Centre Telkom, Bandung, Indonesia*

Abstract

Information systems have an important impact on emergency situations, especially during disasters and effective connections are required for networking between disaster affected areas, field hospitals and emergency departments. Critically ill patients are the first priority during transport, and in addition, the vital signs should be hemodynamically stable and frequently reported from the disaster affected area and during transportation until arrival in the emergency room. Since the geography of Indonesia includes many mountainous areas, this tends to hamper networking, meaning communication infrastructures have not yet covered all areas and districts of Indonesia.

In this article, we propose the creation of a communication network system using radio VHF (very high frequency) as a wireless connection from disaster affected areas, field hospitals and emergency rooms. The use of this prototype would be relatively cheap for developing countries like Indonesia. During this simulation, we operated the reporting system during a landslide that occurred in Garut County, West Java and which needed to be reported to the Dr. Slamet General Hospital, Garut and also to the Hasan Sadikin General Hospital in Bandung as the medical command control centre in the West Java province. The software interface design was created as required to monitor the report systems of the patient's vital signs, hemodynamically and the wound state while in transit.

Keywords:

information system, vital signs, hemodynamic, disaster, software interface

Introduction

After the landslide occurred in Garut county West Java, Indonesia, the victims had to be evacuated to the nearest hospital emergency department as soon as possible. Initial checks were made for vital signs and hemodynamic stability to ensure it was possible to evacuate them to the emergency department. At the time, despite the numerous patients on the field, we used triage to determine whether the patients had to be evacuated or not. Since geographical conditions also presented obstacles during evacuation, coverage allowing reports to be made via network communications was not possible in the disaster area. Although wireless mobile phones could be used for communication, these tended to function poorly, since the BTS (base transmission stations) in the vicinity had already been damaged due to the natural disaster. Meanwhile, the medical team had to report to the hospital while transporting the critically ill patients.

There were 50 victims at the location, who were classified using green tags (non emergency), yellow tags (emergency but non critical), red tags (critically ill) and black tags (deceased). Approximately 10% of the 50 patients had red tags and needed advanced treatment in the local emergency room (disaster area vicinity) or even evacuation to the top referral hospital. We usually have many problems during transport due to unpredictable patient conditions, and despite hemodynamic stability while going to hospital, conditions sometimes worsen during evacuation.

In the clinical scenarios above, if a health information exchange network were installed within the disaster affected area, with Dr. Slamet General Hospital as the front medical post (the emergency room nearest the disaster area), and Hasan Sadikin General Hospital as the top referral hospital in West Java province, thus enabling data exchange from one to another, and if the hospitals were readily available and ready to receive critically ill patients, this may enhance information systems carrying clinical transfer data and patient consultation and result in a more efficient workflow for the medical and paramedics crews (Fig. 1).

This article will describe the background and motivation for current local health information efforts on the disaster in Indonesia and also how to create an interface design which represents a form of transport for critically ill patients suitable for a developing country like Indonesia.

Discussion of certain issues that may be required can be addressed to the emerging local health service, as well as that concerning some of the specific issues that are likely to affect emergency case management in the referral hospital.

Background

Geographical location and geological condition of Indonesia have made this country one of the most potential countries but at the same time prone to disaster such as earthquake, tsunamis, floods, landslides, cyclones, and volcanic eruptions. In general, disasters occur every year. Even in recently years, disasters have become more frequent and taken place one after another.

No	Type of disaster	Event	People affected
1	Flood	229	416
2	Landslide	106	201
3	Fires	91	26
4	Earthquakes	27	47
5	Typhoon	42	3
6	Volcanic eruption	13	0
	Total	687	2,409

Source: BAKORNAS PBP, 2004

Table 1 - Type and time disaster occurrences in 2003

When earthquake and tsunami disaster happened in Aceh last year, more than 200.000 people died, all of main infrastructure in most of Aceh area was down fall includes telecommunication. Red Cross and army are first institution which arrives in location instantly after information had been validated.

Medical care is normally established at the first opportunity, but limited facilities and support and the lack of adequate facilities in medical care units means victims may perish. In this case, we should have a solution to support the exchange of information between medical care units in disaster areas with the principal hospital and logistic units situated elsewhere.

