ABSTRACT

This paper describes our development activities of an ICT-based e-health system for community healthcare, consisting of five stages: system design and development, human resource development, e-health system realization, laboratory & field tests and implementation of the e-health system, as well as the follow-up actions. Initially, some e-readiness evaluations (for the medical personnel in two community health centres) were conducted, through a number of field visits and questionnaires. The results had been used in the e-health system design & development, installation of the internet access infrastructure, and implementation of the education & hands-on training for the medical & administrative staff of the healthcare units. All the staff members of the targeted healthcare unit have completed a series of hands-on training on personal basis, required for operating the ICT-based e-health system.

After completing the e-health system design & development as well as system realization and laboratory tests stages, a series of field implementation and experiments have been successfully conducted. A number of users’ feedbacks have been obtained and used for further improvements on both software and hardware modules. The e-health system with integrated e-prescription module has shown its expected functions in: patient registration, medical record, paperless prescription, and producing the required reports. Further follow-up actions (in the forms of continuing education and technical supports) are required for sustainability of the ICT-based community healthcare e-health system. When the ICT-based e-health system could be implemented in more and more community health centres in Indonesia, it is expected that in the long run, the community healthcare will be gradually improved, thus to contribute towards achieving the MDGs, especially in healthcare.

I. INTRODUCTION

The ICT-based e-health system with integrated e-prescription for community healthcare has been designed for community healthcare providers to utilize the information and communication technology in supporting their daily community healthcare activities and services. Additionally, the e-health system with integrated e-prescription module is also expected to reduce possible medication errors that most frequently exist, in case of adverse drug events. A series of education & hands-on training for the healthcare providers (medical & administrative staff) should be conducted. To be ready for operating the e-health system, each healthcare staff has to successfully completed various training activities, that include:
basic computer usage, utilization of basic word processing, spreadsheet, and presentation software packages (to prepare daily and monthly reports), and basic internet usage (browsing, email, chatting). All the healthcare providers (medical and administrative staff) should also complete the hands-on training on how to operate the “ICT-based e-health system with integrated e-prescription for community healthcare”. The following functions should be thoroughly covered: system initialization, patient registration and retrieval, preparation of patient medical record and paperless prescription, medicine (drugs) preparation, medicine data management, and preparation of various types of medical reports, printing and sending of those reports regularly to the district level health office.

E-Prescription (or electronic prescription) module is a tool for prescribers to easily & safely prepare and electronically send an accurate, error-free and understandable prescription directly to a pharmacy unit from the point-of-care (medical examination unit)\(^1,3\). In a July 2006 report, the Institute of Medicine estimated that about 800,000 adverse drug reactions occurred annually in the U.S. long-term health care facilities at a cost to hospitals of $3.5 billion a year\(^2,3\). It is believed that similar cases also exist in Indonesia, although there is no quantitative data reported on Adverse Drug Event (ADE) yet.

II. ICT-BASED e-HEALTH SYSTEM FOR COMMUNITY HEALTHCARE

In general, the “ICT-based e-health system with integrated e-prescription for community healthcare” has been designed to be used in a community health center (CHC). It consists of a specially developed web-based software package which has the following main functions: to do recording of patient data (patient registration), to prepare medical record (during medical examination phase) and paper-less prescriptions with ADEs alert, to prepare the prescribed medicine (drugs) for each patient, and to prepare different types of patient and medicine regular reports, and to send the appropriate reports to the District Health Office as needed. By using the “ICT-based e-health system with integrated e-prescription for community healthcare”, it is expected that in the long run, the following advantages could be achieved:

- to improve the efficiency of the healthcare services
- to reduce the average processing time in general
- to reduce processing time for preparing/producing different types of regular reports
- it is also expected that healthcare services could be further improved.

