



HOSPITAL PERFORMANCE IMPROVEMENT THROUGH THE HOSPITAL INFORMATION SYSTEM DESIGN

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ABSTRACT

Hospital is a medical service industry that must have standard operating procedure. Quality and performance of a hospital is determined by the effectiveness of operational actions which being carried out. Method that is used in the measurement of operational effectiveness of hospital operation is Lean Hospital method. This research is conducted on one of the biggest hospital in Klaten Regency, Central Java Province. This hospital is routinely provide reports of hospital activities to the Provincial Health Office. The purpose of this research is to improve the reports making performance with the design of Recapitulation Information System of Hospital. The benefit of this research is to eliminate waste or activities that do not provide value added, acceleration of reports making, and operational cost saving in the making process of Reports Recapitulation The Hospital Information System is designed for desktop application with the network architecture formed as Local Area Network (LAN) for the process of data transfer and exchange. The development of Hospital Information System is using Visual Studio 2017 software with Microsoft Access as data basis.

The research result explained that the highest risk priority number (RPN) value is on the activity of file grouping because it is still done manually. To accelerate the classification process, it needed a computer based information system (CBIS) design.

The process of information system design can be done using the method of System Development Lifecycle (SDLC) by doing system analysis, system design, and system implementation. The test result for CBIS from the Hospital Recapitulation Reports explained that this system is able to finish the file grouping quicker. The total work process before using this system was done for 2 weeks with 2 hours of workmanship per day, meanwhile using the CBIS system it can be done for 1 working day with effective time of 10 minutes in accordance with the format that has been in accordance with the provisions by the Public Health Service of Indonesia.

Key words: Lean Hospital, CBIS, and Hospital Performance.

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1. INTRODUCTION

Law No. 44 on 2009 about Hospital as a health service institution with full-scale personal health services that provide inpatient, outpatient, and emergency care services. Hospitals serve as providers of medical services and health recovery in accordance with hospital service standards. Hospitals which located at regency and provincial level are required to routinely report the result of hospital operations to the Public Health Service of Indonesia in accordance to the standard set. The report given to Public Health Service is in the form of recapitulation, so it often referred to Report Recapitulation (RR). As a result, there is often a delay in reporting this to Public Health Service because of manual matching and reporting process. Based on that problem, clear mapping is needed to eliminate waste that cause delay in report recapitulation.

This paper discusses the design of Recapitulation Information System of Hospital Report in general with problem study using lean hospital method which adopted from lean manufacture concept. The application of lean concepts in hospital has been studied by several researchers (Hasle et al., 2016; Emei, 2011) and it requires adjustments in each hospital due to differences in organizational structure, standards operating procedure, and human resource perceptions. In principle, the Lean concept in the design of health facilities should be done with lower capital investment, lower long-term energy consumption patterns, reduced conflicts on human resources, reduced maintenance cost and long term cost. The study from Baddour & Abbas (2016; Pourasghar, et al., 2008) shows that most hospitals (84, 4%) are already using computer applications, and one fifth of the hospital (20%) are using computer network. The most frequently used computer applications are on the administration unit (53, 3%), followed by accounting and finance (48, 9%), laboratorium (46, 7%), pharmacy (45, 9%), radiology (40, 0%), acceptance and disposal (37, 8%), statistic (26.7%), human resource (20, 0%), and medical records (15,6%). On the other side, computer application is the most rarely used by material parts management (8, 9%), and nursing (4, 4%). The research result from those researches in general also shows that information retrieval from electronic medical records is easier and faster, especially in emergency situation. That is why this research wants to fill the research gap by test and analyze the importance of information system design to improve the performance of hospitals in Yogyakarta Province.