This project promotes a system for the data communication exchange with a multi-barrier. Where geographic conditions make it particularly difficult to deliver data, and telecommunication networks are especially distant, the courier transmission and synchronized data could represent the best alternative technique to keep the system working. However, the system includes a solution to reduce the time required for courier delivery – namely, to use radio frequency as the data transfer medium.

Material and methods

Emergency medical care information system (EMCIS) is a communication system for emergency situation by using VHF radio technology to deliver low speed data, voice, and image from disaster areas to the center of disaster management system. In this case, the EMCIS Project designed a VHF modem, a protocol communication for the VHF modem, and a software application for delivering medical information.

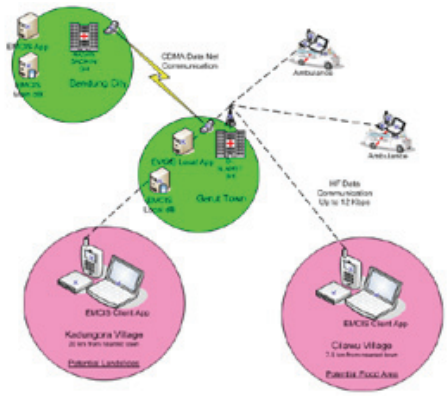

Figure 1 - Network communication and reporting system

Design software interface

On this software interface was designed as needed for critically ill patients. The requirements are user friendly, easy to understand, data entry can be done as quickly as possible, possible for consultation by using instant messenger and must be able to cover patient's conditions reporting whether live threatening or not.

Design input starts by that user needs and translating that data into the engineering terms. Defining design input is not as simple a task as it sounds. The needs itself based on the critical ill patient requirements that can represent the conditions during transporting. Ensuring that adequate safety is built into the interface design and often several trials must be done to reach the best requirements by doing many simulations.

Each patient has their own characteristics of the injury, even if they have the same injury but the problem might be different. There are many parameters for critically ill patient so perhaps need plan for updating design input interface as new information crops up during design.

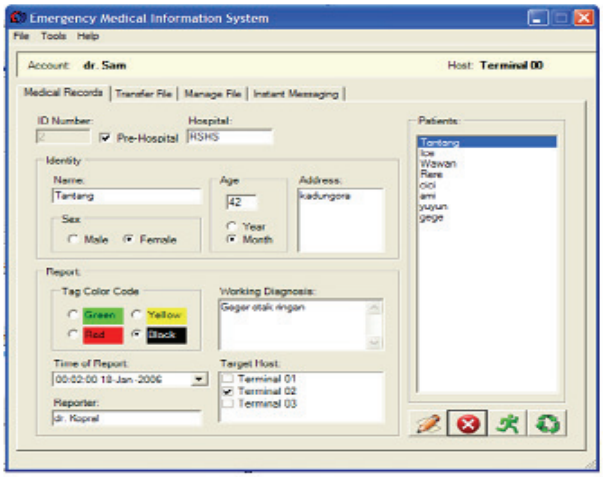

Figure 2 - Main design of EMCIS

In order to focus on how best to support interface design, Westudied the monitoring critical ill patients to find out what kind of parameters that used in emergency room or intensive care unit and suitable for all stages of critical patients. We also collected what is the proper parameter that can be used for live saving and transporting, and what vital sign liked and disliked about critically ill patients. Furthermore we must know when do we have to set the patient in the rest condition of their metabolic system so that the oxygen demand might be in minimum state in order to keep patient a live during evacuation. Using this information, we designed concept to support the core engine for transferring data and making consultation among paramedics in the field and the expert in the hospital. The Clinician that we have discussed has an average of over 10 years experience working with critically ill patient in the intensive care unit or emergency. They work for Hasan Sadikin General Hospital-University of Padjadjaran School of Medicine that focus on areas such as emergency room (ER), intensive care unit (ICU), recovery room (RR), and even operating room (OR). In addition, they have an expert in the critically ill patient caring background.

