

Data Warehouse Information Management System Rsu Dr. Soetomo For Supporting Decision Making

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ABSTRACT

Dr. Soetomo General Hospital (RSU Dr. Soetomo) in Surabaya has computerized their administration system base on the Indonesian Health Department standard. It calls Sistem Informasi Rumah Sakit (SIRS) and it only generates structured information. So far, SIRS can not generate unstructured information for supporting decisions making.

Due to the problem, this research focuses on develop Data Warehouse and Online Analytical Process (OLAP) Tools for supporting decision making about inpatient, payment, and surgery. The Application includes a transformation process from SIRS database into OLAP Warehouse database, and processing OLAP Warehouse database into multidimensional pivot table, and generating graphics. The application was developed using Oracle 9i as the database and Net Beans 5.5 as programming language.

Keywords

data warehouse, OLAP, healthcare information, inpatient

1. INTRODUCTION

RSU Dr. Soetomo is one of the biggest hospitals in the east Indonesia. RSU Dr. Soetomo has computerized their administration system since 2002 using Oracle 9i Database and Oracle Developer. The system is standardized by the Indonesian Health Department and it calls Sistem Informasi Rumah Sakit (SIRS) [1]. SIRS supports periodic reports as structured information that is needed by the health department. The report is produced at monthly basis.

The health department or hospital director often requests inpatient, payment, and surgery unstructured information in several formats (multidimensional) to RSU Dr. Soetomo . Unstructured information is not supported by SIRS. In addition, RSU Dr. Soetomo does not have Oracle Warehouse Tools for generating the needed unstructured information. Moreover, RSU

Dr. Soetomo does not have a full time programmer to develop and maintain application system. To full fill the needed information, RSU Dr. Soetomo must print several structured reports that relate with the needed information and combine several information use Microsoft Excel to become another report.

Based on the problems, RSU Dr. Soetomo need an OLAP tools for generating unstructured report in multidimensional and hierarchal view.

2. MODEL, ANALYSIS, DESIGN, AND IMPLEMENTATION

2.1 Data Warehouse in Health Care

One of the key aspects for a healthcare data warehouse design is to find the right scope for different levels analysis. The analysis of healthcare outcomes is proposed to find scope studies of treatment progress for the next visit. These scopes allow the database to support multi levels analysis, which is imperative for healthcare decision making [2].

The complexity of data analysis determines the number of patients in the risk group for a particular disease. Disease risk levels must be set and adjusted on a regular basis to ensure the coverage of all patients in a care management [3].

2.2 Data Warehouse Methodology

In each state, patient records are registered at a various locations. These records are heterogeneous due to their different source, interpretation, and purpose. There are a number of different stakeholders with the different goals, who have access to the different sources of data. Centralization allows various analysis, data flow, and process mining to search for global estimations and global understanding of a hidden knowledge.

Turning the specific clinical domain information to a Clinical Data Warehouse (CDW) can facilitate efficient storage, enhances timely analysis and increases the quality of real time decision making processes [4].

There are six steps for building a medical data warehouses [5].

- Identify the requirement for the building of the data warehouse

The developers should be able to convince the stakeholders that they have a sound solution for this critical requirement.

- Quality and scope of the sources

Identify the quality and scope of each data source and also the rate of updating (depend on the dynamics of the entities to which the data refers).

- Identify what data is needed by the stakeholders

Match the potentially collectible data with the results that are desired by the stakeholders and the decision makers.

- Build an ontology

In distributed environments, the denominators for data attributes and values can be different.

- How to update the central repository

Establish the update policy for each local source and estimate the costs involved.

- Enact exception handling protocols

The sources should be analyzed with the simplest methods and after the data collected should be analyzed immediately with the same methods to detect anomalies that are induced by the data gathering process.

A star schema is consisted of fact tables and dimension tables. The fact tables describe business fact during a period of time. The dimension tables describe details information for supporting information of fact tables [6].

2.3 System Analysis

The needed SIRS Data to be included into data warehouse are:

- Inpatient room records include roomID and type.
- Room type records include roomType, roomClass, roomRate, and numberOfBed.
- Patient records include patientName, patientAddress, diseaseType, checkInDate, inpatientTime, and roomID.
- Diagnose records include diagnoseType and symptoms.
- Service records include serviceID and serviceName.

