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Integration of Information System Based on Supply Chain Management (SCM) for Pharmaceutical Warehouse in Mamasa Regency

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Abstract **-** This research applied information system by using Supply Chain Management (SCM) in the pharmaceutical warehouse in Mamasa Regency. The scope of the research was maximized on pharmaceutical warehouse operations and drug distribution to clinics. This research did not focus on cost, profit, lead time, and procurement costs. This system was built using PHP programming language and MySQL database. System development process used waterfall method. It consisted of requirement analysis, system analysis, design, development, and testing. The test system used the xampp 6.2 servers with a black box testing method that involved the pharmaceutical warehouse staff as the end user. The results demonstrate technologies that can be used by physicians to submit drug requests faster and report on real-time drug use (LPLPO). For pharmaceutical warehouses, this system is useful for drug availability, drug management, and response information. This technology can help the health department to perform its role as a supervisory or controlling function (internal controls) of the drugs. This research also gives a recommendation for the pharmaceutical warehouse management in providing benefits for the institutions/companies involved. This research has an insight for the management to realize the importance of Information Technology (IT) to support daily operational activities.

Keywords: integration system, Supply Chain Management (SCM), pharmaceutical warehouse

I. INTRODUCTION

A pharmaceutical warehouse is a place that serves the needs of health clinic medicine, work area on inventory and distribution planning, and demand scheduling (Shah, 2004). It is a Supply Chain Management (SCM) in the health sector by involving multiple entities/work units (Qashlim, 2016). Each activity will be coordinated by the district health office (BPOM, 2012). The minister of health and social welfare of the Republic of Indonesian through policies and strategies for the development of Sistem Informasi Kesehatan Nasional (SIKNAS - National Health Information System) has sought to collect the coordinated data. It can be the integration of existing health systems such as assignment, responsibility, and interconnected mechanisms (KEPMENKES, 2001). However, the need for data integration has not been met. This is reinforced by the health sector difficulties in making the right decision because of the limitations or unavailability of accurate, precise, and fast data and information. These conditions indicate the problem of health information system in strengthening the improvement and efforts through data integration (Kementrian Kesehatan Republik Indonesia, 2012).

In general, problems arising related to future needs should be adjusted to demands (Shah, 2004). In addition, the amount of usage will affect the number of requests. When the request is not performed in accordance with or less than the required thing, the health clinic will re-request this. It may take a long time. On the other hand, it may affect the size of the goods demanded by the pharmaceutical warehouse and provided by the supplier's section (Putri & Prihanti, 2016). Then, the pharmaceutical warehouse and all its entities involved in operational activities manage the same data. However, because conventional systems applied cannot show the same data, the inventory calculations are performed by each party as a result of frequently different produced data (Nasir, Satoto, & Kridalukmana, 2014; Mulia, 2016) and resulted in delaying the report of drug use (Mulia, 2016).

Operational activities of pharmaceutical warehouses are procurement, reception, storage, distribution, and recalling (Arustiyono, 2015). The pharmaceutical warehouse should ideally perform drug stock calculations, and provide information on the amount of stock regarding available drugs in real time (Amir, 2011). In addition, collaboration, coordination, and integration among entities must be met for work efficiency (Qashlim, 2016; Rees, 2011). Information Technology (IT) can be the solution to help the business process in the pharmaceutical warehouse to become

simpler, integrated, automated and optimize health services (Lee, McCullough, & Town, 2013).

IT plays a critical role in SCM practice in the company (Hardjo & Suharjito, 2013). It is because it can record all transaction activities for clarification or addition of requests. It can create a good communication between the parties involved in SCM (Arshinder, Kanda, & Deshmukh, 2011; Risnandar & Wulandari, 2010). It can minimize information distortion and create strong interaction between agencies or work units involved in SCM, shorter cycle times, effective information flow and waste reduction (Troutt, Ambrose, & Chan, 2005). It can reduce operational costs and improve performance such as the improvement of health clinic services by shortening lead time and availability of data (Saputro *et al*., 2012).

