Inventory Management Information System in Blood Transfusion Unit

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Abstract - **There are several blood components at the Blood Transfusion Unit to improve health services in Indonesia including *Whole Blood, Packet Red Cell, Liquid Plasma, Fresh Frozen Plasma, Thrombocyte Concentrate, Kriopresipitat* and *Washed Erythrocyte*. To provide services to consumers, this unit faces problem in the form of unbalance blood supply information and consumer demand. Consequently, management of this unit was difficult to manage the blood inventory. Aims of this study is to build an information system model using the *system development life cycle* approach in order to manage blood demand. Furthermore, this case adopted *continuous review* model to conduct the inventory policies involving safety stock, reorder point, and order quantity on each blood components. This study is able to provide benefits for Blood Transfusion Unit in order to increase service level to the customer. Further study is suggested to consider blood inventory simulation in developing several scenarios to manage blood demand.**

Keywords - **Inventory policy, blood demand, continuous review, system development life cycle.**

I. INTRODUCTION

Nowadays, there is increasing number of patients who need blood transfusion for the healing process in the hospital including dengue fever, delivery, medical operations and general accident. Blood transfusion is a method for transferring blood from donors to patients in order to help patients' lives and improve the health of patient [1]. To meet the need for blood supply, the hospital management recommends the patients for looking the blood at the Blood Transfusion Unit (BTU). This unit is under control Indonesian Red Cross which has core business as providing blood transfusion services including blood donation, blood screening and supplying blood to patients. Lestari (2017) revealed that there are four types of blood provided by the BTU including A, B, AB and O. These type are divided into Rhesus Positive (Rh +) and Rhesus Negative (Rh -). In addition, there are seven blood components involving *Whole Blood (WB), Packet Red Cell (PRC), Liquid Plasma(LP), Fresh Frozen Plasma (FFP), Thrombocyte Concentrate (TC), Kriopresipitat (Kr)* and *Washed Erythrocyte (WE)*.

Increasing in the amount of blood demands by patients is not balanced by the amount of blood supply available. In addition, Blood Transfusion Unit provides a variety of different types of blood and has an unequal blood demand each period. Thus, to overcome this problem, stakeholder of BTU need to develop a management information system in inventory control to obtain the blood policy. It serves to meet blood demand of patients and determine the optimal amount of available blood stock.

Most of study conduct inventory management used several methods [3][4]. Thus, inventory method need to be applied in this study to improve service levels for the patient. The continuous review model method was adopted in this study because the demand of blood in term of probabilistic pattern. Furthermore, the results of the inventory policy need to be presented in developing information systems in the form of an application using the system development life cycle approach. Therefore, it has stages in the system development process [5]. Obviously, the purpose of study is to determine the blood inventory policy. Then, it is integrated with designing the information system to Blood Transfusion Unit.

II. INVENTORY MANAGEMENT INFORMATION SYSTEM

Inventory is a number of goods stored to avoid a shortage of product when production is taking place. Więcek (2016) in his research explained that companies able to overcome problems in the form of uncertainty in the demand of goods during a period of time. Excess inventory on the line production increased production time, waste and product storage costs [7]. Furthermore, this approach can determine the amount of safety stock to assist the production process. There are several benefits adopting inventory policy such as determining level of safety stock, re-order point, order quantity [8][9]. Plinere and Borisov (2015) explained that inventory policy is an approach to control of goods which its level is monitored continuously. Thus, whenever the inventory level reaches the point of reorder point, the order must be made immediately.

The implementation of inventory policies on production process can be supported by the application of management information systems. The integration both of them are packaged into an application that can be used by management in the decision-making process. There are many studies that adopt the development of information systems using the system development life cycle approach [11] [12]. Moreover, most of researchers explained that this approach is a process in developing the information systems with several stages including system analysis, system planning, system design and implementation. This approach also described the process of developing the system from the beginning to the final implementation.

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III. METHODOLOGY

Case study of this research was conducted in one of the Blood Transfusion Units in Indonesia. Data collection techniques in this study were carried out by direct observation and interviews. Moreover, primary data was obtained from direct observations involving standard operation procedure of Blood Transfusion Unit and interview respondents. Then, the results of interviews were conducted from 30 respondents who experienced blood donors and blood seekers directly to UTD. Furthermore, secondary data were data of profile BTU, blood products and blood demand in year 2016. All data collection was processed adopting continue review model and then analyzed into system development life cycle.