OLAP tool is needed for processing warehouse database using pivot table. OLAP tool is built on analysis the purpose [2]. Several unstructured information example often request by the Indonesia Health Department or hospital director are:

- Revenue analysis based on inpatient room, surgery type, room type, and inpatient time. For instance, analyst hospital revenue during a period time.
- Inpatient room utilize based on inpatient room, patient, and time. For instance, analyst the most used room in period time.

2.4 Data Warehouse Star Schema

The conceptual frame work of our research work is shown in Figure 1. There are two main processes, i.e. Create Star Schema and Transformation SIRS OLTP database into OLAP Warehouse database as a preparation and cleansing data and Pivot Table Process as a process to generate multidimensional table and graphic. The first process will discuss in this sub section and the second process will discuss in next section.

Firstly, create or modify the OLAP Warehouse meta schema. A user design or modify a star schema by select tables and fields from the SIRS OLTP meta schema into OLAP Warehouse meta schema as a mapping process. Secondly, transform SIRS OLTP database into OLAP Warehouse along with cleansing data process as shown in Figure 2. Users can transform all data or periodically data.

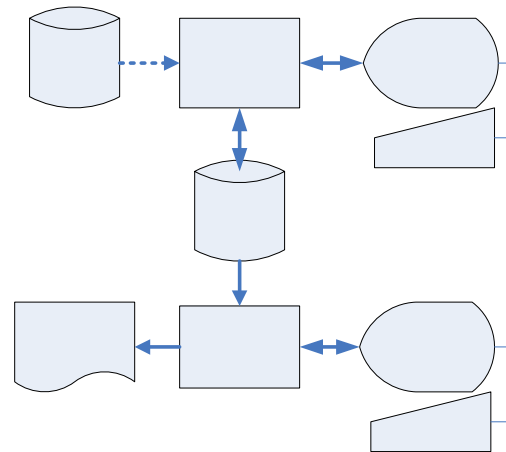


Figure 1. The research conceptual frame

The propose data warehouse star schema consists of three fact tables, i.e. inpatient, payment, and surgery. To make it clear, we describe it into three star schemas. The first star schema is inpatient fact star schema as shown in Figure 3. There are five dimension tables, i.e. time, patient, class, facilities, and room. The second star schema is payment fact star schema as shown in Figure 4. There are three dimension tables, i.e. time, patient, and class. The last star schema is surgical fact star schema as shown in Figure 5. The surgical fact is related with dimension tables time, patient, surgical list, and room.

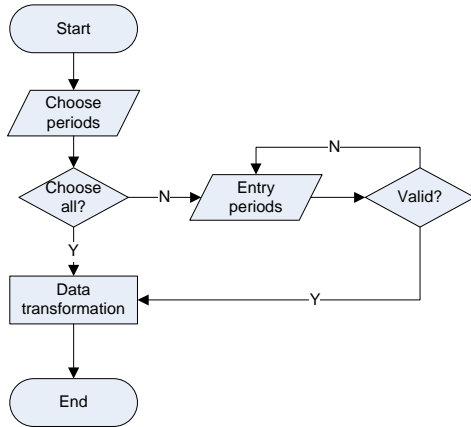


Figure 2. Transformation from SIRS OLTP into OLAP warehouse database

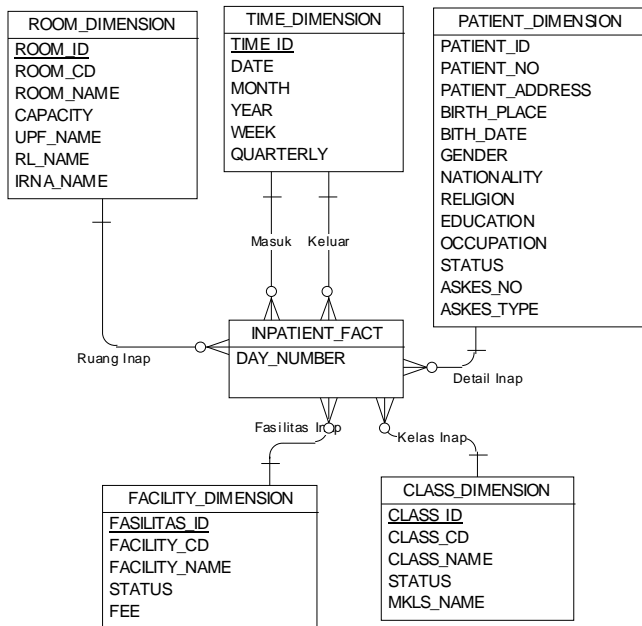


Figure 3. Inpatient fact star schema

The relation between dimension and fact tables is generally one to many with minimum cardinality optional in fact table. The purpose every dimension table is:

