Development of Clinical Decision Support System Prototype for Diagnosis and Management Dengue Hemorrhagic Fever

Suharyanto
Department of Internal Medicine,
Sardjito General Hospital,
Medical Faculty of Gadjah Mada University
Yogyakarta, Indonesia
prharyjo2003@yahoo.com

Rizka Humardewayanti A
Department of Internal Medicine,
Sardjito General Hospital Medical Faculty of Gadjah Mada University
Yogyakarta, Indonesia
rizkaipd2013@gmail.com

Luthfan Lazuardi
Health Management Information System (SIMKES),
Public Health, Medical Faculty of Gadjah Mada University
Yogyakarta, Indonesia

Abstract

Dengue hemorrhagic fever (DHF) is a health problem in many parts of the world, especially in Indonesia. Outbreaks happen in 12 provinces with a total of 12,224 cases and 218 deaths. Diagnostic and management of DHF are required exactly and accuracy to avoid the severity of illness or death. However clinicians still make misdiagnosis because DHF has similarities with the symptoms of some diseases such as malaria, typhoid fever, leptospirosis, and other diseases. Number discrepancy diagnosis by WHO (World Health Organization) criteria approximately 31.1% of due to the lack of clinician’s ability in diagnosing. It is a need to develop a prototype of clinical decision support system in diagnosing and management DHF because CDSS (Clinical decision support systems) has been widely shown to increase the exactly, precision, accuracy, efficiency and effectiveness in health care. Developing a prototype of clinical decision support system for DHF diagnosing and managing that have good validity and reliability or good performance system. This study use action research approach. Development of system with prototyping methods and use rule-based system with the format of “IF <symptoms> THEN <diagnosis>” in support of decision making. Clinical decision support systems have been developed and tested by comparing the output of clinician and the output system based on 2 kinds of guidelines (WHO 1997 and WHO 2009). The first test 46 questionnary data from clinician, the correct result 22 (47.87%), $X^2=0.087$, p=0.768 based on WHO 1997 Guideline and 26 (56.52%), $X^2=0.783$, p=0.376 based on WHO 2009 Guideline, the output system both guideline are 100%. The second test, 108 cases, the correct result 77.78% ($X^2=2.5$, p = 0.114) based on WHO 1997 Guideline and 78.79% ($X^2=0.831$, p = 0.362) based on WHO 2009 Guideline. The output system and diagnosis from clinician are not significant difference and the system has higher performance than clinicians. The system has good validity and reliability to support clinical decision making in diagnosis and management of DHF.

Keywords : Decision Support System, Prototype, Management Dengue Hemorrhagic Fever

I. INTRODUCTION

Dengue hemorrhagic fever (DHF) is a public health problem in many parts of the world especially in tropical and sub-tropical climates countries. Indonesia is the "A" stratification of dengue category by WHO which indicate with number of hospitalization and high of rate mortality. Indonesia is endemic area of dengue that the highest number of cases in Southeast Asia since 2004. During two months the cases of dengue spread rapidly and infect 16,803 people, 267 people was died (Case Fatality Rate / CFR = 1.59%).

The symptoms of dengue fever are similarity with others diseases (Malaria, typhoid fever, leptospirosis, etc) that cause complicate the clinicians to diagnosis of DHF. Mismatch of diagnosis with WHO criteria for DHF in handling approximately 31.1%, one of factor is caused by the Incompetent of clinicians. Private practice of the clinicians and in hospitals still common medical error event. Clinicians have some limitations such as: busyness, memory loss, stress, lack of knowledge and extraordinary events that cause fatal medical error event.

Clinical decision support systems (CDSS) has proven benefits to treat patients better. Clinical decision support systems can improve clinicians performance and have a good effect for patients. CDSS development to overcome problems and clinicians limitation in diagnosis and management of DHF that can be used to support decision making for diagnosis and management of DHF as well as increase knowledge to the clinicians more important.

