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THE DEVELOPMENT OF WEB-BASED MANAGEMENT INFORMATION SYSTEM FOR THE CHILD MALNUTRITION SURVEILLANCE
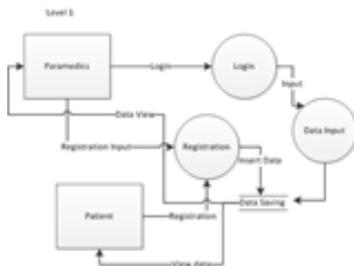
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Graphical abstract

Abstract

The monitoring process of children's health (nutrition fulfillment) carried out by Puskesmas (Community Health Center/ CHC) officials as front personnel of health services for local communities is not well implemented yet. In addition, the unavailability of the early warning system for the identification of child malnutrition had worsen the problem. It is primarily caused by less accurate patient recording system within CHCs, as well as ineffective and inefficient data reporting since the process is carried out manually. This research proposes an alternative early detecting system of child malnutrition within a number of regions in which CHCs are located based on the development of web-based system for the child malnutrition surveillance and integrated into an Internet network to facilitate its usage by medical personnel. The system is mainly aimed to ease CHC officials to input such systematic patient data that it is relatively fast to identify if there is a possible indication of child malnutrition within a particular area. The system is expected to be an early warning detector of children malnutrition cases and assist the head of health authority as a decision maker to take initiatives accordingly. Recommendations from the system are made available for users following which, health authority and the public can monitor the operation of the system directly by accessing the output data from the nutritional status study of a certain area.

Keywords: information system, web-based, child malnutrition, surveillance

1.0 INTRODUCTION

Children malnutrition cases have significantly increased in Indonesia. A number of malnutrition cases were also found in Depok [1] which has at least 16 sub districts in Depok reporting more than 10 cases of malnutrition every month [2]. Despite of the existing 14 nutrition centers to support the nutritional status monitoring in the Pancoran Mas area, the children malnutrition cases continuously exist as well. This situation indicates an escalating need of a comprehensive and integrated management to monitor malnutrition due to its huge impact on Indonesia's future generation.

Child malnutrition can be prevented by a periodic nutritional monitoring program conducted by the local health authority. The community nurses in Community Health Centres (CHCs) together with the health cadres in the village Integrated Service Center (ISC/ Posyandu) play a crucial role in detecting the malnutrition problem in the community. However, the manually handled data monitoring report often leads to delays and less accurate reporting that in turn may delay the decision-making and actions toward occurring malnutrition cases. The documentation, report, and analysis process for nutritional monitoring have not been supported by a systematic, easy, quick, and integrated system. This implies that the early

warning system for the children's malnutrition status monitoring has not been well established yet.

The previous research had examined the effectiveness of the information technology (IT) application in improving and expanding the health care services in the community [3]. The result revealed that 99 % CHCs in the Jabodetabek area were equipped with computers and 50.9 % were connected to the internet. The capacity of the CHCs' officials to use the internet was considered average at 56.73 %. In addition, Delimayanti and Waluyanti [4] have developed the web-based documentation and reporting system in the Maternal and Child Health

Care Polyclinic. This application can minimize the human error factor on managing healthcare in the CHCs.

