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# BUSINESS INTELEGENCE MONITORING SYSTEM OF MEDICINE AND MEDICAL EQUIPMENT INVENTORY AT BAPTIS BATU MALANG HOSPITAL

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A B S T R A C T

An increase in the income level of the population causes the demand for health services to increase and affects the increase in the cost of health services. This needs to be balanced with the increasing public health status. One of the improvement processes is by implementing the BI system in the Batu Baptist Hospital Pharmacy. The method used is implementing the BI system at Batu Baptist Hospital to support quality in strategic decision making. The BI system for drug and medical equipment inventory can be accessed by two types of users, namely admin and warehouse manager/pharmacist. Each of these actors can operate the system according to the access rights they have. Admin can make ETL, and manage BI System dashboard for medicine and medical equipment inventory. The results of the dashboard can later be seen by the warehouse manager/pharmacist. BI development to assist decision making at Batu Baptist Hospital Malang through several stages: data warehouse modeling, ETL process, pentaho application connection with tables, and BI dashboard visualization design. The BI dashboard that has been visualized is a graph of the comparison of drugs and outgoing drugs, a comparison graph of medical device supplies and the use of medical devices, trend graphs so that the expenditure of medical devices in a given month can be used as a manager's consideration for adding medical equipment supplies based on the needs of the most widely used medical equipment. per month in one year.

Keywords: Business Intelligent, ETL, Data Warehouse.
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## 1. Introduction

Technology in its application has changed the way the health industry operates and makes efficient use of resources and is able to improve health services in hospital institutions [1]. The implementation of health services in hospitals has complex characteristics and organizations [2]. This is supported by an increase in the income level of the population, causing the demand for health services to increase and affecting the increase in the cost of health services. This needs to be balanced with the increasing public health status. Information is very important as an asset that the organization depends on and the ability to manage it determines the welfare and success of the organization in the future [3]. The role of information is very important because it provides information in the decision-making phases such as planning, controlling, and evaluation [4]. The hospital's ability to manage the information it has is different between success and failure because the information is used to control the hospital's operations from day to day [5]. The hospital is one of the health service facilities which is a health resource [6]. One of the improvement processes is by implementing the BI system in the Batu Baptist Hospital Pharmacy. The application of the BI system at the Batu Baptist hospital can support quality in strategic decision making, so that the quality of health services in the Batu Baptist hospital will increase.

Currently, hospitals in Indonesia generally have not implemented the BI system in the decision-making process in the field of pharmaceutical services. Direct services to patients are usually processed automatically using information systems, such as inpatient service information systems, outpatient service information systems and financial information systems, but for certain activities that require strategic decisions such as: drug supply still requires policy involvement from the head of the pharmacy installation. or hospital leadership manually. So far, the use of existing information systems at the Batu Baptist Hospital is still very limited for the process of handling operational activities, which were previously done manually and have not really supported strategic decision-making processes. Especially in the process of forecasting the amount of stock of drugs and medical devices that should be in Batu Baptist Hospital.

The BI solution is also the BI system as a decision support system in the hospital environment, especially regarding the policy of drug supply and pharmaceutical equipment [7]. Business Intelligence is a collection of methodologies, processes, architectures, and technologies that transform raw data into useful and useful information and enable users to make business decisions with real-time data [8]. Using OLAP (online analytical processing) and object-oriented approaches to build BI systems [9]. OLAP is the ability to efficiently manipulate data from several perspectives (perspectives) [10]. OLAP not only aggregates data but also has the ability for BI systems to see new ways [11]. After the OLAP

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process, ETL is the foundation of a data warehouse [12]. The ETL process itself consists of extracting, transforming, loading [13]. Statistical analysis and data visualization are very important to pay attention to when communicating the display and the data used [14]. Data warehouse is a source of dimensional storage data that has been through the process of extracting, cleaning, which can provide support in decision making [15]. Medicines and medical equipment are an important part of a Stone Baptist hospital. Without medicine and medical equipment, Batu Baptist hospital cannot run properly. Medicines and medical equipment themselves have a condition whether they are still suitable for use or not. If drugs and medical equipment are not used for too long, they will expire and/or damage due to poor storage conditions.