A. Continuous Review

Determination of the value of blood supply and demand in this study used the continuous review model. This method continuously controls inventory levels through determining safety stock. Then, application of this system orders the goods when the inventory level reaches the point in term of re-order point. Whenever the amount of product has reached the lower limit of the inventory, the order will be placed at the point of ordering the maximum limit of inventory. The overall steps of inventory policy ran into one application of inventory management information system

B. System Development Life Cycle

Preliminary stages in the system development life cycle approach is in the form of identifying the initial system. Then, it is continued with the identification of system requirements as an illustration of the proposed system. Furthermore, inventory control planning is carried out on inventory control data processing. The design of the proposed system for the value of the inventory policy followed by the design of information system modeling involving Entity Relationship Diagram and Data Flow Diagram.

IV. RESULTS

A. Blood Inventory

Inventory policy on blood inventory in this case studies is determined based on strategy of safety stock, reorder point and quantity order. Calculation of the optimal value of safety stock was done to anticipate the uncertainty goods between the blood stock and the amount of blood demand. It served that the safety stock can anticipate blood demand during the lead time. Determination of safety stock was obtained based on calculations using normal distribution. Then, the value of the standard deviation of blood demand was determined based on the operation standard procedures from Ministry of Health Indonesia that determined blood donors were obtained a span of 3 months [12]. Furthermore, the determination of Reorder point was carried out, this policy was implemented to obtain the value of the reorder point for each blood product. Thus, it can fulfill the blood demand from the patient and also prevent stock out. Determining of the reorder point was obtained from the calculation of data processing by considering the average amount of blood demand per month. Another inventory policy was order quantity, the determination of this approach was done to provide the optimal ordering quantity that must be obtained by the stakeholder. Whenever the blood supply is at the position of reorder point, Blood Transfusion Unit will produce blood component based on the optimum quantity of the order. The results of the calculation of safety stock, reorder point and quantity order is calculated based on monthly and it can be seen in Table 1.

B. Entity Relationship Diagram

Entity relationship diagram (ERD) is a tool to describe interactions between entities with their attribute data in a system. This tool able to transform into data structures and it is assisted by several notations and symbols. In this case, there are entities such as donors who can describe the attribute of the data based on the name, donor, blood type, quantity donor and date donor back. This data will be synchronized with donor history data in order to provide the information to the user. This application is a basic stage in the development of an information system. More details, ERD of blood inventory can be seen in Figure 1.

C. Data Flow Diagram

Data flow diagram (DFD) is a graphical approach that describes the flow of information on a system. This approach is used to describe not only the logical data flow of information but also the physical data flow diagrams as entities involved in a system such as hardware, people and goods. In this study, data flow diagram can describe the reorder point on processing process of blood supply. Then, it proceeds to store data related with this process. Thus, the system has a database based on stored data. DFD of blood inventory can be seen in Figure 2.

V. DISCUSSION

This case study showed that characteristic of blood inventory cannot meet the pattern of deterministic inventory assumptions that were constant. Generally, the inventory level was unbalancing because the ordering time and the amount of blood demand were fluctuating. Thus, it was categorized into probabilistic inventories that contain uncertainty of blood demand from donors. Moreover, the process of blood donor was not only from regular donors, but also there were from volunteer donors. Thus, predictions for the amount of blood donors were not ascertained how many blood bags were obtained per day.

This research also developed an information system which this was used by actors who act as regulators, operatives and the main controls of system including donors and management of BTU. Donor actors were users who access the system through the Android application to access the information of blood stock, blood donor schedules and health information. Management of BTU was the user who manages data of blood stock, donor, activity news and health information. In addition, information system was designed to produce several scenarios of interactions on the system that it was developed into the database and Android applications.

Inventory management information system in Blood Transfusion Unit aims to find out the whole process which includes the process of controlling blood supply and delivering information to the public. Main problem of this case shows that public need to find the sources of information related blood donor and efforts to get blood as soon as possible. Thus, the amount of blood supply currently that has not reached the target to meet donor blood assistance needs. To understand the conditions of this problem, this study is necessary to propose a problem solving that must be done in the form of inventory control planning and building a better information system based on the needs of the user. Obviously, management information system need to be build and then design features of system with interesting display and easy to access by users through the Android application.

VI. CONCLUSION

The results of blood inventory able to be integrated with management information system. Thus, this system can be implemented through an application using database systems and android application for users. This system can be managed by operator of BTU to entry the data, update blood stocks and add donor members in order to obtain donor information. In addition, operator of BTU also able to update activity schedules of blood donor. The application is successful for use on smartphone users. Consequently, users can access the information about blood stock, health information, activity schedule information and get notification from BTU when blood stock is running low. Moreover, inventory management information system in Blood Transfusion Unit need to evaluate in order to provide better service for customer. This study proposes prototype system of blood inventory. Further study is suggested to increase other features of inventory policy on the application in order to achieve customer satisfaction and consider blood inventory simulation in developing several scenarios to manage blood demand.

