

Web-Based Application of Community Health Center (*Puskesmas*) for Patient Electronic Medical Records

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ABSTRACT

This research provides the design and implementation of a web-based software application of Community Health Center/ CHC (*Pusat Kesehatan Masyarakat = Puskesmas*). The application is mainly used for recording patient's personal identity and medical treatment at medical services (polyclinics) of CHC. Generally, the polyclinics at *Puskesmas* provides are General Medical Treatment Service (*Poli Umum*), Maternal and Infant Service (*Poli Ibu dan Anak*), Dental Service (*Poli Gigi*), and Drug Service. With the application, all data of patient's personal identity and medical treatment at medical services of *Puskesmas* are recorded and integrated in an attempt to create an accurate report based on the reporting format standard set by Ministry of Health, Indonesia. Furthermore, on technical side, the application is built up with open source-based technology, so a license is not required to use it. Relational Database Management System, MySQL, Apache web server and PHP are aids software which is operationalized to initially implement the system. On the other hand, to implement the application a web browser is needed. The application is equipped with user authentication, That is used to ensure that the application is accessed only by appropriate medical personnel. Users categorized in administrator level have a higher authority than the ones categorized as operator. In fact, the application has been implemented at some of CHCs in Depok Municipality. Moreover, the initiative of the application has been developed for infant malnutrition surveillance. Some of the data obtained from *Puskesmas* are going to be seriously followed up to make effective decisions to take curative actions on infant malnutrition cases.

Keywords

Community health center, web-based application, medical record, recording, reporting

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1. INTRODUCTION

Community Health Center (CHC) or we call it *Pusat Kesehatan Masyarakat* or *Puskesmas* is a unit of health organization and a center of development, which conducts establishment and provides services of community health improvement in its area with an integrated and a comprehensive characteristic [1]. CHCs take a part in Indonesian Perspective of Health Development for actualizing Healthy Indonesia 2010. The services belonging to CHC play the most important role in public health services. These major services are General Medical Treatment Service (*Poli Umum*), Maternal and Infant Service (*KIA*), Dental Service (*Poli Gigi*) and Drug Service (Pharmacy). A general medical treatment service provides medical treatment for patients in general requesting healthcare services. Maternal and Infant service provides medical treatment for mothers before and after pregnancy and babies below five years old. Medical treatment for dental care facilitated by Dentistry and Pharmacy Polyclinic provides drug prescription from all the services. The main activities at CHC are making patient medical records and reporting them with a system. Patient Data Recording and Reporting system (*SP3 = Sistem Pencatatan dan Pelaporan data Puskesmas*) is a regular report from CHC to the higher-level officials (i.e. District Health Office).

The traditional paper-based medical card recording and reporting system has inherent limitations. The missing card and redundant patient data card recording frequently occur in many CHCs. Even when the card is available, poor organization, illegible handwriting and too many patients to serve may result in time-consuming, laborious and incorrect retrieval of data. The development of a web-based application at CHC enables us to use computer technology for medical services. The aim of this research is to develop a web-based application for recording and reporting CHC data. The system has the following functional specifications:

- This application serves the function of CHC services including General Medical Treatment Service, Maternal and Infant Service, Dental and Pharmacy Service. The recording and reporting functions are each conducted by a separated module.
- A recording module is used for recording patient identity data and patient medical treatment data.
- A reporting module provides an automatic initiation of CHC medical data report, presented either on daily, weekly, monthly, or annual time period manner, and

depends on the option chosen from software's menu package.

Additionally, the system is supported by SP3 and the patient medical records can be used for other research. The research is a part of retrospective observation in which patient medical records at a number of CHCs are collected and analyzed in an effort to do surveillance of infant malnutrition at the areas around CHCs.

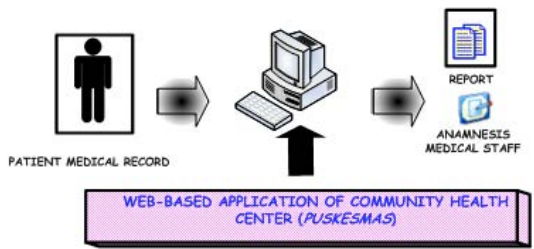


Figure 1. Simplified block diagram of web-based application.

