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DESIGN MODEL INTEGRATION AND SYNCRONIZATION BETWEEN SURVEILLANCE UNITS TO SUPPORT DATA WAREHOUSE EPIDEMIOLOGY

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ABSTRACT

Data monitoring outbreaks of disease in a region and specific populations (epidemiology) requires the support of an integrated data from all related surveillance unit. The integration of data between surveillance units (health centers, polyclinics, hospitals) must be design and good properly managed so as to enable health leaders and analysts to acquire, integrate, analyze and monitor the data (cases of the disease) from different data sources. The source data comes from a heterogeneous system, in this case the data source is a distribution surveillance units. To facilitate the management of surveillance data will be in the design of the data center in the model epidemiological data warehouse so as to form an integrated surveillance system (ISS). The problem faced is related to interoperability, ie the ability to integrate and synchronize data from different systems platforms (heterogeneous). Thus we need a methodology of integrating data in XML model into the epidemiological data warehouse. Since XML becomes a standard for data exchange over internet, especially in the B2B and B2C communication is needed integration system with the model XML data into the data warehouse. In this study we describe the design of a model of integration and synchronization between surveillance unit in the method SOA-based web services architecture. The method used is XML Web Services, a method that can integrate applications and exchange data in XML (Extensible Markup Language). Exchange data in XML format using the technology SOAP (Simple Object Access Protocol) and WSDL (Web Services Description Language) and using the library NuSOAP.

Keywords: *Epidemilogy, Data Warehouse, Integration, Synchronization, XML,SOA, WebServices.*

1. INTRODUCTION

Design data warehouse epidemiology is a strategy that has a very important contribution in improving the quality and quantity monitoring health data. Epidemiological surveillance is a series of systematic sustainable process in the collection, analysis and interpretation of health data. Disease prevention and eradication programs are most effective if they are supported by epidemiological data warehouse, because they one of the functions of a data warehouse is the availability of epidemiological data sourced from all units in an integrated surveillance and up to date With System Data Warehouse then the quality of epidemiological surveillance will always be preserved. Epidemiological data warehousing system is a set of technologies and tools that enable data sources epidemiological surveillance unit (health centers, polyclinics, hospitals) are scattered and heterogeneous can be perform interoperability (communication data), especially in terms of integration and data synchronization. The most important part of this system is a data warehouse data marts, a data mart is a historical collection of data sources (local schema) that is oriented to the needs of particular epidemiological analyzes. Data warehouse system design process consists of several stages such as analysis of data from heterogeneous data sources surveillance unit, the design of data warehouse model, the definition of data transformation and integration process, synchronization design and implementation of equipment needed by the user to access and represent data warehouse. Web services are the most popular method of SOA now [1]. Has a series of criteria and protocols that guarantee the functions to be performed, such as WebServices Description Language (WSDL), UDDI, Simple Object Access Protocol (SOAP) and so on [2]. Web services are platform independent and are suitable for heterogeneous environments.

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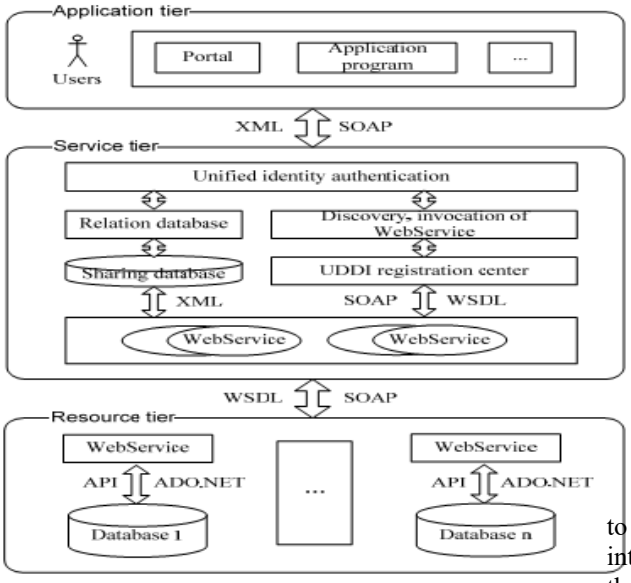

Figure 1. SOA-Based Web Services Architecture

SOA is a leading integration method and the heterogeneous system environment architecture framework [3]. The basic idea of SOA is services cored and integrate information resources on service standards, enabling reconfiguration and reuse of information resources [5]. SOA is respite services that can be combined with architecture services [6,7]. Communication services with a simple interface definition and precision that does not involve programming interface and communication models. There are three parts SOA architecture based on web services: services provider, registry services, consumer services [8]. Consumer service providers and each refers to the system of external and internal corporate systems. As a solution can be divided into three tier architecture, the application tier, services tier and resource tier. Resource tier contains all sorts of databases of the MIS wich need to be integrated. Services tier is the core of the solution, Including web services encapsulation, composition, registration, discovery, invocation and the data mapping module. Application tier consists of the application client of MIS ind information portal. XML is an emerging Internet applications oriented markup language for documents contains both content and structure. Xml is extensible, platform independent and easy to transfer in the network, so it is very suitable for describing information and the data synchronaization and database integration.

