A Study for the design of a Mobile Medical Care System M-LIMS

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Abstract

About 30% of Mongolian population is populated in the capital of the nation. Too many hospitals are concentrated in size as compared to the capital. This creates a difficult environment to provide equal distribution of medical benefit. In order to resolve this issue of medical benefit inequality, a portable/travelling medical treatment system using 'M-LIMS' is proposed for real-life application. The system with M-LIMS to be designed will include functions such as composing, sharing charts among doctors, standardizing charts. M-LIMS will be designed considering Mongol's regional characteristics, and application plans will be proposed accordingly.

1. Introduction

Recently in South Korea, among Korea's international cooperation assistance efforts for developing countries, Mongolia is getting more attention, in particular, in the area of medical aid. As a result, many volunteer activities have been established and provided. However, considering a high population density in Ulaanbaartor, the capital city of Mongolia, distributing medical aid services has become a challenge for the government. Thus, medical aid and volunteer activities in Mongolia may not be seen as sufficient for beneficiaries living in Ulaanbaartor.[2] To provide a solution for the problem of distributing medical aid services, a new design medical aid system called 'M-LIMS' is proposed on this research paper.

LIMS (Laboratory Information Management System) is an automated system used in large laboratories enabling an increase in the area of work efficiency and scientific quality control through the establishment of laboratory information database.[4, 6] M-LIMS is a mobile hospital providing portable medical treatment services. M-LIMS is a system used for offering medical services by visiting a local region with a vehicle installed medical equipment.[1-3, 5]

The authors of this paper propose a high-quality medical aid using a portable technology to other regions in Mongolia and thus move beyond the limitation of medical aid services of the nation, that is centered around the capital city. In doing so, the authors first analyze the basic information, present conditions, and current

system of medical care of Mongolia, and then propose a new design of M-LIMS matching the current circumstances of Mongolia. Lastly, the authors predict the operation of M-LIMS for the entire nation.

2. Research method

2.1 PRESENT CONDITION OF MONGOLIA'S MEDICAL CARE SYSTEM

Mongolia's medical institutions can be classified into the three categories; basic medical institutions (Primary), specialized institutions (Secondary or Tertiary), and private medical institutions.[2] Primary medical institutions are the ones that offer an essential medical service for the settlement of overriding health problem. In the cities of Mongolia, medical services are provided by a private medical care provider called FGP (Family Group Practice), while in the rural areas, Soum Hospital or Intersoum Hospital, provides medical service. Table 1 is a comparison of the system of primary medical treatment between the city and the rural areas.

Table 1. Health care system between city and rural

Category	City	Rural
Agency	FGP(Family Group Practice)	Soum / Inter-soum
Operation	contracting-out	Public
Service and care	Outpatient, Maternity Essential prescription drugs, Inspection Review Visit care, Referral treatment, ETC	Acute illness, Wide range of services than FGP Transport and treatment of patients hospitalized, Associate Medical doctor visits
Facilities and personnel	3-6 people physician Doctors per nurse one people Located in the community	15-30 beds 0-3 or more doctors Doctors in standard seven soum in 2007
Distribution Rate	71.82%	Low utilization

FGP is operated in the private sector, and recognized as a private profit-making corporation. There is yet any articles clearly defining the legal functionality, and is currently growing through governmental support. The rural regions have problems including low receptive capacity, low level of service, geographical barriers, lack of medical professionals compared with the hospitals in the city.[2]

Specialized medical institutions (Secondary or Tertiary) include maternity hospitals, national hospitals, and regional hospitals. Most of the specialized institutions and foreign medical institutions practice medical services are located in the capital city of Ulaanbaator. Such specialized institutions are difficult to locate in other small cities and rural areas of the nation.

2.2 M-MIMS Composition

It is hard to say that the medical service is equal between the capital city and the other regions. High-quality medical service practiced in the capital city is implemented in each region to solve the problem. It is about building mobile hospital equipped with various medical devices for the medical treatment of patients.