2. METHODS

2.1 Concept of Puskesmas

National Health Survey (Survey Kesehatan Nasional) indicates that the number of Puskesmas over Indonesia reaches 7.277, including Puskesmas at regency level, sub-district level and village level. The Survey, moreover, shows that over 30 percent of Indonesian population use Puskesmas to get medical services[2]. This fact illustrates that Puskesmas is the first medical service which majority of people in Indonesia can get access to, especially those living in rural areas. Puskesmas at village level simply offer basic services, i.e., General Medical Treatment, Maternal and Infant, Dental and Drugs Services. Meanwhile, those established at regency and sub-district levels provide more varied and complete services, including the inpatient and childbirth facilities and specialist practice [2].

Nowadays the results of the patient medical treatment, including physical and anamnesis treatments, at majority of Puskesmas in Indonesia are recorded in certain patient books. Medical staffs, then, diagnose the patient according to the recorded result of the treatment and decide a proper therapy as well as make appropriate prescription that in turn will be prepared by drug service (drug store). The recording patient book is useful to track down patient medical records. In addition, the book is helpful to record and keep patient medical treatment at all services of Puskesmas.

2.2 Web-based Application

The advancement of computer technology opens a room to create and enhance web-based computer application. It was stated that web-based application has several advantages[3]:

- ✓ Web-based computer software makes it possible to create GUI-based application software (*Graphical User Interface*) with more user-friendly appearance and operation.
- ✓ Web technology is designed subject to network standard protocol such as TCP/IP and HTTP. This makes the application working in the computer network system perform more easily.

Web-based technology is set up on the basis of three fundamental components which are database, middle ware, and web browser components. Each of them has its own role to operationalize the application. In order to activate a web-based application through browsing a server site, a web browser is needed. Besides, every component within a web-based application requires an application builder to make the application work properly. Figure 2 presents web-based application architecture equipped with the application builder which functions as an open source[4]. It also can work within a PC or an intranet network. The use of open source application makes it possible to create an economical application since it doesn't require a license.

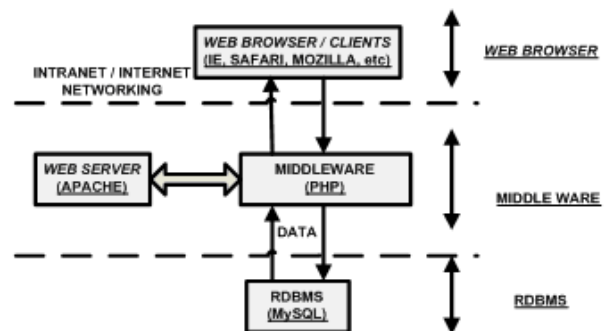


Figure 2. Web-based application structure.

Web-based technology applies multi tier application in its operation. It is an application divided into several elements with their own functions that work together to run the application. Generally, multi tier application includes three primary aspects:

- a) **Client Side Presentation**
Client side presentation regulates how an application interacts with its user. Particularly, Client side presentation regulates how data, functions and features of the application are presented.
- b) **Server Side Business Logic**
Server side business logic, known as middle tier, is one of the application elements that plays an important role in how the application works. Within the application, server side business logic is in charge of making sure that functions and features of it work effectively.
- c) **Back End Storage**
This element is responsible to regulate data storage, which is complex material in the establishment of application. To cope with this complexity of database, some solutions are available. One of the solutions that majority of the application users choose is Relational Database Management System (RDBMS). Data storage management is conducted with Standard Query Language (SQL).

Database is a core element in establishing application software. In particular, it has a significant role in documenting data into a system. It was stated that database is a set of inter-correlated data saved within computer hardware, and computer software is required to process them. The ultimate goal of data processing within database is to enable to retrieve saved data/information easily and quickly[5].

Database management physically is conducted with assistance of specific software known as Database Management System

(DBMS). The software determines how data are organized, saved, converted and retrieved. Additionally, it enables data security, data consistency, and data share.

3. RESULTS

A web-based application used as a recording and reporting system at Puskesmas is set up with assistance of aid software called DBMS MYSQL with system editor of MySQL-Front. The software complies with *Structured Query Language* (SQL) standard which has flexibility in the development of *client-server database*. Figure 3 illustrates structural menu of a web-based application used at CHC.

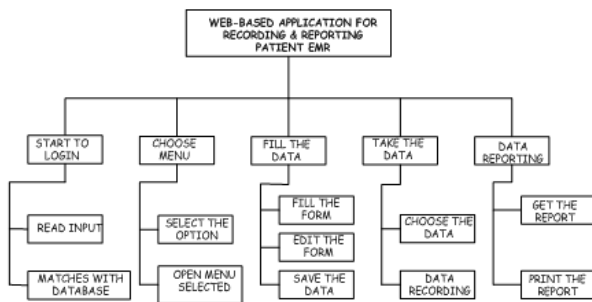


Figure 3. Structural menu of a web-based application at CHC.