2. LITERATURE REVIEW

So far, there is still very limited hospital in Indonesia that has the design of effective and efficient information system. This is because there are some obstacles and limitations faced in between, such as; resource gaps (such as human resources, finance, technology, and others),

insufficient IT knowledge, expertise in the organization, or funding to acquire knowledge. This condition cause high economic costs. Other than that, there are low management commitment and lazy attitude of accepting changes especially in the IT usage (Wahid and Indarti, 2007; Muafi, 2017a; Muafi; 2016; Muafi et al., 2016; Muafi, 2015). Some of these reasons are the basis for the failure of the adoption and diffusion process in the IT usage (information technology). In fact, failure to overcome IT problems can affect the organizational commitment in long term (Sarosa, 2007; Muafi, 2017b). If the IT value is perceived to increase, it can affect the readiness to change in using IT (Jones, et al, 2005; Truong, et al., 2004; Muafi et al., 2012). Meanwhile, organization change readiness will affect organizational performance and competitive advantage of the organization (Weeks,et al., 2004; Lawson, 2003; Harari, 1997). (2004) also added that in the developing country, the IT success is affected by the readiness of the organization and external environment in the IT usage. According to (2006), the IT usage will be affected by attitudes and beliefs about the benefits and ease of using IT. This indicates that in the process orientation approach it is also recommended to consider the aspects of managing behaviour strategies that will be expected to have an impact to organizational performance and competitive advantage of the organization. The lean concept is to build work flow or tasks started from the product design to the acceptance of products by consumer which runs smoothly and does not experience any dismissal or return due to a defect. To determine and describe the existence of waste, there is a diagram flow in the form of Value Streaming Mapping (VSM) so that it will be seen which activities become value adding activity or non-value adding activity. The result of this mapping will be used for the right improvement according to the condition of the organization (Womack, 1996).

Lean gives improvements with an emphasis on developing the ability to operational problem solving using scientific method which is plan – do – check - action cycle. Lean management becomes the final goal to be realized by reducing errors and shortening process flow time and cost suppression by eliminating activities that require funding (Clark, 2016). Waste concept divides into 8 parts as follows: over production, waiting workers, moving goods, over process, excess inventory, unnecessary movement, product and production disabilities, and unused worker creativity (Liker and Meier, 2006). Value Stream Mapping is the flow of all existing activities that add value to the product, and makes the flow of material or information become real (visible) (Miller and Blockhus, 2005). Whereas, Failure Mode and Effect Analysis (FMEA) is a method that is used to evaluate failure that occur on a system design, process, or service by giving score on failure modes based on occurrence, severity, and detection rates. As for how to calculate Risk Priority Number (RPN) value in potential failure mode, it can be done using the formula of *Severity x Occurrence x Detection* (Miller and Blockhus, 2005; Clark, 2016).

In the information system usage in hospital, the research findings of Sinha et al. (2009) concluded that the awareness of information system usage in hospital is getting better, about 63,36% hospital officials including doctors, nurse, or administrator have excellent knowledge of computer and peripheral devices and have a good knowledge about the technology that is used. The research result of Wyatt (1995) also explained that information is one of the most important resources that are owned by hospital. When a doctor makes a decision to take action on the patient, accurate data about the patient in the medical record is required, consist of biodata, check results, laboratory results, hypothesis including the diagnosis of referrals, and action taken.

One example of information technology usage in medical is Electronic Medical Records System (Pourasghar, et al., 2008). One medical university in Iran decided to introduce the system in his hospital. The result is the quality of medical records documentation has increased in several areas. The information retrieval from electronic medical records become easier and

faster, especially in emergency situation Lean laboratory concept always has a holistic view, including medical demands and economic aspects (Halwachs-Baumann, 2010).

The application of lean concept in the medical world is known as Lean Healthcare which is defined as “elimination of waste in every field of activity with the purpose to reduce inventory amount, length of service cycle, and expenses, so that at the end a high quality patient service can be provided with an efficient, effective, and responsive way as possible, while retaining the economic value of the organization” (Doss and Orr, 2007). The lean principle started to be recognized and applied by many hospitals in 2005, and the pioneer of the use of this concept is Virginia Mason in Seattle, Flinders in Adelaide, also Thedacare in Wisconsin (Fillingham, 2007).

Waste in the hospital is in the form of waste that leads to ineffectiveness of work and budget efficiency. The waste that can be eliminated by lean concept based on the research result is by reducing the use of cost, reducing the amount of inventory in the hospital, accelerating the inventory ratio rotation, reducing waiting time, accelerating service process for customer, and reducing the number of service defects (Adrian, 2011).

Healthcare and clinical professional are continue to evaluate and develop healthcare management strategies to be able to follow the medical equipment technology to improve health services. The focus of attention is on the risks caused by equipment failures and anticipating its impact on patients (Wang, et al., 2006). A hospital has a department that carries out operational activities that are ruled by the hospital management. The problems that often occur that cause waste is communication or information flow between departments. The result is to optimize the value added object and reduce the non-value added objects that cause waste (Wasetya. 2012).