Considering high concentration of medical service providers in the city, it is not difficult to say equal distribution of medical care service provided between in the capital city and in the other rural regions. As a solution, a high-quality of medical services practiced in the capital city can be implemented in the remote

areas as well using a portable technology via a moving vehicle. It is about building mobile hospitals equipped with various medical devices for the medical treatment of patients.

Figure 1. Mobile Hospital Vehicles

Figure 1 shows the mobile hospital vehicles. The mobile vehicles equip medical devices and treat patients of various regions in Mongolia. The purpose is to reduce inequality gap of medical service between each regions through the activity. The causes of major diseases and deaths are analyzed, and equipment appropriate for the local condition is composed for efficient medical treatment.
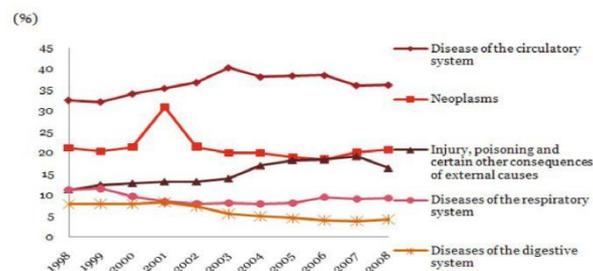

Figure 2. The Main Cause of Illness and Death Mongolian People

Figure 2 shows leading causes of deaths of Mongolian citizens. Causes such as respiratory disease, tumor, and injury appear to be the leading causes of disease and death. Installment of medical equipment and implementation of efficient medical treatment can be done through use of the data measured for patients.

Table 2. Equipment Configuration System

Equipment name	Purpose	Size(W*L*H) (mm)
NET-3000D	Ear, nose and throat Simultaneous treatment	1773*667*829
NET-1500A	Electric Chair	740*600*1340
NET-280B	Imaging equipment	210*230*220

Equipment shown in the Table 2 can be installed in the mobile vehicles. Then, a software supporting the medical treatment of patients by specialists including doctors and nurses can be installed. The software extracts data by interlocking with each medical device and makes a patient's chart on the basis of the patient's previous data. Written charts are transmitted to the central server for storage. Charts recorded on the server are facilitated for browsing by other doctors. Medical support can be given to each patient via a clinical conference with specialists in another hospital via a video communication device through satellites.

2.3 M-LIMS DESIGN
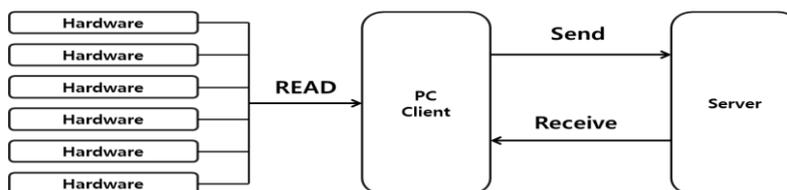
Figure 3. A Configuration of The M-LIMS

M-LIMS can be viewed separately in connection with hardware and client, and client and server. For PC Software data of medical devices are collected through connecting USB/RS232 cable. In client, the data collected from each device is printed out to the users in the form of test results of the relevant devices. The printouts are transmitted to and stored at the main control server through additional input of the user. The results are transmitted to the main control server, saved at the database, and notified to the user.

2.3 M-LIMS FUNCTION

The function of M-LIMS include composition of patient's chart, storage of chart through its main control server, search and share of patients, and a clinical conference utilizing video communication devices.

Composition of patient's chart starts from data collection by medical devices. The status of patient is examined utilizing medical devices, and a result can be printed out to each user by transmission to client. Each user can see the examination result data, draw out a conclusion, and record a patient-related information on client. In addition, the user can record the coordinates where the medical treatment was done through GPS device.