According to Nasir, Satoto, and Kridalukmana (2014), the designed drug management information systems on pharmaceutical installations can help collect Lembar Permintaan dan Laporan Pemakaian Obat (LPLPO - request of drug and report of usage) data from all clinic. It assists in determining the distribution of drugs to clinic (public health service), managing drug supply data in Pharmaceutical Installations, and helping recovering expense and mutation reports. Unfortunately, the system has not yet integrated with the health service. In addition, the implementation of SCM-based systems for drug stocks and distributions can demonstrate drug use reports (Mulia, 2016; Qashlim, 2016). It also briefly discusses the problem. The designed prototype integration system enables health clinics to apply for pharmaceutical warehouses. Thus, stock data of pharmaceutical warehouse can be seen by the clinic. The system for simulation has not been fully used in the LPLPO format, and it has not processed the actual data. As shown by Nasir, Satoto, and Kridalukmana (2014), Mulia (2016), and Qashlim (2016), they have not involved health services as a control function.

This research will implement IT in the practice of SCM pharmaceutical warehouse. This system as an informative media will record all activities to provide information in real-time (Setijadi, 2015). A sub-system for health clinics according to LPLPO format and health department sub-system as a control function (internal control). Each party involved in the supply chain can access information and communicate without having to wait for a long time. The results of this research can be a recommendation for pharmaceutical warehouse management in improving the previous system.

II. METHODS

IT designed for SCM practice in the pharmaceutical warehouse has health clinic sub-systems for submission of LPLPO. The sub-system of health department has a function of internal control. Then, pharmaceutical warehouse system is for drug stock information, LPLPO acceptance, and drug distribution. The system is built using PHP programming language and MySQL database. The testing is done using xampp server 6.2 with a black box testing method. It involves the pharmaceutical warehouse staff as the end user. Besides that, focus discussion involves several pharmaceutical warehouses to evaluate the design and see how much the support is provided for the user. The research stages are shown in Figure 1.

The research phase involves industries that have been using supply chain-based integration systems. This is intended as a comparison of integration systems built with systems that have successfully expanded the company's performance. The results of research on industry become the basis for creating a prototype of systems integration in the health sector. The researchers involve pharmacists for functional system design. The pharmacists will examine the need for drug usage data, streamline data entry, and system of flow determination process.

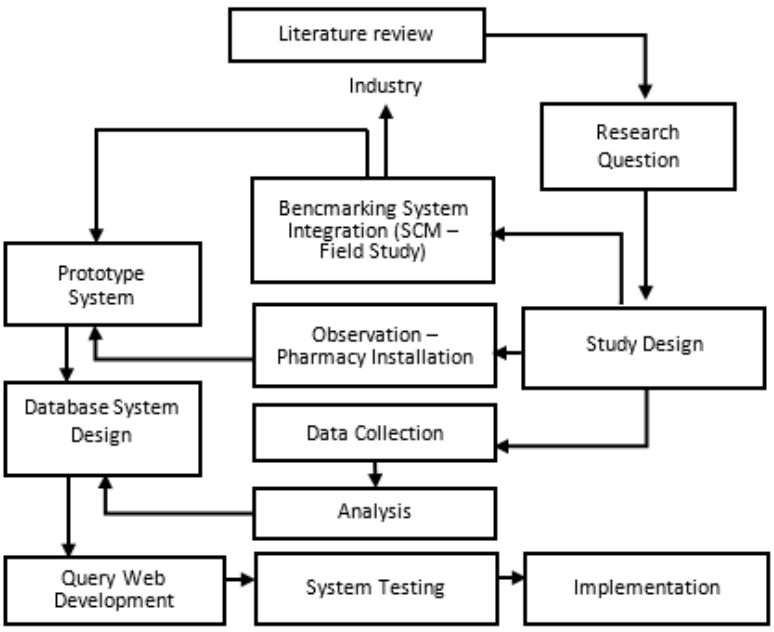

Figure 1 The Research Stages

For the current process path of the pharmaceutical warehouse, Pedagang Besar Farmasi (PBF - pharmaceutical wholesalers) will meet the needs or drugs in pharmaceutical warehouses and clinics. This fulfillment will always be coordinated to health officer as the responsible person. The next operational activity will be an SCM practice where Puskesmas, pharmacy installation, and health office will mutually collaborate. The activity begins when clinics submit LPLPO to the pharmaceutical warehouse. This submission will be verified by health department first. The verification is the process of matching between request submitted with previous stock and usage. The verification results will be submitted to the pharmaceutical warehouse to determine the distribution schedule. The distribution schedule can be known immediately by clinics and health department. This manual process will be the basis for determining the model of computerized systems (Oktavia, 2013).