Almost of the medical staff in that field have the same idea about the parameter for monitoring the patient. The main parameter for the critical patients are chief complaint, level of consciousness, pulse rate, respiration rate, blood pressure (Fig. 4) and location/status of the wound (Fig. 5).

Based on this parameter, the patient will be given tag such as red, yellow, green and black. It is very important because the priority of actions is just depending on this tag. First priority is red tag because this is really critically ill patients and life threatening. Second one is yellow tag where the patient in emergency case but not critical. Green tag is only maybe have a small wound and black is deceased. (Fig. 2).

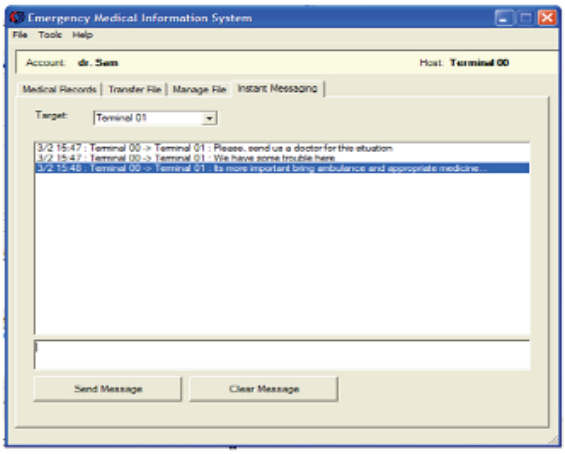

Figure 3 - Instant messaging

During the early stages of interface design we performed the simulation inside the hospital by using radio communication. Some reported that the patient was getting worse hemodynamically or vital sign unstable and then must give the responses and support to the patient. The design that we make based on that simulation so that we made the sketches interface tools, such as multi tab (Fig. 2), and then break down into specific one in every tab. In this part we viewed the general information of the patient (victim) such as identity, report and list of victims. The identity was so simplify in order to make an easy way for data entry during disaster. It only takes a little typing and a click on the box according to the condition. The explanation of interface must be recognized by user as simple as possible and tested with users before building a prototype. In the early stages of design is critical and might be something happen so that simulation must be done as much as possible two or three times a week in emergency room.

A user will interact with the application mostly through forms, so by the simulation hopefully can decrease the error. Whether you are an experienced user or just new comer on using computer, this interface will provide you an easy way for entry data as essential information to the patient, expertise and hospital.

The other facility on this application is instant messaging (Fig. 3). Through this option, paramedics are possible for consultation and transfer file. Even though only small data that can transfer like small size picture but it is very useful on disaster area whereas infrastructure communications collapse.

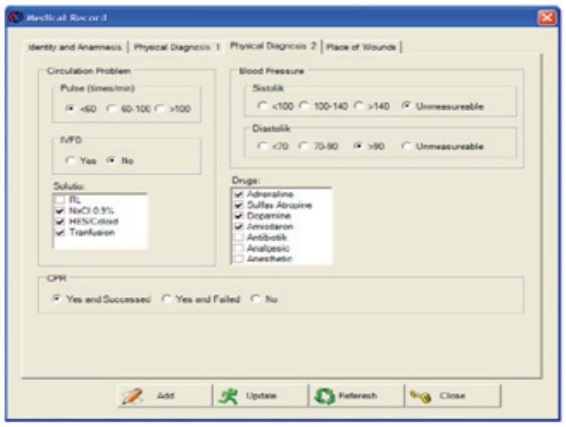

Figure 4 - Physical diagnosis

The other important things are also the actions during the evacuation. After classified into red, yellow and green tag we must do something. For example if the blood pressure decrease, pulse rate increase and location of wound might broken main artery so causing bleeding then we have to give solution and drugs to keep the patient survive. In this case the user is just click the box, what kind of solution and drugs that had been given and then reported to the hospital (Fig. 4). Every patient will have their own data and reported to the referral hospital frequently.

Location of wound in disaster area was needed due to most of the patients are trauma cases. It might have open or closed wound, contusion or fractures, active or occult bleeding so that can describe on the picture by clicking in the box. Every box on the picture represents the main common artery which may cause the active bleeding like on the upper and lower extremities. There is a special case on chest and abdominal trauma because it may cause of massive bleeding even it closed wound. In the chest wound sometimes pneumothorax can happen and it is one of life threatening case so that the paramedics must do something like needle decompression even in the transport (Fig. 5). All organs in the thoracic cavity are related with airway, breathing and circulation which may cause life threatening if we do not do something aggressively.