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TABLE I
BLOOD INVENTORY POLICIES

No	Blood Product	Demand (Bag)	Ordering Frequency (Period)	Order Quantity (Bag)	Safety Stock (Bag)	Reorder Point (Bag)
1	O - Rh (+) – WB	421	5	77	32	41
2	O - Rh (+) – PRC	755	8	91	34	50
3	O - Rh (+) – LP	27	2	12	1	2
4	O - Rh (+) – FFP	65	3	21	4	6
5	O - Rh (+) – TC	433	6	74	29	38
6	O - Rh (+) – Kr	9	1	7	1	1
7	O - Rh (+) – WE	7	1	6	0	1
8	A - Rh (+) – WB	301	5	59	25	31
9	A - Rh (+) – PRC	607	9	70	24	37
10	A - Rh (+) – LP	19	2	10	1	1
11	A - Rh (+) – FFP	60	3	20	4	5
12	A - Rh (+) – TC	272	5	59	24	30
13	A - Rh (+) – Kr	6	1	6	0	0
14	A - Rh (+) – WE	8	1	6	1	1
15	B - Rh (+) – WB	310	5	56	23	30
16	B - Rh (+) – PRC	567	8	67	19	31
17	B - Rh (+) – LP	21	2	11	1	2
18	B - Rh (+) – FFP	44	3	16	2	3
19	B - Rh (+) – TC	293	6	50	17	23
20	B - Rh (+) – Kr	14	2	7	1	1
21	B - Rh (+) – WE	4	1	4	0	0
22	AB - Rh (+) – WB	79	4	22	5	7
23	AB - Rh (+) – PRC	421	5	77	32	41
24	AB - Rh (+) – LP	755	8	91	34	50
25	AB - Rh (+) – FFP	27	2	12	1	2
26	AB - Rh (+) – TC	65	3	21	4	6
27	AB - Rh (+) – Kr	433	6	74	29	38
28	AB - Rh (+) – WE	9	1	7	1	1