II. METHODS

The design of the study use an action research approach that involving researchers team that consists of 4 members: 2 of lecturer, internist and student of internal medicine. The development of system use knowledge-based with “IF THEN” rule base. The process of diagnosis and treatment of DHF is based on the knowledge base of decision-makers compromise accordance WHO 1997 guidelines and WHO 2009 guidelines. The method of development systems is prototyping. The alpha testing to determine the functional aspects of the systems. The data was collected through the clinicians questionnairre and medical records data that used to evaluation the validity systems.
III. RESULTS

The systems development involve of the team members that consists of: internist a person who provide a diagnosis role playing and evaluation of the systems, clinicians who give standard therapies information and other researcher collected of data, identification of systems requirements, interface design, database and programming systems. The first step of systems development process is analysis of needs systems, design of the context diagram as illustration the relationship of components and processes of the systems. Data flow diagrams (DFD) to describe the process flow of data within the systems. The level 0 DFD describe the simple process flow of data. The level 1 DFD describe the detail process to clarify the flow of data that conformity the data flow and processes. The level 1 DFD can be show at Figure 1.

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The systems development process is analysis of needs systems, design of the context diagram as illustration the relationship of components and processes of the systems.

Programming is process to make instructions, rules, codes, database connection with programming software. The systems development used Visual Basic 6.0 software and Microsoft Access 2003 for database develop. The systems development success if its can be executable, work properly and produce the good performance output. Previous studies determining the relation between the output results with other studies database. Produce output that has value: probably, likely and almost certainly by the method of certainty factor (CF) to determine the level of confidence to the problem. The interfaces of the systems as media interaction between users with the systems.

The figure 1 describe step by step data flow and process of the systems. The first data flow start with Expert who person to design and develop of rule base systems. Admin who the person maintain and input the patients personal data. Users are person who will used the system to get output as advise and information about diagnosis and management of DHF. The figure 1 describe the diagnosis processes of DHF that started input of symptoms step, check of the positive or negative symptom were found, diagnosis process dan therapy.

The interfaces are media to interact between the user with the systems. The first model of interfaces is Yes / No Question. The desain of interfaces used good composition of colours, text, images, menu choices that its attractive and easy. Other studies use based web systems that can be connecting with internet and the people can access the systems.

The systems process input into output used the rule base "IF THEN". This rule base can process inputs to get outputs that it to support decision for diagnosis and management of DHF. Previous studies using the rule base "IF < condition 1> OR IF < condition 2> OR <condition 3> THEN <statement>".

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The main menu of the system is Menu Utama that the user show all of the facility of systems. The facility consists of manipulation data (input, change, add or delete).
The user select “YA” or “TDK” when the symptoms were not found. The end process of the system is produce the diagnosis and therapy of DHF.

The figure 4 show the output as decision support to diagnosis and management of DHF. The systems testing to know and evaluate of the performance system. Preliminary testing performed by clinicians, the systems is simulated by entering the symptoms of the disease and the systems give output. The results were count and the percentage of number correct and incorrect output accordance the guidelines were compared. The results can be used as validity of system.

The second test of validity systems are compare between the output systems by the clinicians answer from questionnaires with the output system after input the symptoms from questionnaires (table 1)

Table 1. The result of compare between clinicians found with the output system after it was gift input with the symptoms were found in medical record. The result of compare between the output diagnosis by clinician in the medical record with the output systems was show tabel 2.

Table 2. The result of compare diagnosis of DHF between the clinicians with output of the systems in cases of DHF based on WHO 1997 guidelines and WHO 2009 guidelines.

The tabel 2 show that the system has value more high than the clinician output. The result of the compared between output system with the clinician output was analysis to know the validity system. The validity of the system can be show form the result at tabel 3.
The performance systems for DHF cases of children, adults and the whole sample was 100% compared to the clinicians diagnosis results based on WHO 1997 Guideline is 82.76% (X^2 = 0.943, p = 0.331) and based on the WHO 2009 Guideline was 87.50% (X^2 = 0.133, p = 0.715). The performance of systems for adult dengue patients based on WHO 1997 Guidelines is 68.75% (X^2 = 1.852, p = 0.174) and based on the 2009 WHO Guideline was 76.47% (X^2 = 0.553, p = 0.465). The performance of systems for all patients based on WHO 1997 Guidelines is 77.78% (X^2 = 2.5, p = 0.114) and based on WHO 2009 Guideline was 78.79% (X^2 = 0.831, p = 0.362). This results indicate that the output of the systems is better than the diagnosis by the clinicians.

IV. CONCLUSION

Based on the results and discussion it can be concluded that the systems development used action research approach and prototype method can be applied in this study. The systems has fairly comprehensive knowledge base and good validity and reliability. The systems increase of the clinicians knowledge and users to diagnosis and management of DHF.

REFERENCES