- Time dimension is used for recording the event of inpatient, payment, and surgical. It prepared for multidimensional hierarchical information, e.g. weekly, monthly, quarterly, annually.
- Patient dimension is used for recording the detail patients data who are inpatient and or surgical and pay their medical expenses.
- Facilities dimension is used for recording the facilities for supporting medical care patient, such as Astek, Askes, Jamsostek.
- Room type dimension to record type of room
- Class type dimension to record class of room
- Surgery lists dimension to record list of surgeries

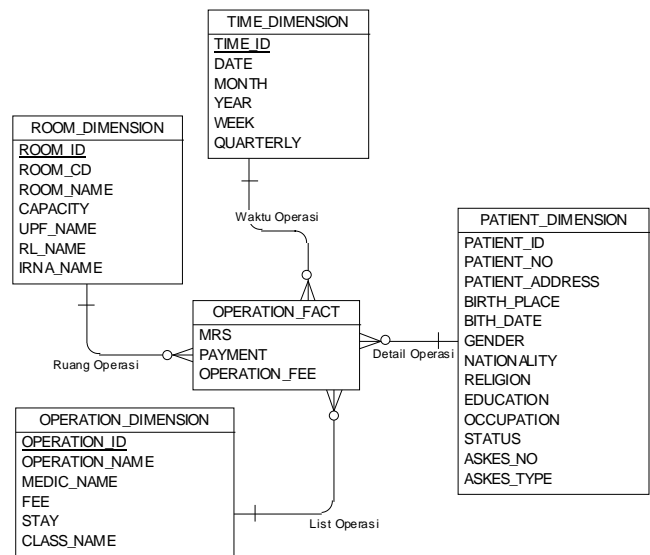


Figure 5. Operation fact star schema

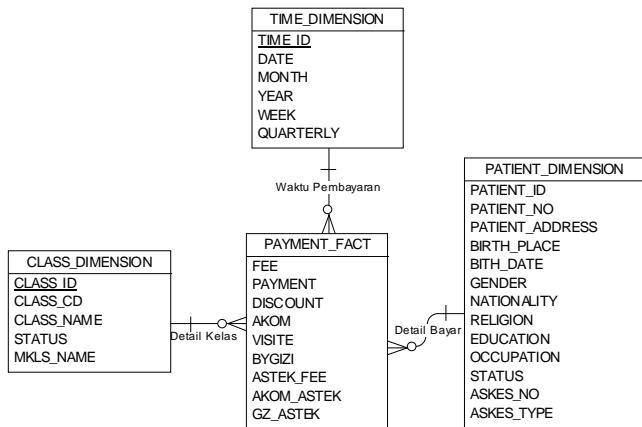


Figure 4. Payment fact star schema

3. THE DESIGN PROCESS

The pivot table process algorithm is shown in Figure 6. The user can set up new parameter or using the saved parameter to process data into multidimensional information as a table or a graphic. The user can select a fact table and several related dimensional tables follow with set attribute to row, column, and data. Furthermore, the user can set the value in the distinct value in the attribute to be included in pivot process. In addition, the user can set the start and end date data to be processed by default is current date. At last, the user can choose the operation process, i.e. count, sum, max, min, and average. The default operation process is count.