Basically, the system is running as shown in Figure 2. It is the practice of SCM in the field of health. SCM practice starts from procurement of pharmaceutical warehouse stock and inventory to the distribution for the health clinic. The process of planning in the needs of drug and health supplies begins from the data of LPLPO in public health clinic. This data is based on the type and amount of drugs according to the pattern of disease. Then, it is submitted to district health office for verification and matching between stock, usage, and demand. Further verification results are submitted to the regency pharmacy installation. It is compiled into a plan for the need of public drugs and health supplies in the regency. Furthermore, in planning the stock and needs of the central and provincial health clinic, it will adjust to the needs of public drugs and health supplies in the regency/city and refer to Daftar Obat Esensial Nasional (DOEN - national list of essential medicines) (Direktorat Bina Obat Publik dan Perbekalan Kesehatan, 2007).

Figure 2 is the requirement in the analysis phase. It will assist the system design. The file system based on the flow is the initial support of the system to computerize the manual process systematically (Oktavia, 2013). The utilization of IT in the pharmacy field should involve pharmacists from designing and building information systems and technology to ensure the quality and safety. Involving pharmacists can help to design functional systems by examining drug usage data, streamline data entry, and to reduce the risk of excessive drug stocks. However, in the end, the pharmacist's involvement will be constrained by a lack of understanding of how pharmacists can engage in IT design (Stecklera *et al*., 2017).

In IT on business operational, SCM can help companies in completing the work. It can support business needs both internally and externally (Susarla & Karimi, 2012). IT used in companies is more likely to maximize business processes. Then, the most popular function is to provide information on stocks in which a customer has purchased or a notice to the customer about the remaining stock, delayed delivery order information, and inventory conditions. It should lead to a complex SCM implementation (Risnandar & Wulandari, 2010).

Supply chain technology that only adopts business processes is not a good strategy. It cannot create benefits or influence on the inter-firm relationship. It ultimately does not show improvement of company performance (Magutu, Aduda, & Nyaoga, 2015). This situation demands the new creation of various models and designs to support supply chain networks (Zahiri, Zhuang, & Mohammadi, 2017) For example, it can be visibility process and global flow control support for intelligent transactions that provide real-time business process information, demand planning and distribution scheduling, a collaboration of activities, and information synchronization (Estrada, 2011).

Management in the company begins to aware of the need to automate tasks and control inventory through the benefits of IT implementation (Hardjo & Suharjito, 2013). The practice of SCM in pharmaceutical warehouses can be automated using IT. This means that only companies that have managed their supply chain with good IT are companies with the right strategy to run a business operation. It also has an opportunity to improve performance (Magutu, Aduda, & Nyaoga, 2015).

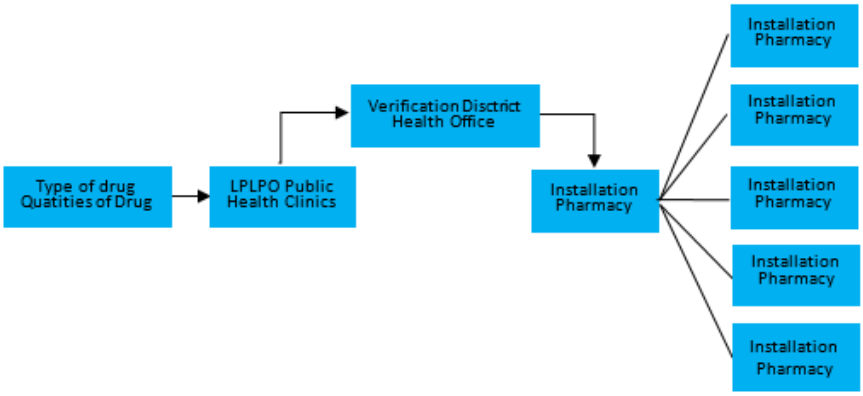

Figure 2 Demand Flow and Drug Distribution on Pharmaceutical Warehouse

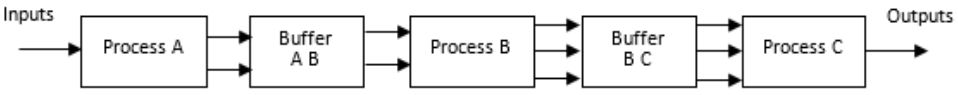

Figure 3 Model Proses
(Source: Troutt, Ambrose, & Chan, 2005)

The illustration of IT is shown in Figure 3. It is one of the programming models that can be applied to supply chain model. This model shows that in every process, there is a buffer on each stage. This model is the order of the overall process of the supply chain. Then, the buffer is the output of the results of one process. It will be the input of the next process (Troutt, Ambrose, & Chan, 2005).