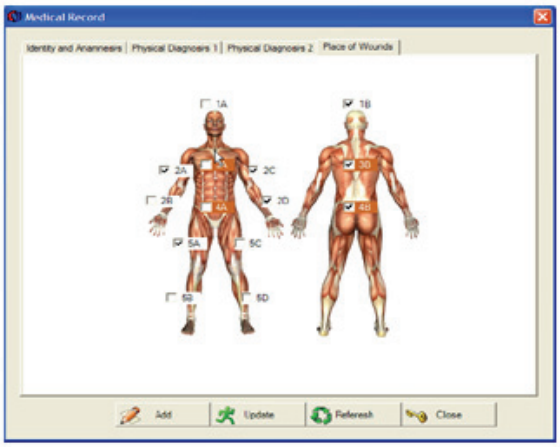

Figure 5 - Place of wound

Discussion

An interface design must reflect both user requirements and a means of communication with the software. A user friendly design is vital as an input maker and each input action will become part of a valued patient database. The interface design component must also be guaranteed to correspond to the bidirectional exchange of communication and data during transport. When interfaces are designed, the composition combines not only user requirements, as the input data maker, but also the environment of critically ill patients. Whatever the patient's condition, they generally have equivalent parameters when life threatening events occur. There are also specific cases, namely head trauma, thoracic cavity trauma and abdominal trauma, where closer attention is vital because if life saving intervention is performed as rapidly as possible, the patient will improve dramatically. For this design feature, a survey was conducted regarding the types of parameter and limitations of the interface design on critically ill patients by performing a simulation evacuation within the hospital. The conclusion was that vital signs, hemodynamic stability and the location of wound/s represent the whole spectrum of patient conditions. The other inputs include therapy while in transit, which can be performed by providing the solutions and/or drugs required in resuscitation. This means a hospital doctor avoids providing over-therapy in solutions or drugs when the patient arrives in the emergency room and will only administer advanced treatment, such as resuscitation surgery, in the event of internal bleeding and/or in an intensive care unit facility. This will allow optimum treatment to be given to patients. Although there are several means of treatment in the hospital, the challenge is how to ensure the patient survives while in transit. With this in mind, the software will be part of pre-hospital care in the field or an medical data information system.

Acknowledgements

The authors would like to thank Setyo Budi Agung, Hariyo Santoso, Andri Qiantori, Samudra Prasetyo from Telkom Risti and Harry Prihanto from BPPT Indonesia for their supporting on this paper.

We would also like to thank Prof. Cissy RS Prawira, MD, MSc, PhD as President Director Hasan Sadikin General Hospital/University of Padjadjaran School of Medicine Bandung Indonesia, and Director Garut Hospital for our survey during research. This research was sponsored by Ministry of Internal Affairs and Communications of Japan and APT as an HRD Program for Exchange of ICT Researchers and Engineers.

Reference

[1] Hasan Taufik, et. al. "Development and Implementation Emergency Medical Care Information System for Disaster Area in Indonesia", Project Completion Report APT, Bandung, Indonesia, July 2005 - March 2006.

[2] James A. Landay and Brad A. Myers, “Interactive Sketching for the Early Stages of User Interface Design” http://www.cs.cmu.edu/~landay/home.html, Carnegie Mellon University, USA 1995.

[3] Martijn van Welie, Gerrit C. van der Veer, Anton Eliëns, “Patterns as Tools for User Interface Design” , http://www.cs.vu.nl/~martijn/gta/docs/TWG2000.pdf , Vrije Universiteit, Amsterdam, The Netherlands, 2000

Address for correspondence

Agung Budi Sutiono, MD
Graduate School of Information Systems
The University of Electro-Communications
1-5-1 Chofugaoka, Chofushi, Tokyo 182-8585 Japan
Email: agungbudis@ohta.is.uec.ac.jp