The objective of the research was to develop the web-based management information system for the child nutrition surveillance. It can be integrated and employed in the nutritional service domain of the CHCs and Public Health Organization (PHO). The system is expected to be a malnutrition supporting monitoring tool and an early warning system in order to help the health authority as the decision maker to take initiatives and respond to the children malnutrition cases effectively.
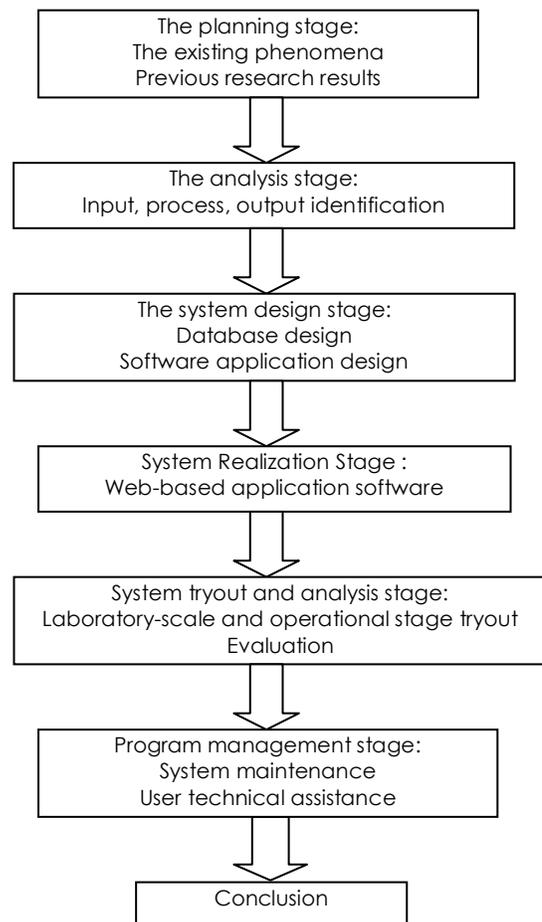
2.0 EXPERIMENTAL

The research was designed within the systematic problem solving approach. The system approach was an incremental study with the prototyping method. The incremental method covered the stage of planning, analysis, design, coding, and the prototype trial. The schematic research stages are described in Figure 1.

3.0 RESULTS AND DISCUSSION

The research results are described in the following stages.

3.1 The Planning Stage

The identification of the nutritional surveillance indicators from various sources were conducted in the planning stage. This stage consists of the nutritional status and data availability in the community and CHCs as well. The children's nutritional status indicator is divided into the direct and indirect causes. The direct causes include the imbalance of food intake and the occurrence of infectious disease. On the other side, the indirect causes range from the inadequate food supply in the community, lack of water, sanitation, and the primary health care services (immunization, vitamin A, health cadres, and the health care officers) and also poor parenting sills due to the lack of education and livelihood environment. The causative factors were rooted within the socioeconomic problems in the community, such as lack of women empowerment (within the family context) and limited community sources.

Figure 1 The schematic research stages

These nutritional status indicators are already incorporated in the PHO's nutritional program report and are operationally carried out by the CHC officers. The data are compiled from the under-5 children in the Posyandu/ ISC and measured by the weigh/ age index. It can be obtained from the under-5 children health card (Kartu Menuju Sehat/ KMS) monthly report [3]. In addition, local monitoring (PWS) for weekly nutrition fulfillment, and children nutrition fulfillment monitoring (PSG) was done annually every August. All of the data are still managed manually. Thus, the

documenting and reporting processes are both time consuming and possibly less accurate. Furthermore, the decision-making and actions toward the emerging issue take longer period accordingly.

3.2 The Analysis Stage

The data identification results, including the input, process, and output of the children malnutrition surveillance was then designed into the software application. Sequentially, the database architecture was identified to serve as the framework of the database table arrangement. The process was continued by the link mapping of every single data input elements.

3.3 Prototype Development Stage

The system development was based on the analysis and evaluation report. The systematic step is divided into database design and software application design. From database design, the compiled and identified data were categorized into the data tables. For software application design, a structured analysis method was utilized to design the web-based software. This method consisted of the arrangement of the system flow chart, context diagram, level-1 data flow diagram, E-R diagram, program structure, data dictionary, and the process specification (PSPEC). The Graphical User Interface (GUI) and the menu application will be designed to be user friendly. During this stage, the researchers tried to develop the optimal security data system, since it will interface with the Internet network. The result of system analysis can be simplified into the flow chart as in Figure 2.
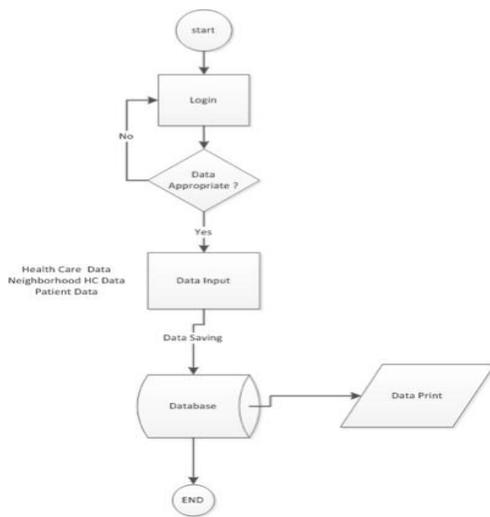

Figure 2 Simplified flowchart diagram

3.4 Context Diagram, Data Flow Diagram (DFD)

The context diagram or the level-0 data flowchart diagram is the starting point of the software application design. The data flowchart diagram

depicts the picture of the system globally as modeled as the process of outer entity-system interaction. Figure 3 is the context diagram for the children nutrition surveillance management information system in the CHC.