Charts about each patient can be synthetically recorded on the main control server. The charts are transmitted and recorded to the main control server after the completion of medical treatment of a patient at the mobile hospital. The authority of the transmitted charts can be adjusted to provide the medication prescribed by the administrator and the relevant user.

Other users may browse the recorded charts of patients on the server in case that a patient uses other mobile hospital vehicles. The necessary information for the medical treatment of patients such as the name of a disease, visitation date, and prescription can be adjusted via browsing by other users.
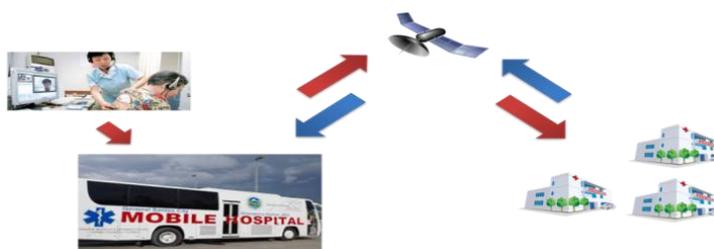
Figure 4. Clinical conference system

In providing medical treatment services with patients, it becomes necessary for a team of doctors more than one particular area of expertise to visit patients. In such cases, patients can be treated through clinical teleconferencing by the in-house specialists and outside hospital personnel using video communication devices installed in the vehicle.

2.4 EXTERIOR STRUCTURE

Figure 5 shows the exterior and the interior blueprint of M-LIMS. The doctor's office can be set up at the space behind the car, and medical equipment are installed in the space. The equipment is   utilized by selecting a specific area of medical treatment rather than utilizing various equipment for the enhancement of spatial efficiency.

Figure 5. Exterior and Interior View of The M-LIMS

2.5 UTILIZATION METHOD

Several conditions should be confirmed before the utilization of the mobile medical treatment system M-LIMS. Confirmation on the area distribution consisting more than 100 thousand population except the capital city should be done. Administrative districts consisting more than 100 thousand population are Bayan-Olgii, Khovsgol, Selenge and Ovokhangal. Mobile medical treatment will be practiced from the populated administrative districts by utilization of M-LIMS. During times of operation, confirmation on the smooth conversation is required through composition of specialists proficient in the local geography, climate, and language of administrative districts.

3. RESULT and DISCUSSION

The authors of this paper discussed about the composition and design of mobile medical treatment system utilizing M-LIMS to provide a high-quality of medical services to many regions other than the capital city. We propose the above system by implementing medical treatment services by loading medical equipment on the vehicle, which can be called a mobile hospital. The functions of the system include the composition of patient chart, chart sharing, and telemedicine through satellite communication. Several considerations should be made before the utilization of the system including distribution of population, analysis of major diseases and area of originated disease, and a living climate of a patient under treatment.

References

[1] K.S. Yang, S.S. Park, K.W. Koo, "Import quarantine for supporting local fisheries 'M-LIMS' Analysis and Design," *Proceedings of the Korean Society of Computer Information Conference*, Vol. 22, No. 2, pp. 433-436, 2014.

[2] K.S. Yang, S.S. Park, K.W. Koo, "Mongolia Medical Assistance 'M-LIMS' Design and Analysis," *Proceedings of the Korean Society of Computer Information Conference*, Vol. 22, No. 2, pp. 437-441, 2014.

[3] K.S. Yang, J.Y. Chea, K.W. Koo, "'M-LIMS' design for Quarantine Fisheries and interworking with smartphone," *KIEE autumn conference*, pp. 244-245, 2014.

[4] J.H. Kim, W.I. Kim, D.H. Hwang, "The Development of LMS/LCMS that Supports Real-time Interactive Video Contents," *Proceedings of the Korea Society of IT Serviecs, autumn conference*, pp. 463-468, 2010.

[5] Yunseong Nam, Design of Learning management System Interconnection Model for University e-learning Group.

[6] Doo-Young Min, The Comparison and Evaluation of Learning Management Systems based on Open Source Software.