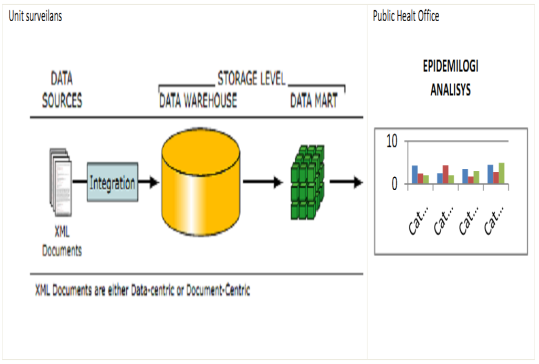

Figure 2. Integration Of XML Document Within A Data Warehouse Epidemiology

XML web srvices is a software system designed to support interoperability in machine to machine interactions in a network [9]. Interaction is done through a specific protocol. Thus the ability of web services can be increase the ability of the web to communicate and share information and data with the pattern of program-to-program. With the design of XML web services will can be integrate the system, programming language support, database and operating system platform that is different from the protocol http (Hypertext Transfer Protocol). Thus dbms application and heterogeneous between surveillance unit can communicate with the system of epidemiological data warehouse. The purpose of this study was to analyze, design, system integration and synchronization between surveillance unit with the health service system in a prototype model epidemiological data warehouse.

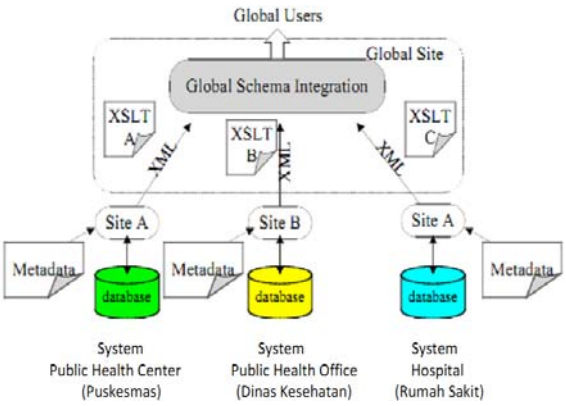

Figure 3. The Heterogenous Database Integration Architecture

1.1. Heterogenous Data Integration Problem

Integration is the process of combining different data in different data sources, and provide users with a unified view of the data [11]. Basically this

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process through the development of an integrated system. Lazerini [11] characteristics of the system as a data integration architecture based on a global scheme and a set of data sources. The data source contains data riel, while global scheme provides a reconciliation, integration, and a virtual view of the basic sources of data. With global virtual global view, users can be gain access system integrated uniform data from different data sources. Two basic approaches are used between the model of global schema and data sources (local scheme). The first Global-as-View (GAV) where the global schema as the data source [12]. The second is the Local-as-View (LAV) in which each data source is defined as a view over the global schema. Some of the problems related to the integration of heterogeneity of data between data sources as a local schema with a global schema is schema mapping, the data cleansing, transformation of data, the data reconsciliation problem.

1.2. Heterogenous Data Synchronization Problem

Sinkronsai heterogeneous data directly related to the process of replication of data between heterogeneous databases. Data replication is the process of generating, producing, and maintaining a set of data in one or more locations [13].]. Data replication between databases is very important to the availability of the data up-to-date whenever and wherever the data is needed. In terms of communication and the timeliness of the data replication process can be be synchronous or asynchronous. The process of data synchronization is the process of transforming the current data status of the application system to other heterogeneous systems and update the data to maintain data consistency. Synchronization of data as "a technical method that can Achieve consistency of data from databases in heterogeneous multi-platform". Synchronization is also a specially needs data integration to provide real-time consistency between local and global data sources through the update mechanism. Thus, data synchronization means that if there are changes to the data on the local data source will be notified, or distributed to a datasource that corresponds to the domain administrator information. Therefore, an integrated environmental changes will automatically perform inter-system update. Synchronization can be classified into uni-directional data synchronization and bi-directional data synchronization. Some of the problems related to the data synchronization is inter-process communication on the use of data and resources together.