The data flow diagram mainly serves as the system development aid tool and consists of several levels of diagram which depends on the system's complexity/ depth. It describes the completely depicted system and avoids ambiguity. The level-1 data flow diagram (N = 1) is developed from the context diagram. Context diagram can be shown in Figure 3 and DFD level 1 are described in Figure 4. The modeling system stating the unit functions / services is provided by the use-case diagram of the system used (refer Figure 5). The use-case diagram describes an interaction between one or more actors in the system developed.
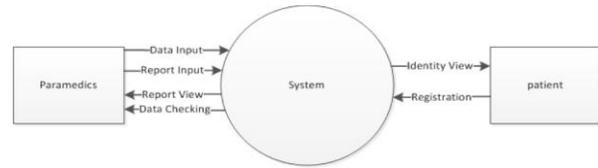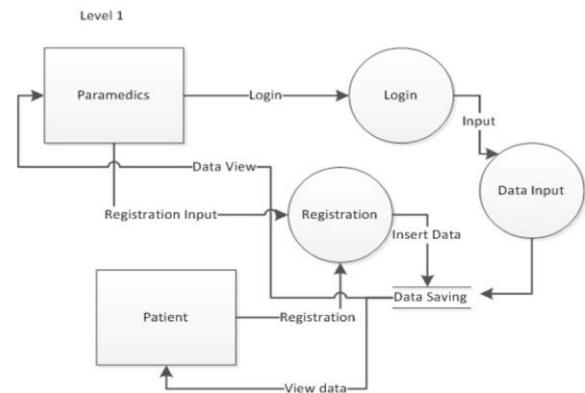

Figure 3 Context diagram

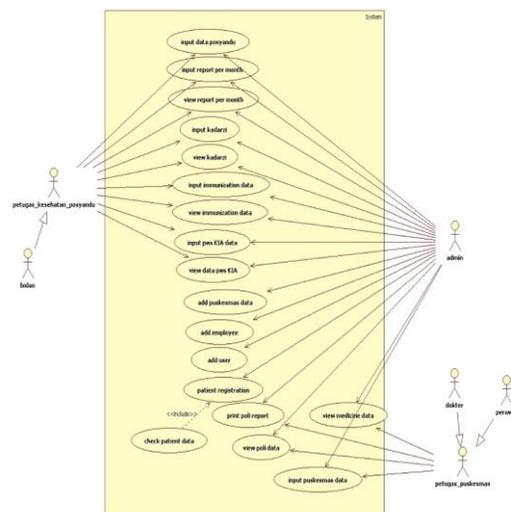**Figure 4** Data Flow Diagram (DFD) level-1

Figure 5 Use-case diagram system

3.5 E- R Diagram (Entity Relationship)

The ER diagram (ERD) is a conceptual model representing the relationship between the data storage system. It is based on the actual realm perception which comprises of the object group (entities) and its interrelationship. The ERD builds the data structure and data relation modeling. The model can be examined by ERD without considering the current process. The web-based nutrition surveillance software has a couple of functions related to the documenting and reporting process that can be configured on the ER diagram. The ERD of the system is described in Figure 6.
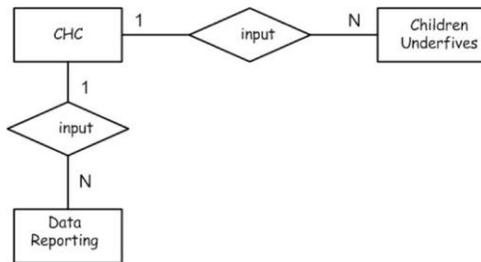
Figure 6 ER Diagram of the system

3.6 The Modules of the Application

Three major modules have been designed to function as the web-based children nutrition surveillance management information system.