3.1 Context Diagram

Context diagram is known as Data Flow Diagram Level 0 which is fundamental basis of a system model. It is an initial arrangement of Data Flow Diagram reflecting a global system in which external entity interacts with the internal system[6]. The following is a context diagram for a web-based application at CHC.



Figure 4. Context Diagram

3.2 Data Flow Diagram

Data Flow Diagram functions as an aid appliance of the advancement of a system comprising several levels based on their complexity or depth. It is always included in the application in that it has particular features that can explain that a system is a complete entity and avoid ambiguity. Data Flow Diagram Level 1 (N=1) is an elaborate construction of Context Diagram. Process Specification (PSPEC), on the other hand, is the illustration of all processes within DAD and data dictionary involved within it[6].

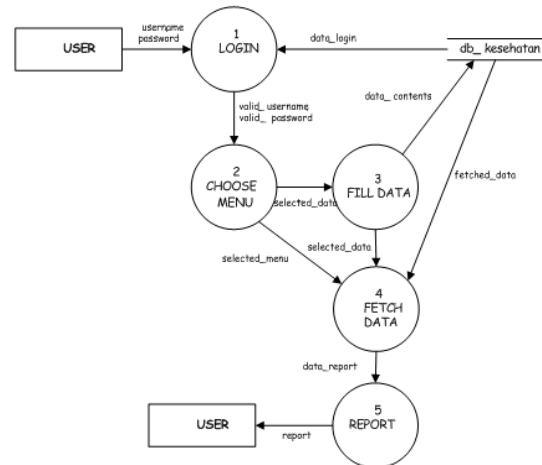


Figure 5. Data flow diagram level 1 (N=1)

3.3 E-R Diagram & Application Structure

Entity-Relationship Diagram (ERD) is a conceptual model describing relation among data within data storage on the basis of perceptions in a real life that consists of a number of objects known as entities and relation among the objects. The diagram is used to model a data structural organization and connection among data[6].

Application structure is designed in an attempt to illustrate the whole processes that take place within the system and the connection among the processes. The structure is known well as control hierarchy. Figure 6 obviously shows structure of a web-based application incorporating application structure.

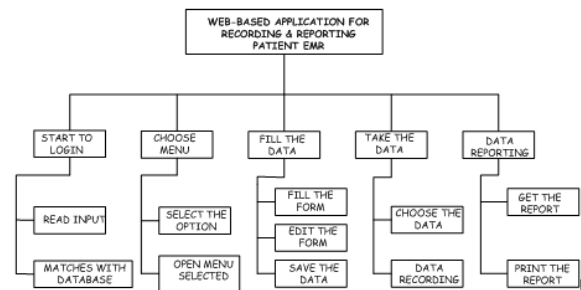


Figure 6. Structure of web-based application incorporating application structure at CHC

Application is made in the form of coding and scripting at each edge of multi tier application. The application which is already made is ready to be operationalized with assistance of computer machine that works independently (desktop) or the one working within a network (networking). Below are application menus along with their functions:

1. Data Master Menu; it functions as an instrument to do administrative purposes and this can only be done by an application administrator.
2. Registration Menu; it functions as a tool to register a new patient coming to get medical services at Puskesmas. It consists of initial data of patient medical treatment.

3. General Medical Treatment Menu; it functions to provide application users with General Medical Treatment services. Patient data is taken according to number of medical examination card directly connected to patient card.
4. Maternal and Infant Menu; it functions to give medical services to pregnant mothers and children. Within it are sub-menu of Mother Anamnesa, Maternal Treatment, Infant Treatment, Child KMS which all are integrated with Data Reporting.
5. Dental Treatment Menu; it functions to provide users with dental treatment services and is used as a recording instrument of patient dental treatment at Puskesmas.
6. Drug Menu; it is used to record and report drug flow at Puskesmas.
7. Log Out Menu; it is used for a user to end an application operation.



Figure 8. Face appearance of a web-based application at CHC

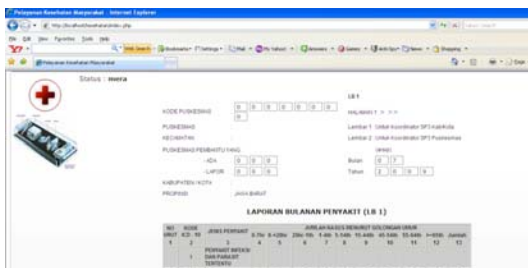


Figure 9. Face appearance for reporting menu

3.4 Security System

Security and privacy are among the most critical problems of patient data identity and medical examination data recording. The main security mechanism implemented in this software is user authentication, which is used to ensure that only appropriate medical personnel access the software. This is done by having the input page dynamically created only after the user name and a valid password has been verified by the system based on registered records in the login table of software database. Users can be categorized into an administrator level and an operator level. Users categorized in administrator level have a higher authority than the ones categorized as operator. The firewall of the computer server is used to increase data and application security.