3. RESEARCH METHOD

This research is conducted in the administrative part of recapitulation report of Hospital Records by taking case study at the biggest Islamic Hospital in Central Java Province, Indonesia. The identification of flow process is using lean hospital concept to understand the waste that occurred. The type of this research is design and development with the arrangement concept using System Development Lifecycle (SLDC) including, system analysis, system design, and system implementation. The final result of this research is an information system in a form of software that will be used as tools or data processing tools into certain information for the hospital report recapitulation. Type of data that is needed is primary data from interview method with respondents, such as data processing officer and medical record report, external reporting officer of hospital medical record, and also head of data processing and medical record report. Data that was conducted from the interview method is data of the flow of report recapitulation for inpatient care. Respondents used in this research are all the officers that handle the report which is officers who directly make the report and the head of data processing and medical record reports as leader who participates in determining the result. Besides, this research also uses secondary data using documentation method from various sources, such as inpatient data and medical records and the secondary data from Public Health Service.

The definition of waste and standard operating procedure document become the first step that will determine the form of conceptual design before it is implemented into an information system. To get a clear picture of the system, then performed the analysis of the flow process by using lean hospital through the Value Stream Mapping (VSM) so it is expected to obtain the point of waste in the hospital, which then searched the cause by using the 5 why's method and determined the most critical priority by using the Failure Mode and Effect Analysis (FMEA) method so that it could produce the most risky cause in the form of Risk Priority Number (RPN).

Observation of the research is conducted at working hours that is starting at 08.00 am until 16.00 pm with the consideration that at that time, hospital has more patient visit density than at

night. Observation was made to observe the Standard Operating Procedure of patient handling up to recapitulation process of inpatient report. Hospital Information System is design for desktop applications with network architecture in the form of Local Area Network (LAN) for the process of migration and data exchange. Development of Hospital Information System is using Visual Studio 2017 software with Microsoft Access database. The design of information system before being applied is tested by white box text to see coding errors, and black box text to determine ease of use.

4. RESULTS AND DISCUSSION

Based on the result of data collection in the field, obtained the operational data of hospital activities during working hours in the form of inpatient medical data. Activities that happened on the hospital operational until report process are shown on the diagram of Value Stream Mapping in Figure 1.

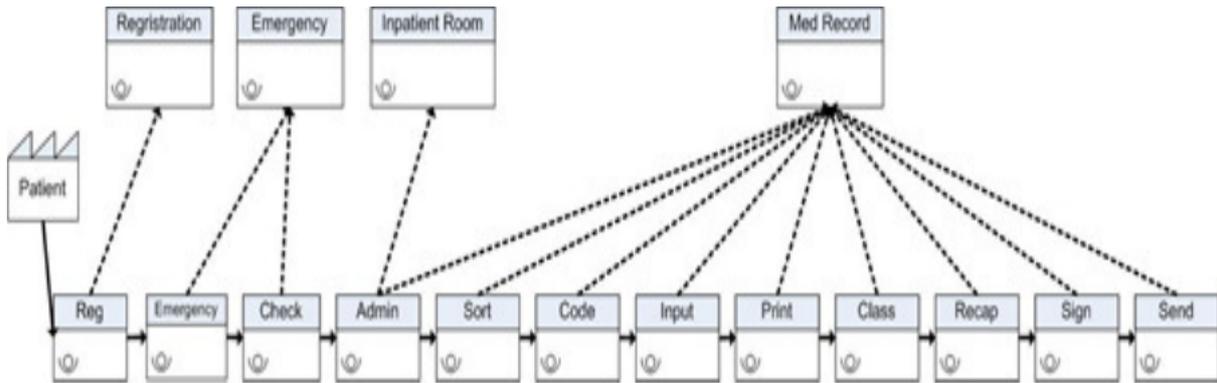


Figure 1 Value Stream Mapping of Report Recapitulation

The process of making the report recapitulation of the hospital as shown on VSM is divided into 12 activities. The process of making the report recapitulation of inpatient takes 14.3 hours each day. The process of classification of patient data after hospitalization in accordance with the provisions given by the Public Health Service is repeated every day until all patient data of completed inpatient are finished to be classified, with the average on the 14th day of each month. Identify the waste in the process of making the Report Recapitulation by determining the activities or stages which belong value adding activity, non-value adding activity, and necessary non-value adding activity are shown on Table 1.