2. EXPERIMENTAL

2.1. Architecture Model Integration Between Surveillance Units

In the draft for a model of integration between applications to be built with webs services is the integration of epidemiological data from surveillance units health centers and hospitals. Where the surveillance unit that uses dbms and different applications (My Sql and PostgreSQL). Access will be built in advance of the application communication occurs in two directions, which through web services each surveillance unit will take the local epidemiological data from the database was changed into the form of a document in a format specific parameters (SOAP Services). Then the web service to send and request access between applications will continue to health office (dinkes) epidemiological database as epidemiological data warehouse.

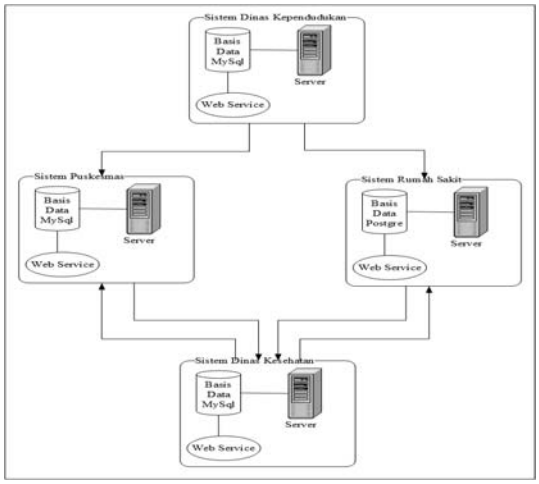

Figure 4. Model Design Data Integration Between Units Surveillance In A Data Warehouse Epidemiological

2.2. Design Model Integration Web Services Between Units Surveillance.

a). The integration between the systems department of population with health center system. The system of official of population information will provide a service to health centers and hospitals. Here is the architectural integration between the system of population with health center system.

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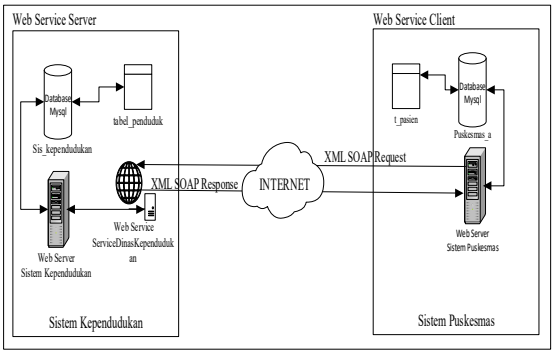

Figure 5. Architecture Web Services Integration Between The System Of Population With Health Center System

Population system also provides service to the hospital system that integrates both, the following is the architectural integration between the system of population with hospital systems.

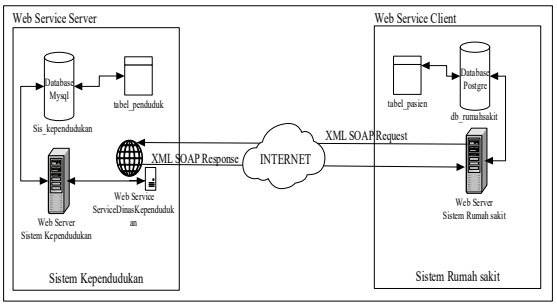

Figure 6. Architecture Web Service Integration Between Systems Of Population With Hospital Systems

b). Integration between health center systems with system health office. Health center information system will provide service to the health department, so the health department can receive data from each recording of cases of the disease. The following is a system architecture integration.

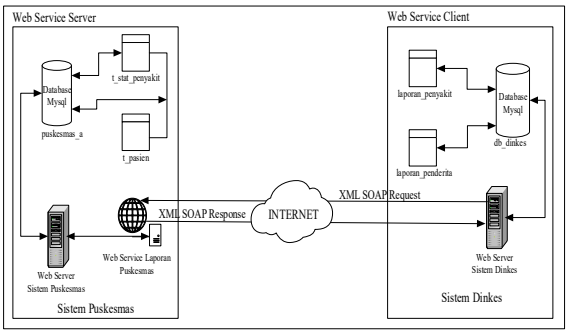

Figure 7. Integration Of Web Services Architecture Health Center System With System Health Office

c). The integration between the hospital system with system health office. The integration between the hospital information system with a system allowing health office to monitor health office epidemiology ddata sourced from hospitals, the following is a systematic integration architecture.

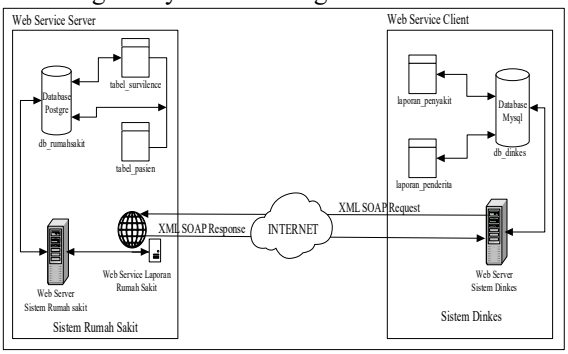

Figure 8. Integration Architecture Webservices Hospital System With System Health Office

d). Integration between health center systems with system health office. Integration of health services system will provide service to the health centers system, so that epidemiological surveillance data each case the disease will be able to monitor the health office. The following is a the architecture of system integration between health office with health center system.