3.5 Software Application Testing

Software testing is conducted through several experiments on system verification, carried out both in laboratory (laboratory testing) and in CHC (field testing) using advanced computerized instruments using intranet networking. Once testing of software

application is done, testing of data is conducted. This is done toward all application menus. The following is a parameter of data testing:

- A. Data addition testing (add)
- B. Data editing testing (edit)
- C. Data deletion testing (delete)
- D. Data abortion testing
- E. Data saving testing
- F. Data security testing (*security*)

During the testing phase, we encountered several significant problems to be evaluated and solved. Those tests were carried out by utilizing the real data from CHC and the shortcomings of these tests were a lot of incomplete data.

3.6 Hardware & Software Specification

Hardware specifications used to construct, operationalize, and test a software application include:

- CRT Monitor
- CPU with specifications: Processor 3 GB, Memory 1 GB and Hard Disk 80 GB
- Keyboard and mouse
- Printer to print a report
- Intranet modem to connect to the Intranet

The above specifications are the optimum specifications required. Meanwhile, functions and specifications of computer software which are prerequisites for constructing, running and testing the web-based application at CHC are described in detail below :

Table 1. Specifications of computer software

Operating System	MS Windows XP
(DBMS)	MySQL 5.0, MySQL-Front 2.5
Web server	Apache 2.0.50
System establishing Software	HTML, PHP 5.0.1, Javascript with editor of Macromedia Dreamweaver MX
System running software	XAMPP Windows Version 1.7.1
Web browser	Internet Explorer, Mozilla, Safari
Data Output Format (Report)	- .xls (Microsoft Excel) - .htm (Hypertext) - .bmp (Bitmap)
System Functions	<ul style="list-style-type: none"> ▪ To record identity of patients getting services at General Treatment, Maternal and Infant, and Dental Clinics of Puskesmas and those getting drug service at Puskesmas. ▪ To record patient medical treatment at General Treatment, Maternal and Infant, and Dental Clinics of Puskesmas ▪ To create standard reporting of medical services at all Puskesmas clinics. ▪ To make report files complying with standar reporting format set up by Health Center Service (in .xls & .bmp formats).

4. DISCUSSIONS & CONCLUSIONS

From the field testing phase mentioned above, we found the fact that most of the users (or medical personnel) were in general not familiar with the computer. This problem could influence a problem such as most of CHC personnel have difficulties on utilizing this system for CHC services. A number of users' training workshop need to be conducted to solve the above mentioned problems. Moreover, we provide supports for assisting CHC daily activities especially in using web-based application for CHC.

Lack of computer unit at Puskesmas, moreover, brings a problem of implementing the application in an actual environment. Ideally, all polyclinics of Puskesmas must be integrated with support of the web-based application system connected to one another with the intranet network. However, due to the lack of computer unit at Puskesmas, the application isn't implemented yet. There is a need for CHC personnel who are always ready to record and report patient medical record using web-based application.

In this paper, the web-based application of patient electronic medical record in CHC has been presented. Considering the above-mentioned explanation, we can draw the following preliminary conclusions that from the encouraging results of the field-testing and evaluation, it is believed that the implementation of the system may increase the efficiency of CHC personnel work performance. The system is expected to be installed and implemented in more CHCs especially in Depok Municipality for helping to record and report patient medical data with regularly reports because there has been no software developed to be implemented on recording and reporting patient medical records of CHC.

A final outcome of the system is web-based application software used at all polyclinics of Puskesmas to electronically record integrated patient medical treatment. Besides, the software is highly likely to support eHealth which is an ICT application that affects health sector[7]. According to Supriyatno and Romzi[8], eHealth an enterprise solution in health sector since it involves many elements of society, ranging from drug consumer to drug producer/manufacturer. A recording system of patient medical treatment is a fundamental part of eHealth. EMR enables medical record sharing within intra- and inter-health institutions (hospital, Puskesmas, etc.). the web-based application software is run with support of open source technology, which is technology that is eligible to be operationalized within all computer operating systems without license. This is the response to Supriyatno and Romzi's suggestion that the web-based application is eligible to be implemented with assistance of open source within the computer unit.

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