Pharmaceutical warehouse operational activity is a repeated monthly routine. IT implementation to automate the process will improve work efficiency. Figure 4 shows the pharmaceutical warehouse operational activities designed for IT implementation. It is the proposed process flow of the IT system.

In Figure 4, there are three entities involved in the pharmaceutical warehouse operations activity. Each entity manages the transaction data. It can share information without ignoring the independence of each entity. The managed data is basically the same, but the assignment of each entity is different at the time of the transaction. The result of the health department activity has a buffer as the output. Then, this output becomes the input for processed activity on the pharmaceutical warehouses. The work of pharmaceutical warehouse is the final information that will be received by the clinic about the drugs to be distributed. It also becomes report for the next needs of public drugs and health suppliers. Basically, to control the movement of the materials, each department has roles. It is to control and inform regarding the needs that should be shared (Wibisono, Sofianti, & Awibowo, 2016). The functions of each entity are described in Table 1.

The data in this research is LPLPO. It is obtained in pharmacy installation of Mamasa Regency. The data will be used to simulate and test the system.

LPLPO from 17 clinics is shown in Table 2. The researchers analyze this to see the trends or patterns in disease based on drug demand and usage. Each clinic has different drug requirements and disease trends. This will certainly affect the demand and usage of medicines in the clinic area. Figure 5 is a database system design. Moreover, the data analysis results are presented in Table 3

The design of the database indicates that the proposed drug demand data (LPLPO) will be connected to the acceptance or supply table. It will be accessed by the pharmaceutical installation. Based on the data of drug demand, this data will describe the pattern of disease in the clinic.

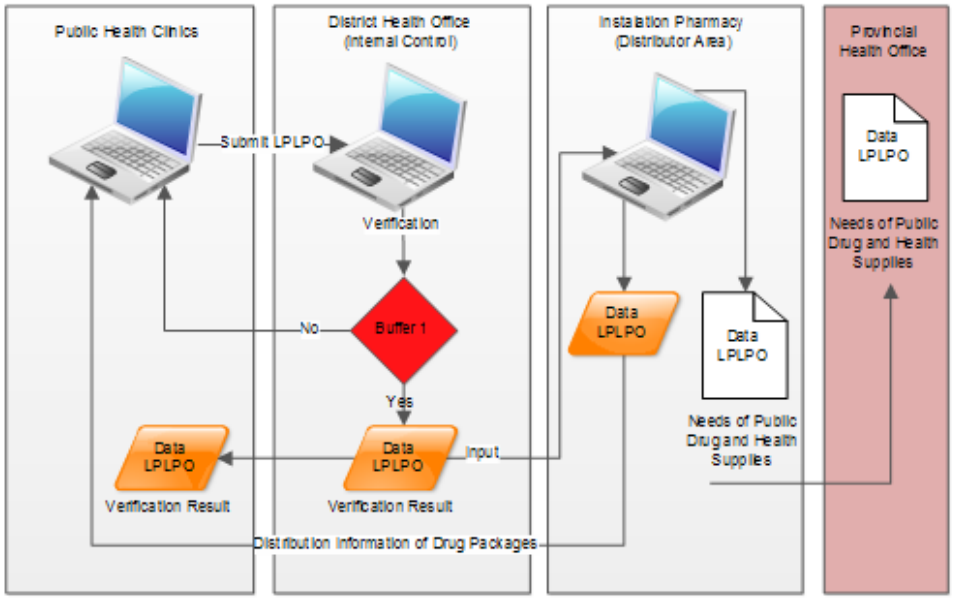

Figure 4 SCM-based IT Design for Operational Activity Process Flow

Table 1 User Involved in Functional Systems

No	User	Description
1	Super Admin	Manage user of data in pharmacy, clinic, health department
2	Pharmacy Admin	Manage drug data including procurement, receipt, storage, distribution, recalling, and monthly report printing.
3	Clinic Admin	Submit LPLPO data, view pharmaceutical warehouse stock, and print LPLPO report
4	Public Health Service Admin	Conduct LPLPO clinical data verification and control pharmacy distribution of pharmaceutical drugs