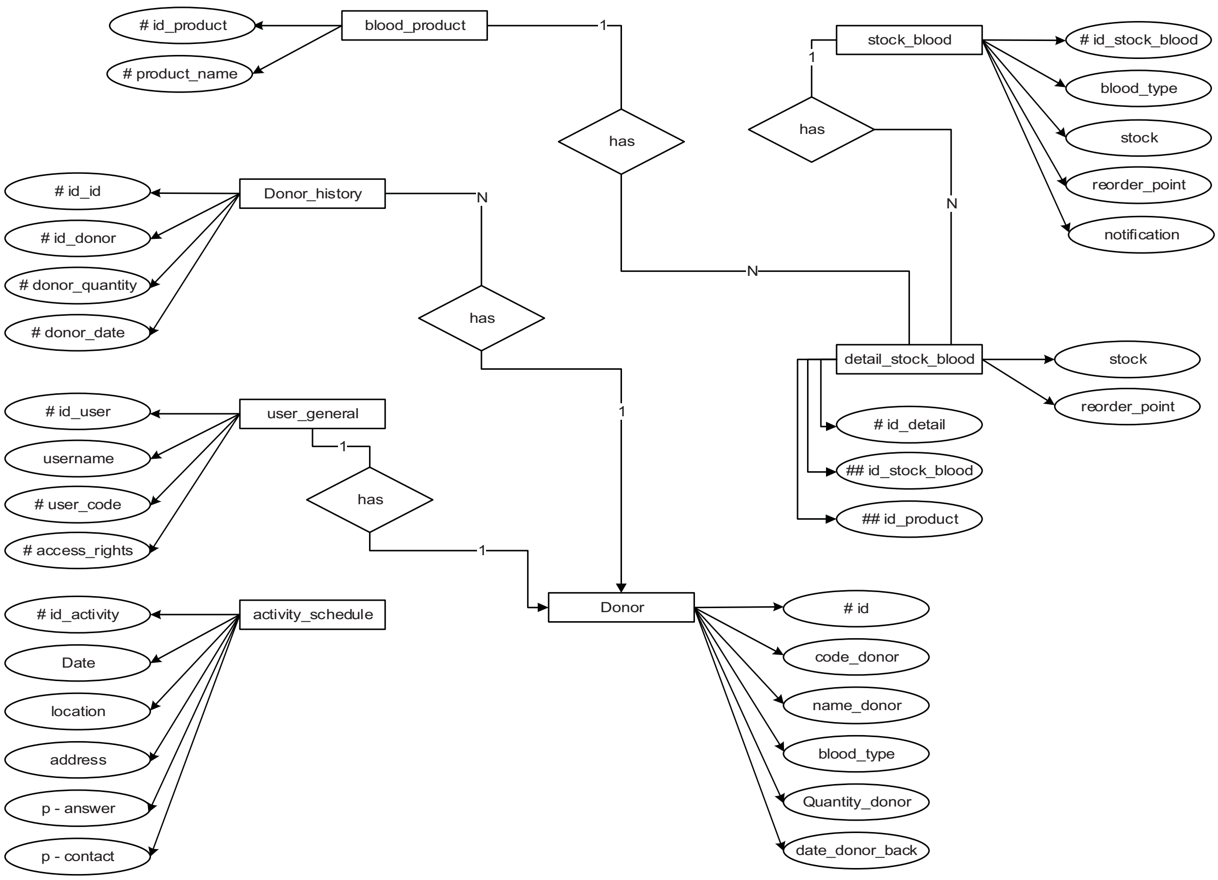

Fig 1. Entity relationship diagram

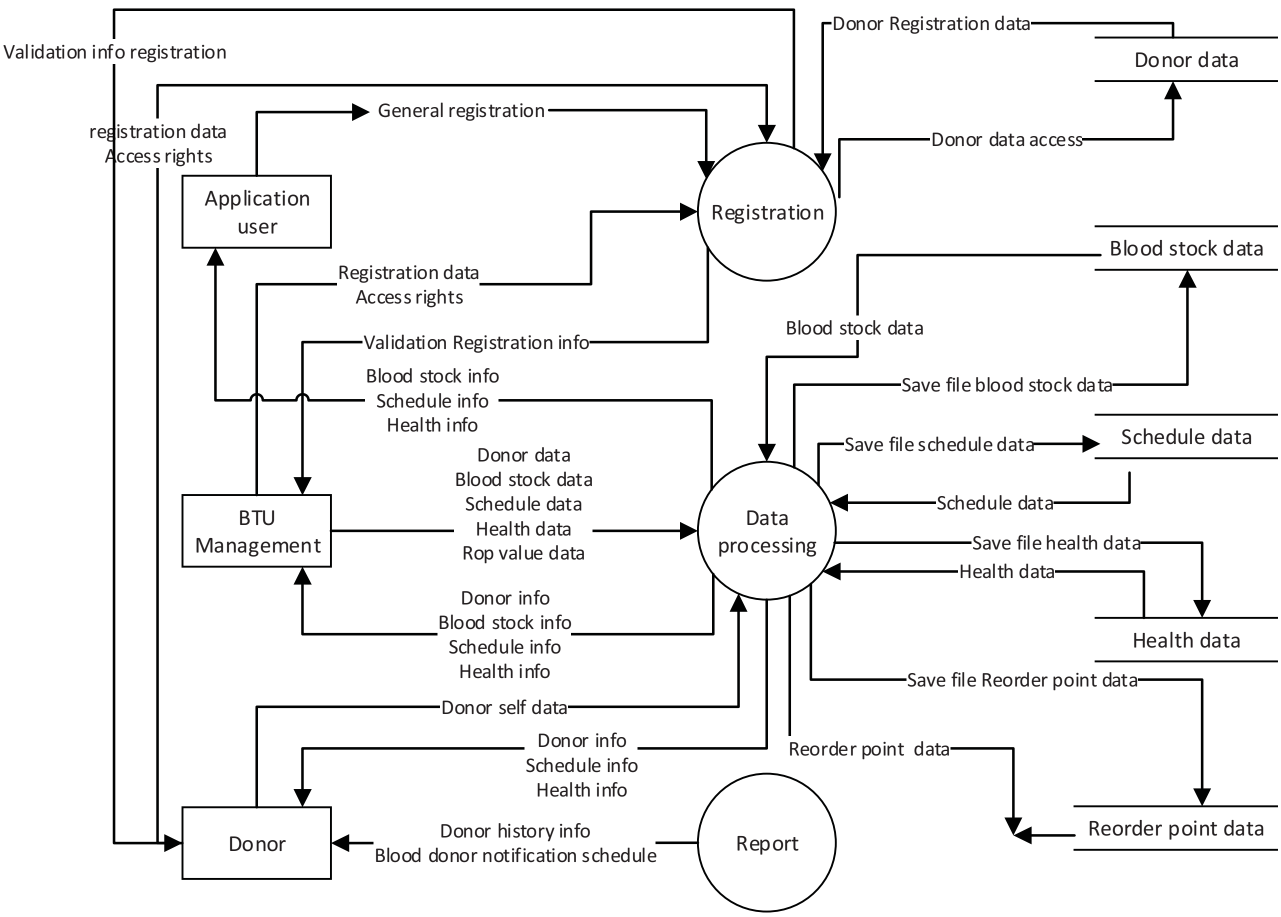

Fig 2. Data flow diagram