Because it cannot be monitored at any time by doctors or pharmacists, the importance of implementing BI in Batu Baptist Hospital to assist staff and doctors in monitoring is very important. In addition, with the application of BI, it is hoped that it will simplify the monitoring process and the most important thing is the forecasting process so that the Batu Baptist Hospital can determine the amount of stock of drugs and medical equipment that is suitable for the needs of the Batu Baptist Hospital in the future so that there will no longer be drugs and medical devices that eventually wasted due to expired or damaged due to storage. In the case of this research there is a limitation of the problem is that BI will only display a visualization report comparing the total number of medical devices with the number of medical devices issued, a report on the comparison of the total number of drugs with the number of drugs issued. The developed Business Intelligence is expected to be able to help provide knowledge to assist the management of tools and medicines at the Batu Baptist Hospital in Malang in making decisions and be a consideration for Batu Baptist Hospital to be able to apply the Business Intelligence system in the future.

## 2. Literature Review

### *2.1. Business Intelligence (BI)*

Business Intelligence (BI) is a system whose use is still small, especially in the health sector or hospitals. BI is not just an application, but rather a business process or architecture that directs hospital operations to achieve their business goals. BI includes various applications, methodologies, and services that can be used to collect data which is then analyzed and displayed in an understandable report. BI can be used to obtain useful information from certain data held.[7].

In addition, BI can also increase the value of organizational data and information by integrating all data so as to produce complete decision making.

### *2.2. Data Warehouse*

Data warehouse is a place for storing information collected from various sources, stored in unified schema and usually located in a location / site [16]. The data warehouse has four characteristics are:

a. ***Subject Oriented,*** The data warehouse is into many subjects the main ones such as customer, product, and sales. Data warehouse do not concentrate on daily operational activities and transaction processes in an organization, data warehouse focus to modeling and data analysis for retrieval decision

*b.* ***Integrated,*** Data warehouses are usually built with integrate disparate data sources, such as relational databases, flat files , and online transactional. Technique data cleaning and data integration are used to ensure consistency in naming conventions, coding structures, attribute size, and so on.

c. ***Non-volatile,*** The data warehouse physically separates the collection data from application data found in operational environment. In the data warehouse separation is not Requires transaction processing, recovery, and concurrency control mechanism. Usually only requires two operations in accessing data, initial loading of data and access of data.

d. ***Time Variant,*** Data is stored to provide information from historical perspective (eg, the last 5-10 years). Each key structure in the data warehouse contains both implicit and explicit time element.

### *2.3. Online Transaction Processing (OLTP)*

OLTP is a task-oriented, data-focused process in daily transactions (insert, update, delete) where the data is data that up-to-date and specific. The main emphasis in this OLTP system is placed on the process Fast querying, maintaining integrity in a multi-access environment and effectivenessmeasured by the number of transactions per second.

### *2.4. Online Analitical Processing (OLAP)*

OLAP is usually characterized by a relatively low volume of transactions. Query usually very complex and there is aggregation. For an OLAP system the response time is a measure of effectiveness. OLAP applications are widely used for data mining techniques. In OLAP databases there is aggregation, historical data, stored in a multidimensional schema (usually a star schema).

### *2.5. Extraction, Transforming, and Loading (ETL)*

The definition of ETL is a process in the formation of a data warehouse. The ETL process has the objective of collecting, screening, managing and combine valid data from various different sources and then to stored in a data warehouse. The ETL process consists of Extracting,Transforming, and Loading. Here's an explanation of each process :

a. Extract
   Extract is the process of retrieving data extracted from the operational system, Can use the query or the ETL application itself. This process can take place many times to get quality data.

b. Transforming
   Transform is the second process after the extract process. Data obtained from the extract will be cleaned and changed from the original data to the appropriate data form with data warehouse standards.

c. Loading
   Load is the last process whose use is to enter data which has been transformed into the database.