Table 1 Activity Classification

No	Activity	Description	Value Added		
			VA	NVA	NNVA
1	Registration	Inputting patient’s social data by registration section	√		
2	Polyclinic/ER	Documentation of patient’s service data by polyclinic/ER	√		
3	Doctor’s Action	Documentation of inpatient service by Doctor/Nurse in the inpatient room	√		
4	File Taking	Officers go around the ward to take medical records of patient after completed hospitalization			√
5	Sorting	Officers sort the patient’s medical records document after completed inpatient		√	

No	Activity	Description	Value Added		
			VA	NVA	NNVA
6	Coding	Officers code the patient disease according to ICD10	√		
7	System Input	Officers input the patient data into SIRS	√		
8	Printing	Officers print all the data of the patient		√	
9	Classification	Officers classify the data one by one according to the provisions given by the Provincial Public Health Service		√	
10	Provincial Public Health Service Recapitulation	Officers input the data back to the computer for the Provincial Public Health Service		√	
11	Report Recapitulation for the Regency Public Health Service	Officers input the data back from the Provincial Public Health Service form into the Regency Public Health Service form manually		√	
12	Authorization	The signature was given from the director/CEO	√		
13	Sending	Sending recapitulation Report	√		
Total			7	5	1

From Table 1, can be grouped activities that are not important and do not give added value or waste. The result is that there are wastes in the form of over-processing on some activities such as: sorting, printing, classification, and Provincial Public Health Service Recapitulation. The identification result of the causes of failure is prioritized using Failure Mode Effect Analysis method as shown on Table 2.

Table 2 Identification the cause of failure using FMEA

Failure	Cause	Occurrence	Cause	Saverity	Control	Detectio n	RPN
Sorting of medical records document	Differences in the use of forms	7	The document is not in order	8	Checking the medical records document	2	112
	Differences in patient service documentation	6		8		2	96
	Stacks up files	4		5		1	20
	Deadline	4		4		1	16
Printing	Format differences between system and recapitulation	7	Reprint	7	Adjustmen t	1	49
Classificat ion	Done manually by workers	8	Takes a long time	8	Adjustmen t with the standard	2	128
Provincial Public Health Service Recapitula tion	Input data to the website	4	Process repetition	5	Adjustmen t	2	40

The determination of Occurrence, Severity, and Detection value is using a scale where the lowest rating is worth 1 and the highest rating is 10. The value of Risk Priority Number (RPN) is derived from multiplication of severity, occurrence, and detection. Based on the RPN result, obtained the highest value in the process of classification with the RPN value of 128.

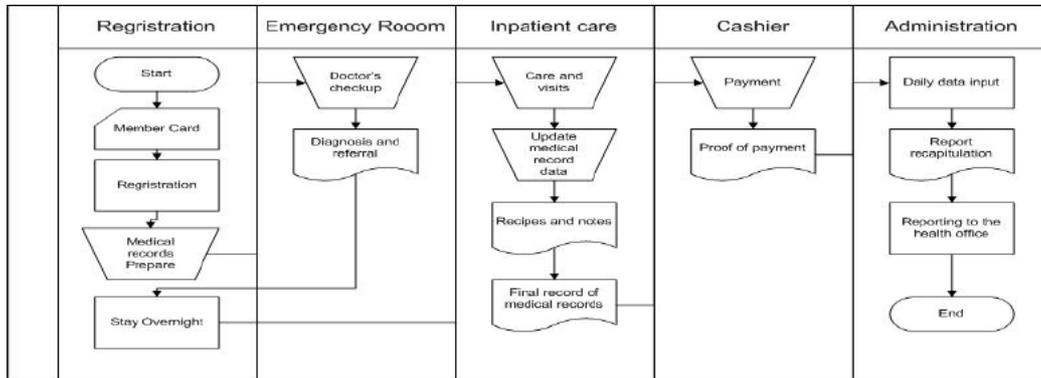


Figure 2 The Flow of Hospital Information System

The flow of information system in Figure 2 shows the revolving data from the beginning to the end of the data processing of administrative reporting of hospital activities that will be recapped. Entities and attributes are then pictured in the form of relationships between entities called the Entity Relationship Diagram as in Figure 3.

