Development of A Simple e-Health System
for Tuberculosis Management
at Community Health Center Level in Indonesia

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Abstract: **This paper describes a preliminary development of an Internet and mobile phone-based e-health system for Tuberculosis (TB) management in a Community Health Center (CHC) or hospital. A standard DOTS (Directly Observed Treatment Short-course) strategy is applied to support the diagnosis and therapy of the TB patients in Indonesia. Unfortunately, the number of TB prevalence is still relatively high, perhaps due to the relatively high percentage of patients with uncompleted therapy. Such cases are caused by several factors, for example: "healthy feeling" before completing the therapy, not taking regular medicine as required, not attending regular medical visit, and possible drug side-effects.**

Basically, the TB management e-health system under development includes measurement, recording, evaluation, reminder and reporting functions. The system consists of: personal computer (PC), simple digital microscope, patient database software, SMS (Short Message Services) gateway software, and telecommunication module. The digital data is saved in the web-based patient database for further information retrieval and education purposes to improve diagnosis quality of TB. The system can also send 16 SMS reminders to the patient for taking the medicine or attending medical visit during 6 months. Moreover, the patient can do remote TB consultation through her/his mobile phone using the SMS facility.

The system can also be further developed for tele-consultation to a Pulmonologist or other medical specialist in the referral hospital. Therefore, the Internet and mobile phone-based e-health system for Tuberculosis management is expected to increase the number of TB patients with completed therapy and to improve the quality of health services.

Introduction

Tuberculosis (TB) is a chronic infectious disease by Mycobacterium tuberculosis, and is still currently a major problem for health community in Indonesia. The Standard DOTS (Directly Observed Treatment Short-course) has been applied to support the diagnosis and therapy of TB patient in Community Health Center (CHC) and Hospital[1]. Unfortunately, the prevalence of TB is still relatively high. The Case Detection Rate (CDR), both new AFB (+) and relapse TB cases, tend to increase year by year[2], perhaps due to the relatively high percentage of patients with uncompleted therapy. The following factors have been considered, e.g.: "healthy feeling" before completing the therapy, not taking regular medicine as required, not attending regular medical visit, and possible drug side-effects[1].

To assist the TB patients, in general, each CHC usually has a simple laboratory unit, with limited medical personnel and medicine facility. In this research we develop a preliminary prototype of an Internet and mobile phone-based e-health system for TB management in a CHC or hospital. The main objective of our ICT-based e-health system development is to improve the existing TB management, so that the number of TB patients with completed therapy could be significantly increased.

System Development

Basically, the TB management e-health system under development includes measurement, recording, evaluation, reminder and reporting functions. Figure 1 shows the functional block diagram and Figure 2 illustrates the block diagram of the simple e-health system for TB management.
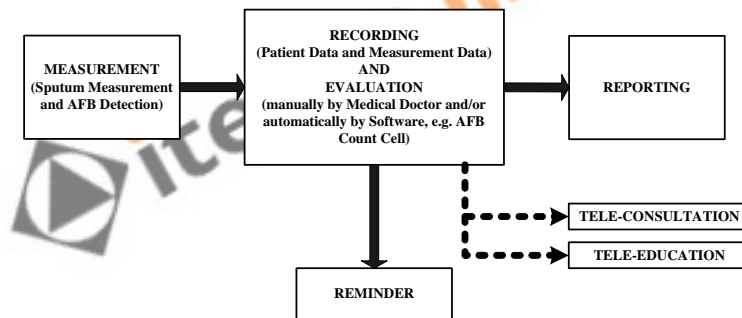

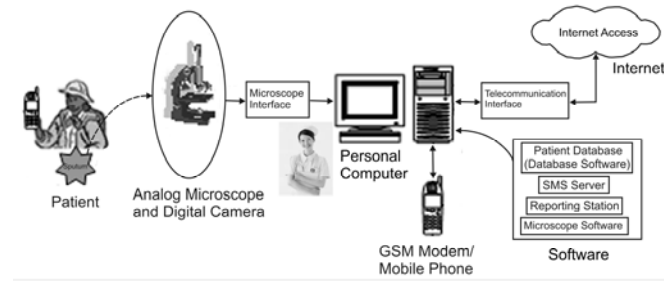Figure 1 Functional Block Diagram of the Tuberculosis Management e-Health System

Figure 2 Block Diagram of Simple e-Health System for Tuberculosis
Management at Community Health Center Level

The functional block diagram describes main and additional functions that can be achieved by the system. To implement all of the functions, the system consists of: personal computer (PC), simple digital microscope, patient database software, SMS (Short Message Services) server software, telecommunication interface and mobile phone.

A simple digital microscope is currently being developed from an analog microscope, digital camera or webcam and PC with appropriate microscope (image processing) software and interface; it is used to detect the Acid-Fast Bacteria and to capture patient's sputum in digital form. We have detected the Bacteria using analog microscope with 1000 times magnification. The sputum has also been captured using the webcam with an existing shareware tool and manually using a digital camera. The two examples of sputum smears in digital format, captured by a webcam and a digital camera respectively, are shown in Figure 3 a and b respectively.
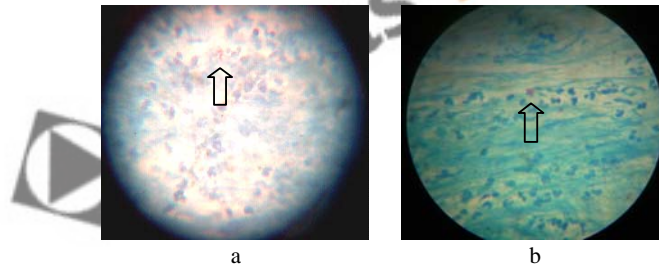

a   b

Figure 3 Examples of sputum smears captured by
a webcam (a) and a digital camera (b)

The digital data is saved in the web-based patient database for further information retrieval and educational purposes for the medical personnel. The steps are expected to indirectly improve the TB diagnosis quality in the future. The system can also be used to report to the Health Office Centre through the Internet, to inform medicine supply and the epidemic in the coverage area of the CHCs. Based on the information, the Health Office Centre can make an appropriate fast decision.

The system can also send 16 SMS reminders to the patient for taking the medicine or attending medical visit during 6 months. The patient will receive 8 SMS reminders during intensive care period in the first 2 months and additional 8 SMS reminders during the last 4 months. Furthermore, the patient can do remote TB consultation through her/his mobile phone using the SMS facility. A medical doctor in a CHC can also conduct a TB tele-consultation to a medical specialist in the hospital through the internet[3].

Final Remarks

The system can be further developed for tele-consultation to a Pulmonologist or other medical specialists in the referral hospital.   This application is required for obtaining a second opinion to improve the diagnosis quality of Tuberculosis.   Therefore, the Internet and mobile phone-based e-health system for Tuberculosis management is expected to increase the number of TB patients with completed therapy and to improve the quality of their health care services.

Acknowledgment

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