## 3. Research Methods

The method used is quantitative research methods. This study used primary data in collecting data, namely drug recap and secondary data

obtained from a literature review. There are stages of needs analysis, including:

1. External interfaces include: user interface, hardware interface, software interface, communication interface,
2. Use Case Diagrams
3. Functional Requirements
4. Non-Functional Requirements

A more detailed explanation is as follows:

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**1. External Interface Needs**

The user interface of this software is built using a web-based user interface. The user interacts with the software through the user interface on a web browser.

1.1 User Interface

In interacting with the user, this software requires a device to carry out the process of transforming input and output from and to the user. The devices are as follows

- Mouse and keyboard, for means of entering input data into the system.
- Monitor screen, used to display applications to the user.

1.2 Hardware Interface

a. Server Site

- Server Computer Requirements:
  - Asus Server RS300S4-020201
  - AOC 15.6" E1670SWU LED
- Logitech Classic MK120 USB + Optical USB
- DBMS : DB2
- Development tools : Data Studio, Data warehouse 10 enterprise edition
- Linux Centos 6.5 OS server computer, with 16 GB RAM
- Data storage capacity 10 TB

b.Client Site

- Operating System : Windows
- Internet network: LAN, WiFi adapter
- Browsers: Google Chrome, Mozilla Firefox, Opera, etc.
- Hardware Requirements:
  - Computer (Intel Core Compatible), 4GB RAM
  - Keyboard and mouse do not have special specifications
- Data For the data warehouse schema from the ETL process, it is expected to produce the following data:
  1. Knowing the current total drug supply
  2. Knowing the total drug out
  3. Knowing the current total medical equipment inventory

1.3 Communication Interface

The hardware interface required by this software includes:

LAN, Wi-Fi Adapter. LAN, Wi Fi Adapter is used to connect a computer / device that runs the software with the internet network.

**2. Use Case Diagram**

Figure 1 is a use case diagram of the BI system for equipment and drug inventories at Baptist Hospital Malang. This system has 2 users, namely Manager and Admin. Managers have activities, among others: See the number of media tools and the use of medical devices, see the number of drug supplies and medicines that come out, see the trend of the need for medical devices per month. While the Admin has activities including: making ETL and managing dashboards (input, update, delete data).

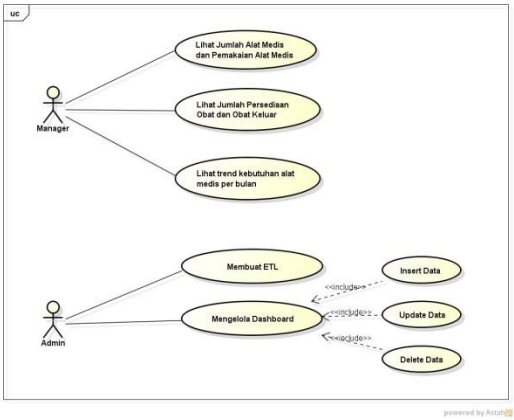


**Figure 1.** Use Case Diagram of BI Inventory System at BAPTIS Batu Malang Hospital.

**3. Functional Requirment**

**Table 1.** Functional Requirements for BI System Inventory at Batu Baptis Malang Hospital

| Functional Code | Functional Name | Description |
|---|---|---|
| BI_F_001 | See the number of medical devices and the use of medical devices | Managers can see a report comparing the total number of medical devices with the number of medical devices issued. The report is described in the form of a bar chart with a diagram description if the medical devices that come out are less than 50% of the total number of medical devices, it is necessary to reduce the number of medical equipment stocks in the coming year. And if the number of medical devices comes out more than 80% of the number of medical devices, it is necessary to increase the number of medical equipment stocks in the coming year. |
| BI_F_002 | See drug supply and medicine out | Managers can view reports comparing the total number of drugs with the number of drugs issued. The report is depicted in the form of a bar chart with a description of the diagram if the drug that comes out is less than 50% of the total drug amount, then it is necessary to reduce the amount of drug stock in the coming year. And if the number of drugs out more than 80% of the total number of drugs, it is necessary to increase the |