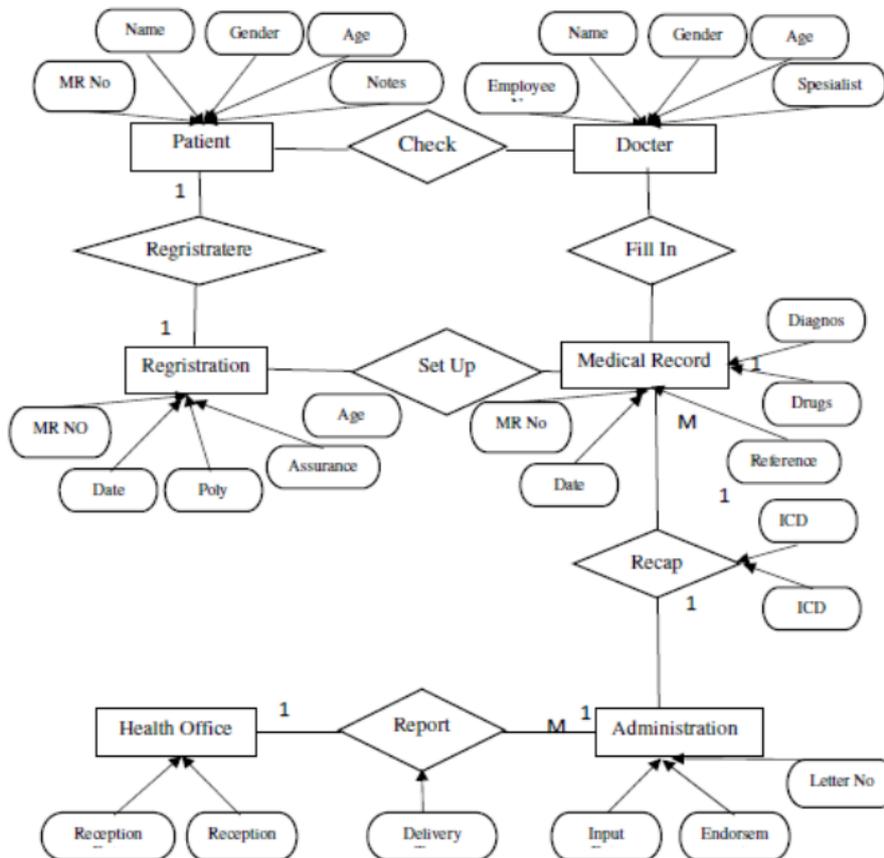


Figure 3 Entity Relationship Diagram (ERD) of the Information System of Hospital Report Recapitulation

The interface input design is used to input the data to computer or information system, and the process of the interface input design is based on the reference document, the monitor screen, and the type of user interaction with the computer. The consideration of the creation of input design is Capture data for adding new data and document source for saving the Hospital data.

The output design of Hospital information system is information in the form of report obtained and presented by the Information System. One way to design this output is by considering the templates used by the Public Health Service and the report model used by the internal hospital management. The next process is translation into the programming language to be run by computer. Users need a bridge that facilitates the operation, so then created a display or user interface as in Figure 4.