Table 2 Data of 17 Clinics in Mamasa Regency

Number	Community Health Clinic	Type	District
1	Tabulahan	Inpatient	Tabulahan
2	Balla	Outpatient	Balla
3	Sumarorong	Inpatient	Sumarorong
4	Nosu	Inpatient	Nosu
5	Tabang	Inpatient	Tabang
6	Sesenapadang	Outpatient	Sesenapadang
7	Mehalaan	Outpatient	Mehalaan
8	Rantebulahan Timur	Outpatient	Rantebulahan Timur
9	Pana	Outpatient	Pana
10	Mambi	Inpatient	Mambi
11	Aralle	Inpatient	Aralle
12	Malabo	Outpatient	Tandukalua
13	Tawalian	Outpatient	Tawalian
14	Buntu Malangka	Outpatient	Aralle
15	Bambang	Outpatient	Bambang
16	Mamasa	Inpatient	Mamasa
17	Messawa	Inpatient	Messawa

From all drugs in the clinic, the groupings are based on the type of disease. There are general and dental; maternal and child health and nutrition; tuberculosis and leprosy; malaria and filariasis; and immunization. The five types of diseases will be used to monitor and control the development of disease patterns. Each clinic has different drug needs. The tendency of drug usage also varies based on the most common consumption and the most frequently requested for pharmacy installation. This level of tendency will be considered to determine the pattern of disease in the community in five diseases groups. The data will be displayed on the system.

Data on demand, usage, and stock are the results of the overall recapitulation of drug used in each type of disease. The tendency of the disease can be seen in the usage of the drug. It is shown in Table 3.

Table 3 Data of Diseases Pattern of Trend

Type of Diseases	Demand	Usage	Stock
General & dental	23	43	23
Maternal and child health & nutrition	34	23	23
Tuberculosis & leprosy	45	43	32
Malaria & filariasis	21	32	23
Immunization	23	12	32

III. RESULTS AND DISCUSSIONS

The results of this research show an integrated information system and use the SCM concept to support pharmaceutical warehouse operations. This system can be the recommendation for management in the pharmaceutical warehouse. It is to repair old systems to assist the operational activity. Figure 4 shows the relationship between entities in SCM. Each entity will describe the shape of SCM practice, and the applied IT model. It also shows the business process between pharmacy installations, clinics, and health offices as SCM actors. It also describes the scope of each major entity in the use of IT to be implemented. IT to train SCM on each entity is as follows.

First, it is IT for SCM practice in clinic health. The clinic's LPLPO contains information about the trends of the drug requested. This can be the basis for determining the pattern of public illness. LPLPO will be compiled by pharmaceutical installations to become a plan for the needs of public drugs and health supplies in the district. This LPLPO health office becomes a control system to formulate a health action plan. It also determines the intervention or policy determination of community disease management. Figure 5 is a GUI clinical subsystem. Graphical User Interface (GUI) in Figure 6 is a clinical subsystem for the submission of this LPLPO. It is the beginning of the process to be performed in the pharmaceutical warehouse.