| | | |
|---|---|---|
| | | number of drug stocks in the coming year. |
| BI_F_003 | Create ETL | Admin can retrieve data from OLTP (HOMS) as input data to ETL. Then the data is extracted, transformed, and loaded. |
| BI_F_004 | Manage Dashboard | Admin can manage dashboard based on data generated from ETL process. The dashboard system consists of two dashboards. Namely the medicine stock dashboard and the medical equipment stock dashboard |
| BI_F_005 | See the trend of medical device needs per month | Manajer dapat melihat pengeluaran alat medis pada bulan tertentu. Sehingga dapat dijadikan pertimbangan untuk penambahan persediaan alat medis berdasarkan kebutuhan alat medis yang paling banyak digunakan perbulannya dalam satu tahun |

**4. Non Functional Requirment**

**Table 2.** Non-Functional Requirements
System BI inventory of Batu Baptis Hospital, Malang

| Non Functional Code | Functional Name | Description |
|---|---|---|
| BI_NF _001 | *Ergonomy* | The application is designed to use a maximum of 4 colors with a menu display to make it easier for users, but the display has not been made responsive so that it cannot be accessed via mobile. |
| BI_NF_002 | Performance | The system does not crash or hang during use. The division of the area of use of the system will increase and maintain the strength of the system in terms of speed and data efficiency. |
| BI_NF_003 | Kehandalan | This system can be accessed anytime (24 hours/week). |

## 4. Results and Discussion

BI development can be explained in 3 stages, namely data warehouse modeling, ETL process, and dashboard visualization process.

**1. Data Warehouse Modeling**

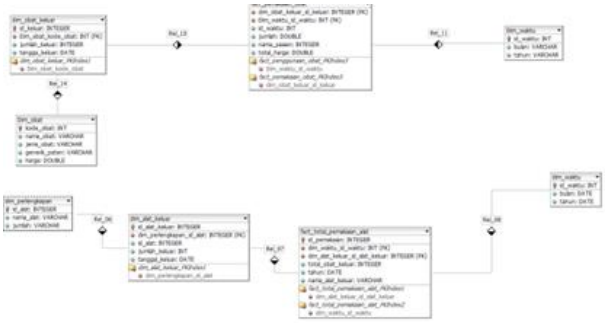

**Figure 2.** OLTP Data for BI Inventory System at BAPTIS Batu Malang Hospital

Figure 2 is the required OLTP data in the form of drug inventory and medical equipment in the form of drug data, outpatient drug data, medical equipment data, and outgoing device data..

**2. Extract, Transform, and Load (ETL) Process**

ETL is the process of transferring data from the source database (OLTP) to the data warehouse (OLAP). The ETL process using the Pentaho Data Integration facility results in the Drug ETL in Figure 3 and the Medical ETL in Figure 4.