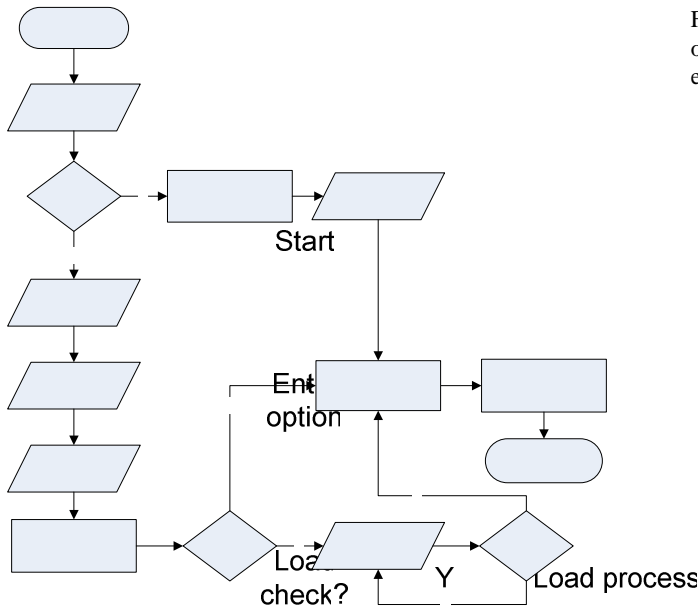


Figure 6. Pivot table process

4. RESULTS

In this section, we demonstrate the developed application system. Pivot table about count of patient based on education vs. room name on February 1–May 1, 2005 is shown in Figure 7. Base on RSU Dr. Soetomo requirement analysis, they also want to know the detail information from the pivot table easily. Therefore, we design a pivot popup to zoom out the cell pivot table detail information. For example, the zoom out of *pendidikan Tamat SMTP nama ruang Anak Keld* is shown in Figure 8.

Periode : 02/01/2005 - 05/01/2005

Row : PENDIDIKAN Column : NAMA_RUANG

	Anak Klas 1	Anak Klas 2	Anak Klas 3
Tamat SD	0	0	3
Tamat SMTA	0	0	0
Tamat SMTP	1	0	1
Grand Total	1.0	0.0	4.0

Figure 7. Pivot table count operation in periods

Periode : 02/01/2005 - 05/01/2005

Row : PENDIDIKAN Column : NAMA_RUANG Data : JUMLAH_HARI

	Anak Klas 1	Anak Klas 2	Anak Klas 3
Tamat SD	0	0	3
Tamat SMTA	0	0	0
Tamat SMTP	1	0	1
Grand Total	1.0	0.0	4.0

Pivot Popup

ID_WAKTU	ID_WAKTU	FASILITAS	RUANG_ID	KELAS_ID	PASIEN_ID	JUMLAH_H
37	42	1	8	3	2770	4

Popup Menu

Figure 8. Pivot table zoom out

Figure 9 shows a comparison of Pivot Table Microsoft Excel and output application system for children inpatient based on education and room type in all periods. It shows the same results.

Drop Page Fields Here

Count of JUMLAH_HARI	NAMA_RUANG	Anak Klas 1	Anak Klas 2	Anak Klas 3	Grand Total
Pendidikan					
Tamat SD		3	4	21	28
Tamat SMTA			2	10	12
Tamat SMTP		2		6	8
Grand Total		5	6	37	48

Set Value Graphic Save Load Pivot Table

Periode : ALL PERIOD Row : PENDIDIKAN Column : NAMA_RUANG Data : JUMLAH_HARI

	Anak Klas 1	Anak Klas 2	Anak Klas 3	Count of
Tamat SD	3	4	21	JUMLAH_HARI
Tamat SMTA	0	2	10	
Tamat SMTP	2	0	6	
Grand Total	5.0	6.0	37.0	

Figure 9. Microsoft Excel vs. output application system comparison

Entry data

Figure 10 and Figure 11 show a bar chart and a line chart of children inpatient based on education and room type in all periods using count operation.