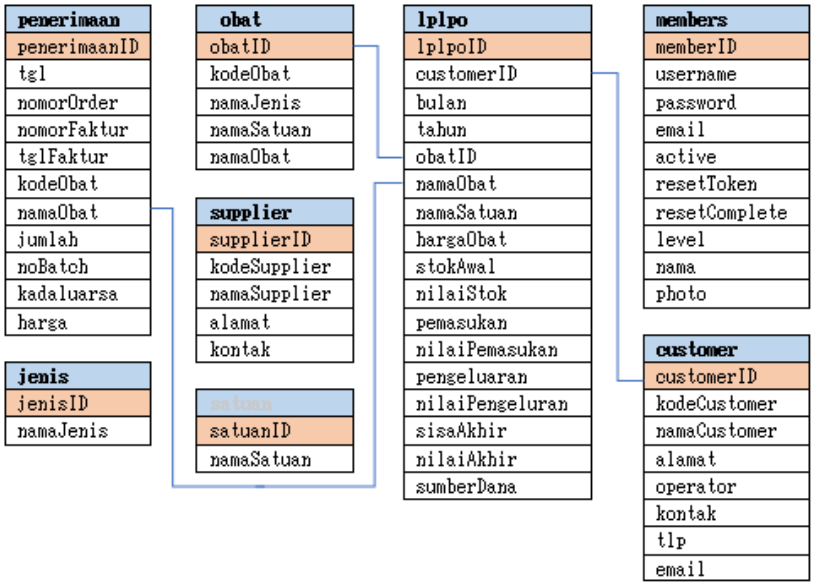

Figure 5 Database System Design

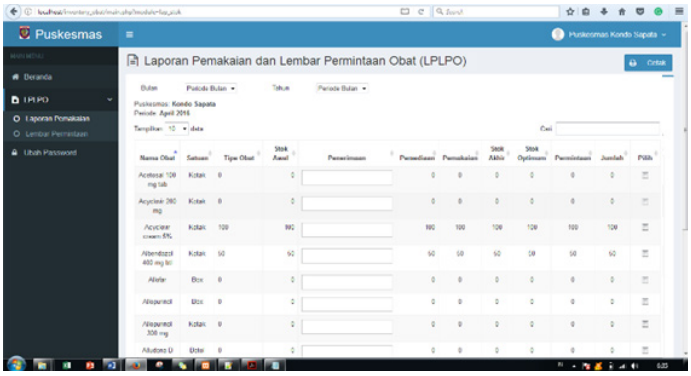

Figure 6 GUI Submit LPLPO Clinic

Second, it is IT for SCM practice in pharmaceutical warehouses. SCM practices in pharmaceutical warehouses are more likely to be in inventory management. GUI pharmaceutical storehouse subsystem is presented in Figure 7. The researchers really maximize system performance in here. To calculate inventory, the researchers use the equations as follows.

$$f = d + e \tag{1}$$

Equation (1) explains that f is supply, d is initial stock, and e is acceptance. The sum of the initial stock (d) and the receipt (e) is the stock inventory for the future. For calculating the remaining stock (h), the researchers use the following equation.

$$h = f - g \tag{2}$$

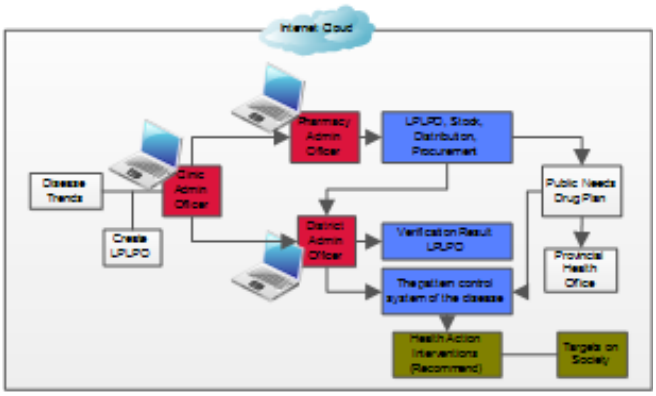

Figure 7 The Relationship between the Entities Involved in SCM in the Scope of the Study

The remainder of the stock (h) can only be determined by subtracting the supply (f) by the amount of use (g). Equation (2) automatically provides information about the state of the drug stock in the warehouse.

Third, it is IT for internal control. The supervisory function undertaken by the public health service is more as a form of control (internal control). It is to monitor drug management and distribution. Figure 7 shows some functional systems that can be performed by the health service such as LPLPO verification. It is by receiving reports of pharmaceutical warehouse and LPLPO verification, and seeing dashboards about disease patterns. Then, Figure 8 is a GUI sub-system for the health service supervision function.

Figure 8 and 9 are data of visual analytics. This is the tendency of disease patterns. It can be seen in the high usage of the drug. By district government, this data can be used to support the health policy.

Fourth, it is system testing. The system testing is done by black box testing method. It involves pharmaceutical warehouse staff as the system users. The test results are presented in Table 3. Portal system can be visited in http://scm.fikom-unasman.ac.id.