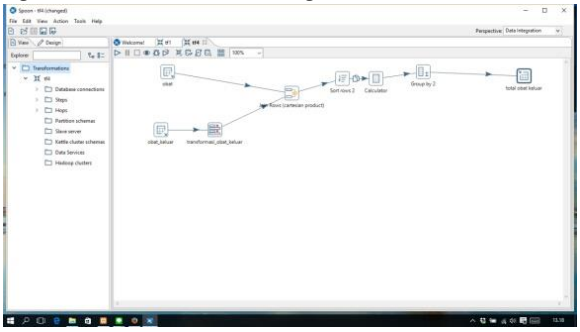

**Figure 3.** Results of Drug ETL

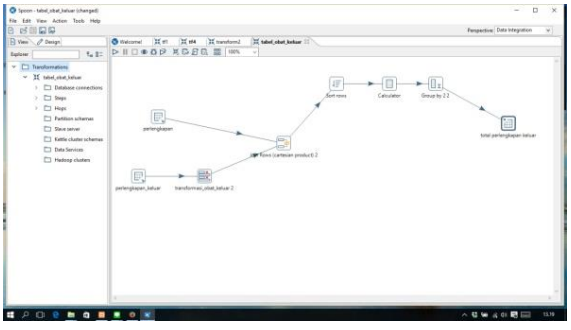

**Figure 4.** Results of Medical Equipment ETL

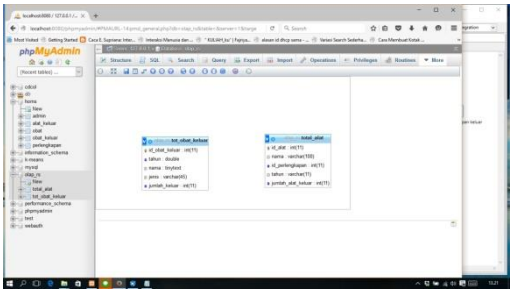

**Figure 5.** Results ETL

### 3. Visualisasion Dashboard BI

BI Dashboard will be created based on the type of decision-making that has been determined. Figure 6 dashboard display chart comparison of drug supplies and drugs out.

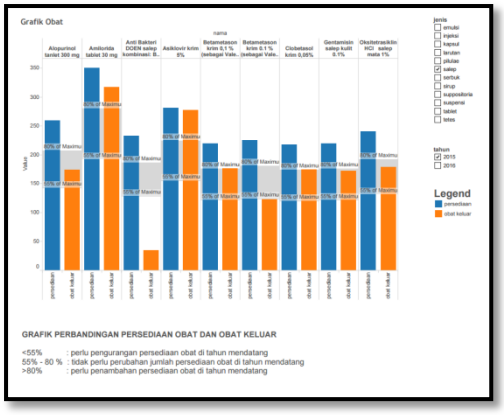


**Figure 6.** Display of Medication Dashboard

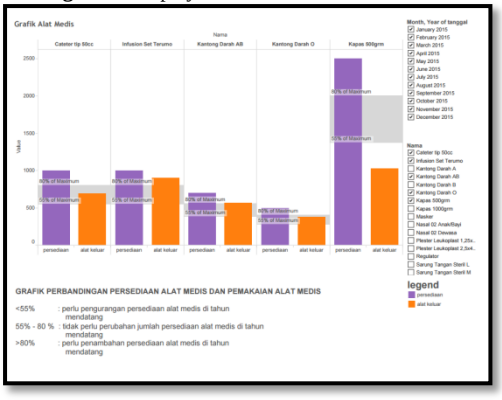


**Figure 7.** Display of the Medical Device Dashboard

Figure 7 shows the dashboard of medical devices, comparison of medical devices and the use of medical equipment so that they know the limits of the shortage of medical equipment supplies, the addition of medical devices.

**Figure 8** shows the trend dashboard of certain medical devices in a certain month so that it can be used as a manager's consideration to add drugs based on the most used per month in one year.

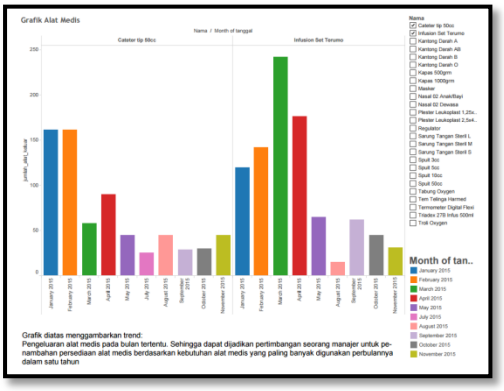


**Figure 8.** Display Medical Device Trend Dashboard

## 5. Conclusion

The conclusions obtained from the research carried out are as follows:

a. BI development to assist decision making at Batu Baptist Hospital Malang which went through several stages: data warehouse modeling, ETL process, pentaho application connection with tables, and BI dashboard visualization design

b. The BI dashboard that has been visualized is a graph of the comparison of drugs and outgoing drugs, a comparison graph of medical device supplies and the use of medical devices, a trend graph so that the expenditure of medical devices in a certain month can be considered by a manager to add medical equipment supplies based on the needs of the most widely used medical equipment. per month in one year.