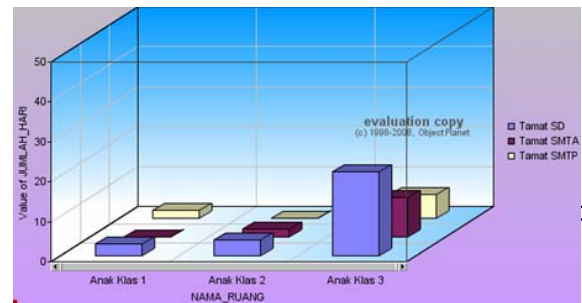


Figure 10. Bar chart education vs. room type in all periods

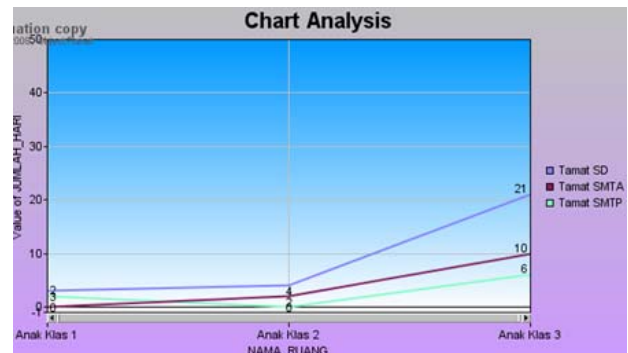


Figure 11. Line chart education vs. room type in all periods

Furthermore we demonstrate the multi dimensional table as the main RSU Dr. Soetomo requirement. Figure 12 shows a pivot table with two dimensions on row (education and facilitates name) and one dimension on column (room name). Figure 13

Period : ALL PERIOD	Count of		
Row : PENDIDIKAN dan NAMA_FASIL...	Column : NAMA_RUANG	Data : JUMLAH_HARI	
	Anak Kelas 1	Anak Kelas 2	Anak Kelas 3
Tamat SD\Askes Gol I..	0	0	0
Tamat SD\Askes Gol I..	0	0	0
Tamat SD\Askes Gol I..	0	0	0
Tamat SD\Askes Gol I..	0	4	
Tamat SD\Askes Gol I..	0	0	0
Tamat SD\Askes Gol I..	0	2	0
Tamat SMTA\Askes G..	0	0	0
Tamat SMTA\Askes G..	0	0	0
Tamat SMTA\Askes G..	0	0	0
Tamat SMTA\Askes G..	0	0	0
Tamat SMTA\Askes G..	0	0	0
Tamat SMTA\Askes G..	0	0	0
Tamat SMTPI\Askes G..	0	0	0
Tamat SMTPI\Askes G..	0	0	0
Tamat SMTPI\Askes G..	0	0	0
Tamat SMTPI\Askes G..	0	0	0
Tamat SMTPI\Askes G..	0	0	0
Tamat SMTPI\Askes G..	0	0	0
Grand Total	0.0	2.0	4.0

Period: ALL PERIOD											Count
Row : PENDIDIKAN	Column : NAMA_RUANG dan NAMA_FASILITAS										Date : JUMAH
2)Askes On	Anak Klas 2)Askes On	Anak Klas 2)Askes On	Anak Klas 2)Askes On	Anak Klas 2)Askes On	Anak Klas 2)Askes On	Anak Klas 2)Askes On	Anak Klas 2)Askes On	Anak Klas 2)Askes On	Anak Klas 2)Askes On	Anak Klas 2)Askes On	Anak Klas 2)Askes On
0	2	0	0	0	0	0	4	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	
0.0	2.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	

Period:	ALL PERIOD						Count of
Row :	PENDEKATAN dan NAMA_FASIL...	Column :	NAMA_RUMAH dan NAMA_KELAS	Data :	JM.AHAP_HARI		
Tamat SCSAseskin	Anak kelas 1CUJ IRD	Anak kelas 1Ketas 1	Anak kelas 1Ketas 2	Anak kelas 1Ketas 3A	Anak kelas 2CUJ IRD	Anak kelas 2Ketas 1	
Tamat SCSAseskin	0	0	0	0	0	0	
Tamat SCSAseskin	0	0	0	0	0	0	
Tamat SCORUD Dr	0	0	0	0	0	0	
Tamat SCUUmum	0	0	0	0	0	0	
Tamat SMTAAseskin	0	0	0	0	0	0	
Tamat SMTAAseskin	0	0	0	0	0	0	
Tamat SMTAAseskin	0	0	0	0	0	0	
Tamat SMTAFORUJ	0	0	0	0	0	0	
Tamat SMTAFORSUD D	0	0	0	0	0	0	
Tamat SMTAUmum	0	0	0	0	0	0	
Tamat SMTPAAseskin	0	0	0	0	0	0	
Tamat SMTPPAseskin	0	0	0	0	0	0	
Tamat SMTPPCUIJU	0	0	0	0	0	0	
Tamat SMTPPRSUD D	0	0	0	0	0	0	
Tamat SMTPPPumum	0	2	0	0	0	0	
Grand Total	0.0	5.0	0.0	0.0	0.0	0.0	

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