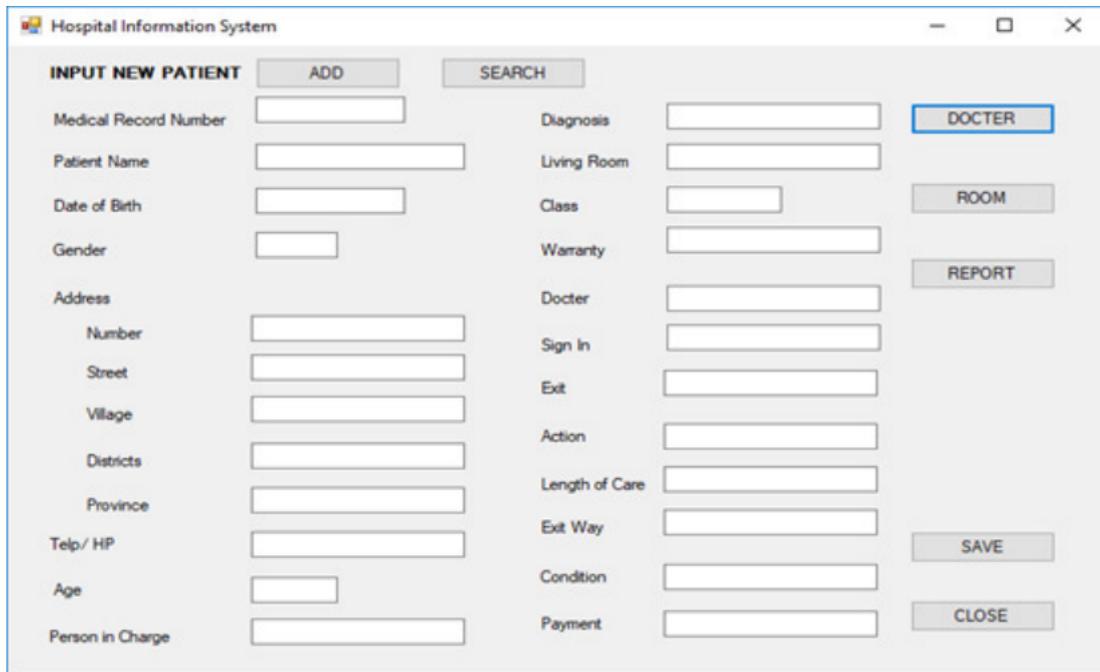


Figure 4 Display of the Hospital Recapitulation Information System Program

The information system component that needs to be prepared is hardware and software to guarantee that the information system is compatible and can run on platforms that match the computer they owned. It also needs to consider about the data communication network that will be used which is using Local Area Network or internet. Because of this application is in the internal Hospital, then it is determined that the software developed is a desktop application with LAN network using the Operating System of Windows 10, Visual Basic Programming Language, and Microsoft Access database. The Hospital Recapitulation Information System that is in the form of Table can be seen on Figure 5.

No	ICD Code	The category of illness	Number of patients living and dying by age and sex group																		patient out (live and dies)		the number of patients out of life	the number of patients out dead
			0-6 d		7-8 d		28 <1y		1-4y		5-14y		15-24y		25-44y		45-64y		>65y		M	W		
			M	W	M	W	M	W	M	W	M	W	M	W	M	W	M	W	M	W				
157	H 33	Ablation and retinal damage	0	0	0	0	1	0	2	0	1	0	0	0	0	0	0	0	2	0	6	0	6	0
158	K65.0	Abdominal abscess	0	0	1	0	0	0	6	0	0	0	0	3	0	0	0	1	0	0	7	4	11	0
159	N81.4	Female genital prolapse	0	0	0	0	0	0	0	0	0	0	4	0	2	0	0	0	0	0	6	6	6	0
160	N83.2	Disorders are not on the ovaries	0	0	1	2	0	2	3	0	0	2	1	0	0	0	2	0	0	7	6	13	0	
161	N93.9	Urinary system disorders	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2	0	2	0	
162	I02.2	Inguinal abscess	0	0	0	0	0	0	2	0	0	4	0	0	0	0	0	0	0	2	4	6	0	
163	K61.0	Parialen abscess	0	0	0	1	0	0	0	2	2	0	0	0	0	0	0	0	0	2	3	5	0	

Figure 5 Output of the Hospital Recapitulation Information System

The test result of the Information System of Hospital Report Recapitulation can accelerate time of report arrangement process, so it will improve the hospital administrative performance, saving significant time, minimizes human errors, and saving the print cost. The system also tests using the white box and black box method to find out the functional capabilities and programming errors by giving questionnaire to user administrator and technical. The result is the average respondent gives a value of 3 with choice of scale 1 (worst rating) to 4 (best rating) meaning that the respondent says that this information system has been feasible and suit the user needs and also easy to operate.

5. IMPLICATION

The theoretical implication that can be obtained is the hospital organizational performance, especially in the making of the report which can be done using lean hospital concept in the design of the Information System of Hospital Report Recapitulation, so that it can accelerate the process of making report recapitulation.

The practical implication is the Information System of Hospital Report Recapitulation can be the Office Automation System and accelerate time of report arrangement process from 2 weeks to 1 day so it can improve the hospital administrative performance and saving the print cost. The test result using white box and black box method shows that this information system is feasible and suit the user needs and easy to operate by hospital.

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