I.   Information module

The initial preface offers the general information about the system and the children nutrition. The background and objective of the system development are displayed along with the knowledge of the children nutrition and malnutrition. The screen shots form information module can be seen in Figure 7.
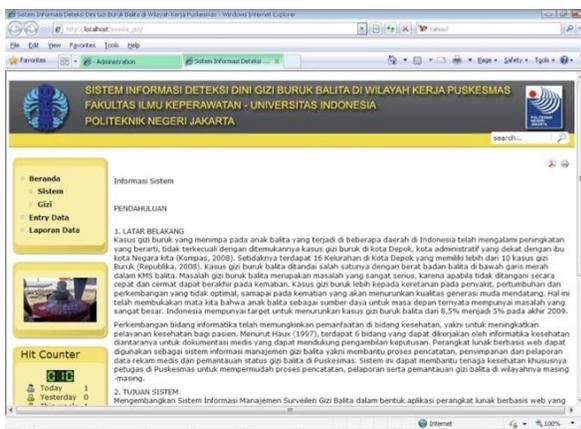
Figure 7 The Preface module of the system

II.   Data Entry Module

The Data Entry Module functions as the data master of location, and help menu. The data master of location and system indicator comprise the data of the provinces, districts/ cities and subdistricts, CHCs altogether with their coverage areas. In addition, the CHC officers, as the system user is required to determine the log in name and password. As a part of the authentication pocess, it provides captcha random codes so that the system can be accessed by eligible users. This screenshot can be seen in figure 8.

Figure 8 Data Entry module of the system

III.   Data Report Module

This module yields the system output as the calculation of the children nutrional status for the working area of CHC. It is generated from the previously arranged indicators. The system result has been adjusted into the data input pattern carried out by the CHC. The report module is shown in the Figure 9.
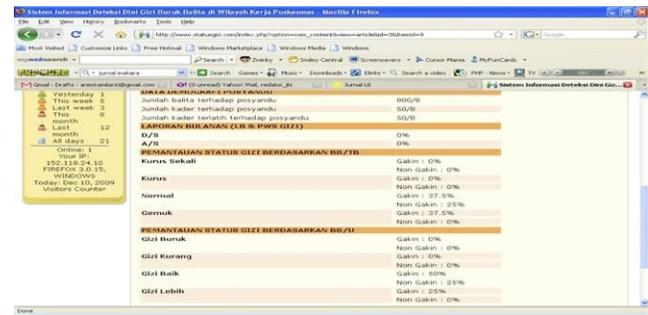
Figure 9 The Data entry module of the system

The system was developed using web-based application formed client-side and server-side coding. The client side presentation was formed on the HTML script, CSS, and JavaScript. In addition, it is connected to the back-end storage/database system side. The software is finally ready to undergo trial using the single

desktop or the network. The data security system was provided by the user authentication using the compulsory random codes login system.

The application software was tried out in two levels – the laboratory and the operational scale. Initially, the researchers tried the system in the intranet using the local host system in the computer laboratory. Furthermore, the trial was carried out operationally on the computer server on the Internet network by a free web hosting and domain. However, because of the broadband and network limitation, the researchers moved to the expended web hosting and domain in the http://www.statusgizi.com. On each of the trial stage, we examined the data according to several data trial parameters that consist of the input, change, delete, cancel, save, and security functions. The researchers conducted the looping evaluation method so the examination will always be followed by evaluation, reexamination and so forth. It was carried out by the children nutrition surveillance system until it is ready to use.

The one-day workshop was conducted in the computer laboratory, Faculty of Nursing University of Indonesia to simulate the system developed. It was attended by 32 participants. 30 were the nutritional program officers from all of the CHCs in Depok, while 2 participants were from the Depok PHO representing the nutritional program officer and IT consultant. The participants were mainly women (93%) and working as experienced nutritional program officers (87%) for more than 5 years of experience (80%). The learning materials covered up the background, contents, and application guide of the children nutrition surveillance system. They individually tried to log in, entry, change, remove, and save data into the system. Finally, they analyzed and printed out the data.