## Acknowledgements

Suggestions from this research are that in the future it is necessary to develop other decision making because there are many aspects that need to be managed by hospital management so that information related to finance and inventory can be taken into consideration for further development.

## REFERENCES

[1] Abusweilem, M. A., & Abualous, S. “The impact of knowledge management process and ….business intelligence on organizational performance. Management Science Letters”, Hal. 2143–2156, 2019.

[2] Azemi, N. A., Zaidi, H., & Hussin, N. “Information Quality in Organization for Better Decision Making“. International Journal of Academic Research in Business And Social Sciences, Vol. 7 No. 12, Hal. 429-437, 2018.

[3] Trieu, V.-H. T., Cockcroft, S., & Perdana, A. “Decision-Making Performance in Big Data Era: The Role of Actual Business Intelligence Systems Use and Affecting External Constraints “. Research-in-Progress Papers ECIS 2018 Proceedings, Vol. 12. 2018.

[4] Vayena, E., Dzenowagis, J., Brownstein, J. S., & Sheikh, A. “Policy implications of big data in the health sector”. Bulletin of the World Health Organization, Vol. 96 No. 1, Hal. 66–68. 2018.

[5] T. V.Y., R. G., and P. J., “Penerapan Sistem Informasi Rumah Sakit X Kota Manado Dalam Perencanaan Ketenagaan Dan Peralatan Medik,” J. Kesmas, Vol. 8, no. 6, pp. 36–48, 2019.

[6] M. R. Atsani, G. T. Anjari, and N. M. Saraswati, “Pengembangan Business Intelligence Di Rumah Sakit (Studi Kasus: Rsud Prof. Dr. Margono Soekarjo Purwokerto),” J. Telemat., vol. 12, No. 2, pp. 124–138, 2019.

[7] A. Maulana and D. A. N. Wulandari, "Business Intelligence Implementation To Analyze Perfect Store Data Using the OLAP Method," Sinkron, vol. 3, no. 2, pp. 103–109, 2019.

[8] J. P. New, D. Leather, N. D. Bakerly, J. McCrae, and J. M. Gibson, "Putting patients in control of data from electronic health records," Br. Med. J., 2018.

[9] Darman, R. "Pembangunan Dashboard Lokasi Rawan Tanah Longsor di Indonesia Menggunakan Tableau". Jurnal Teknik Informatika Dan Sistem Informasi, Vol. 4 No. 2, Hal. 256–269. 2018.

[10] Haekal, M. F., Supian, M., & Sabrina, W. "Efektivitas Penetapan PSBB Dalam Menurunkan Perilaku Konsumtif Masyarakat Pada Masa Covid-19". Jurnal Kajian Ilmiah, V. 1 No.1, 93–98. 2020.

[11] Syarli, S., Tamin, R., & Qashlim, A. "Perancangan Business Intelligence System Pada Gudang Farmasi Dinas Kesehatan Kabupaten Mamasa ". Jurnal Keteknikan Dan Sains. JUTEKS), Vol.1 No.1, Hal. 7–14, 2018.

[12] Yunus, N. R., & Rezki, A. Kebijakan pemberlakuan lock down sebagai antisipasi penyebaran corona virus Covid-19. Salam: Jurnal Sosial Dan Budaya Syar-I, Vol.7 No.03, Hal. 227–238, 2020.

[13] Riksazany, R., & Ayub, M. "Eksplorasi Data Warehouse Penjualan dengan Tableau." Jurnal STRATEGI-Jurnal Maranatha, Vol. 1 No.2, 574–584, 2019.

[14] Rizaldy, I. "Sistem Pendukung Keputusan (SPK) Penentuan Kabupaten yang Terkena Corona Virus Disease19 (Covid19) Untuk Pemberlakuan Sistem Pembatasan Sosial Berskala Besar (PSBB) dengan Menggunakan Metode Topsis. " 2020.

[15] Lin, L., & Hou, Z. "Combat COVID-19 with artificial intelligence and big data." Journal of Travel Medicine, Vol. 27 No.5, 2020.