![Fig. 1 Simplified block diagram for minimum system](image1)

![Fig. 2a. Simplified block diagram for medium system with 2 PCs connected in peer to peer](image2)

![Fig. 2b. Simplified block diagram for medium system with 3 PCs in a LAN](image3)
The “ICT-based e-health system with integrated e-prescription for community healthcare” can be implemented in either one of the following hardware configurations: minimum, medium and full size. Figure – 1 shows a minimum e-health system configuration consisting of one PC, Figure – 2a shows a medium e-health system size/configuration consisting of 2 PCs/laptops – peer to peer connected, and Figure – 2b shows a medium e-health system configuration with 3 PCs/laptops connected in a local area network (LAN). A full size system configuration needs at least 6 PCs (laptops or Net stations) in a LAN is shown in figure – 3.

![Simplified block diagram for full system needs at least 6 PCs in a LAN](image)

**III. DEVELOPMENT AND IMPLEMENTATION ACTIVITIES**

Five different development and implementation activities will be briefly described in this section. The various possible e-health system configurations are expected to cater for the existing Community Health Centres with different infrastructure and computer facilities.

3.1. Evaluation (Questionnaires)

Initially, some e-readiness evaluations (of the medical personnel and healthcare unit) had been conducted, through a number of field visits and distributions of questionnaires.

3.2. Preparation Activities (Internet access and Education & Hands-on Training)

The results of the e-readiness evaluations were used in the e-health system design & development, installation of an ADSL internet access infrastructure, and education & hands-on training for the medical & administrative staff of the healthcare unit. All the staff members of the healthcare unit have completed a series of hands-on training on personal basis, required for operating the ICT-based e-health system. After completing their hands-on training activities, the healthcare providers are encouraged to continuously improve their computer competency by accessing a specially developed Facebook account “Computer and eHealth Learning” [Belajar Komputer dan eHealth].

3.3. Development of ICT-based e-Health System with Integrated e-Prescription for Community Healthcare

The web-based software package has been developed using open source software (XAMPP from www.apachefriends.org) and presented in Bahasa Indonesia (Indonesian language) to
facilitate healthcare providers in using this program without problem. Figure – 4 shows a screen shot of the main page.

Fig. 4 Screen shot of ICT-based e-Health System with Integrated e-Prescription main page

3.4. Laboratory Experiments and Clinical Trials

On completion of the e-health system realization and laboratory tests, a series of field implementation and experiments have been successfully conducted. A number of users’ feedbacks have been obtained and used for further improvements on both software and hardware modules. The e-health system with integrated e-prescription system has successfully shown its expected functions in: patient data registration & retrieval, medical record, paperless prescription, and producing the required reports.

3.5. Follow-up Actions and related Community Education

Further follow-up actions (in the forms of continuing education and technical supports) are required for sustainability of the ICT-based community healthcare e-health system. A screen shot of the Facebook account for “Computer and eHealth Learning” is shown in figure – 5. The account has been developed and maintained by the research team members.

Fig. 5 Screen shot of the Facebook account for Learning and Information sharing on “Computer and eHealth Learning” (Belajar Komputer dan eHealth)
Another Facebook account to attract and facilitate the community in improving their knowledge and to do information sharing on “Pharmaceutical Products, Food and Cosmetics” has also been developed. Figure – 6 shows a screen shot of the particular Facebook account.

Fig. 6. Screen shot of the Facebook account for public, Information Sharing on Pharmaceutical Products, Food and Cosmetics (Obat Makanan dan Kosmetik)

IV. CLOSING REMARKS

The “ICT-based e-health system with integrated e-prescription for community healthcare” has been successfully developed and implemented in CHC. The system can be implemented in a CHC that has only one PC for minimum system configuration, 2 or 3 PCs for medium system configuration and at least 6 PCs are needed for full size system configuration. When the ICT-based e-health system could be implemented in more and more community health centres in Indonesia, it is expected that in the long run, the community healthcare will be gradually improved, therefore they are expected to contribute towards achieving the MDGs, especially in healthcare.

V. REFERENCES