The participants then answered the given questionnaires after the workshop. It was aimed to evaluate the developed system. The results of the data analysis indicated that most of the participants (86,7%) documented the nutritional program report manually. The data analysis report was mainly carried out in the Puskesmas (63%), and the rest of it was carried out in the PHO (36.7%). Almost all of them were performed manually as well (96.7%).

The majority of the participants agreed (46.7%) and strongly agreed (36,7%) if the CHC owns the internet-linked computer. They also agreed (80%) and strongly agreed (16.7%) that the developed application system will be able to serve as the needed of the nutritional program documentation system. They predominantly agree that this application can be employed to meet the need of the nutritional program reporting (83.3%), the nutritional program analysis (87.7%), and the malnutrition early warning system in the community setting (83,3%). The rest of the participants even stated they strongly agreed with all of the aforementioned statements.

The web based software application was developed as a surveillance management information system for the child nutrition in the CHC's working area. The researchers referred to the Center of Disease Control/CDC (2005) guideline that stated surveillance as the continuous and systematic data collecting activity to be followed by the data analysis and interpretation to plan, implement, and evaluate a health program. The system was built to ease and integrate those processes. Through surveillance, the researchers can have the children nutrition status monitoring in a particular location within the CHC working area, early case finding, and evaluating the enacted program dealing with the occurring cases.

According to Haux [6, the children nutrition surveillance can be facilitated to be more efficient, accurate, and well integrated by the informatics technology in the data documentation and report. Soegijoko [7] also proposed the need to address how this information system can be utilized for the health care function in providing the information support in the decision making process on all level. Therefore, the researcher can monitor and tackle the children malnutrition more efficiently with minimal human error. This human error minimization has been evidenced based on Delimayanti and Waluyanti's [4] research about a similar system developed for the Maternal and Child Polyclinic.

The system was initially designed in accordance with the malnutrition indicators from the CHC and ISC documentation. These indicators were derived from the UNICEF (1988) into a more applicable surveillance indicator framework of the Ministry of Health/ MOH RI [5]. The nutrition indicators comprise of the monthly nutritional report as an important indicator presented by the Monthly Report 3-Nutrition and local nutritional monitoring (Pengawasan Wilayah Gizi Setempat/ PWS). All of the indicators were then transformed into variables for the documentation data entry menu. Furthermore, the system documentation result was previewed on an automatic report that could operate needed calculation functions. This application was also featured by some modules to provide the general information about the system and the sufficient knowledge about children nutrition.

The assembled application has already been tried by the user samples, the nutritional program officers from PHO and all CHCs in Depok. Initially, the system did not completely met the need of the users to make the documenting and reporting process easier. Thus, the researchers had accommodated the suggestions conveyed in the workshop forum of the nutritional program officers for further system enhancement. The surveillance system has already been redeveloped based on the standardized format from the MOH RI. Nevertheless, we adjusted the documentation format into a format used in the PHO and all of the CHCs in Depok for an efficiency consideration. The automatic anthropometry measurement was also attached into the surveillance system according to the forum recommendation. In addition, the print out facility was really helpful for the data report and archive.

This web application system can be accessed through a web browser so the users can take advantage of its ease of use. The system output is the identification result summary in the form of many types

of CHC's reports. The reports include the periodic data report that is made on the spreadsheet file to be easily converted. The nutritional status study of a certain area can also be presented as the decision making support data in dealing with the nutritional problem in the community.

4.0 CONCLUSION

The application system consisted of both thorough and summary of nutrition fulfillment status in each area of CHC, automatic anthropometry measurement, data report printing, and secured by single user authentication. The nutrition fulfillment status comprises of the monthly nutritional report as an important indicator presented by the Monthly Report 3-Nutrition and local nutritional monitoring (Pengawasan Wilayah Gizi Setempat/ PWS). The web-based children nutritional early warning system is expected to ease, fasten, and integrate the data documentation to generate the analysis and report as the decision making data support for the related health authorities in responding the malnutrition problem. It is recommended to enhance the availability the system for the system users and to expand the database coverage (within one or more regions) by using the generated facility incorporated in the system [8-9].

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