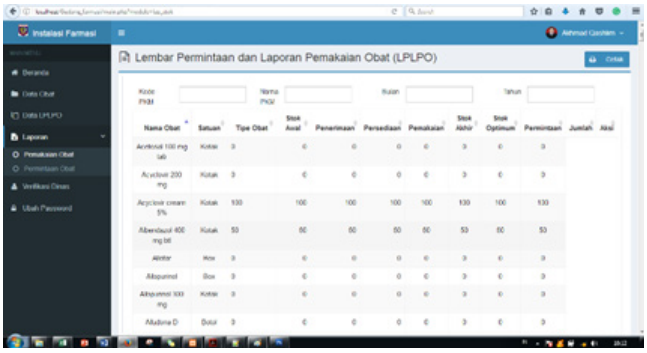

Figure 8 GUI Pharmaceutical Warehouses

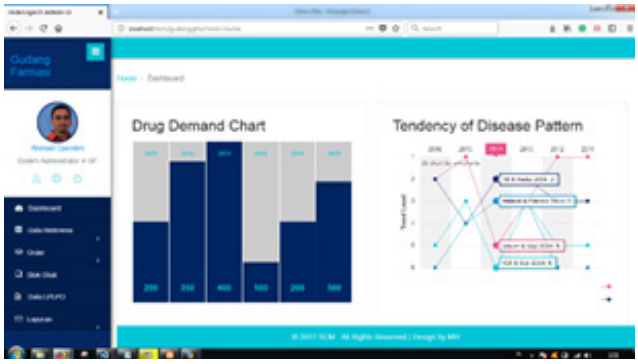

Figure 9 GUI Sub-System of the Public Health Office

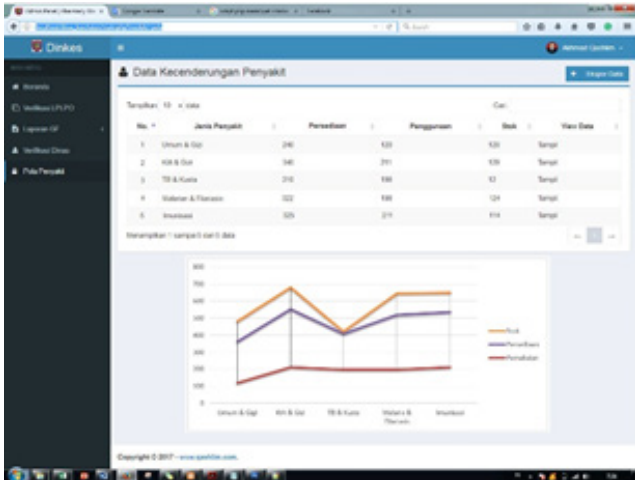

Figure 10 Data of Visual Analytics

Table 3 The Test Results of User Acceptance

No	Test Cases	Expected Result	Status Pass/Fail
Clinical Sub-system			
1	Login System	User can login	Pass
2	Show amount of medicine Stock from Pharmaceutical warehouse	Drug stock is displayed	Pass
3	Show progress request	Request progress is displayed	Pass
4	Data Input Drug demand	Drug requests are successful	Pass
5	Input drug usage	Drug request is sent	Pass
Pharmaceutical Warehouse Sub-system			
6	Login System	User can login	Pass
7	Show stock count	Drug stock can be seen	Pass
8	Show LPLPO clinic	LPLPO is in process	Pass
9	Show total drug usage	The overall drug stock is displayed	Pass
10	Input of drug data	Drug data is recorded	Pass
Subsystem Public Health Office			
12	Login System	User can login	Pass
13	Show LPLPO Clinic	LPLPO is displayed	Pass
14	Input drug verification	Verification is possible	Pass
15	Graph of clinic drug usage	Users can view the drug charts	Pass
16	Pharmaceutical warehouse distribution chart	Users can see the drugs distributed	Pass

Last, there is a recommendation for the management. The graph presented in the system is sourced from clinical drug demand data. The system can be a strategic decision-making tool to assist management knowledge in mapping out health care needs. It is by determining disease patterns and ensuring public health policy intervention planning. This technology is a sustainable product that shows system integration with SCM concept. This is considered as a tool to improve performance and services in the health sector. The implementation of this IT should be supported by a good internet service to produce good results as well.

IV. CONCLUSIONS

The operational activities of the health sector involved in the demand, acceptance, and distribution of medicines such as Puskesmas, pharmaceutical installations, and health department have conducted supply chain practices. Maximizing supply chain practices is done by integrating all existing information systems. The integrated information system will help them to access the pharmacy distribution and distribution division. This allows pharmaceutical supply planning and the fulfillment of clinical needs to be met on demand at the right time. Systems in each sector have been integrated. People can access information related to inventory and distribution, establish cooperation with outsiders, and enable communication with other institutions.

Further research can be done to test the challenges existing in distributing data or information to each sector. System development can be a control system to monitor the ups and downs of disease patterns in each clinic. It can also be integrated with other units. Additionally, this technology offers a new way of making healthcare policy. The implementation of this technology will be constrained by the availability of a good internet network and limited human resources who will manage the system. This solution will also need support from the government. This system can also be developed by involving biomedical, so it collaborates with the fields of engineering, science, and complete technology.

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