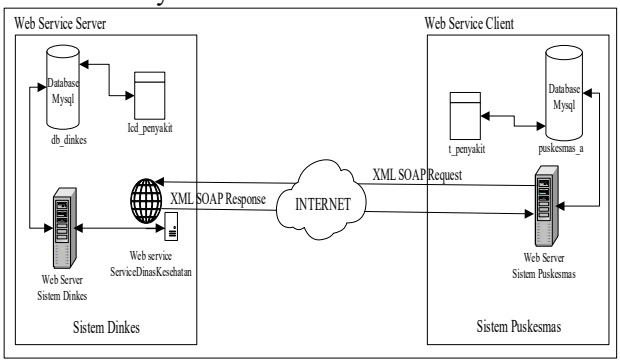

Figure 9 Integration Of Web Services Architecture System Health Office With System Health Centers

2.3. Web Services Design

After the design phase of web services integration model between several surveillance units, then the next stage is to perform the implementation of the XML programming on each web design services related to system integration Atar surveilasn related units. Some of web design services are as follows:

a). Web services system of reporting health centers to integrate with system health office.

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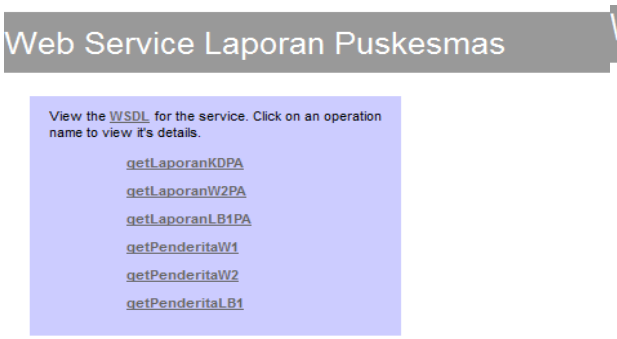

Figure 10. Web Services For Health Centers System

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<definitions xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/"
xmlns:tns="urn:DataLaporanPuskesmas"
xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
xmlns="http://schemas.xmlsoap.org/wsdl/"
targetNamespace="urn:DataLaporanPuskesmas">
<types>
<xsd:schema targetNamespace="urn:DataLaporanPuskesmas">
<xsd:import namespace="http://schemas.xmlsoap.org/soap/encoding/" />
<xsd:import namespace="http://schemas.xmlsoap.org/wsdl/" />
</xsd:schema>
</types>
<message name="getLaporanKDPARequest">
<part name="tanggal" type="xsd:string" /></message>
<message name="getLaporanKDPAResponse">
<part name="output" type="xsd:Array" /></message>
.....
<input><soap:body use="encoded" namespace="urn:DataPenderitaPenyakitLB1
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"/></input>
<output><soap:body use="encoded"
namespace="urn:DataPenderitaPenyakitLB1"
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"/></output>
</operation>
</binding>
<service name="Web Service Laporan Puskesmas">
<port name="Web Service Laporan PuskesmasPort" binding="tns:Web Service
Laporan PuskesmasBinding">
<soap:address
location="http://localhost/ta/puskesmasA/ws/puskesmas_service.php"/>
</port>
</service>
</definitions>
.....
```

Figure 11. Example WSDL Web Services Health Centers System

b). Web services for hospital reporting system integrated with health office system.

Figure 12. Web Services For Hospital System

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<definitions xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-
ENC="http://schemas.xmlsoap.org/soap/encoding/"
xmlns:tns="urn:DataLaporanRumahSakit"
xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
xmlns="http://schemas.xmlsoap.org/wsdl/"
targetNamespace="urn:DataLaporanRumahSakit">
<types>
<xsd:schema targetNamespace="urn:DataLaporanRumahSakit">
<xsd:import namespace="http://schemas.xmlsoap.org/soap/encoding/" />
<xsd:import namespace="http://schemas.xmlsoap.org/wsdl/" />
</xsd:schema>
</types>
<message name="getLaporanW1RSRequest">
<part name="tanggal" type="xsd:string" /></message>
<message name="getLaporanW1RSResponse">
<part name="output" type="xsd:Array" /></message>
...
<message name="getLaporanPenyakitTahunanRSRequest">
<part name="Tahun" type="xsd:int" /></message>
<message name="getLaporanPenyakitTahunanRSResponse">
<part name="output" type="xsd:Array" /></message>
<message name="LaporanPenderitaPenyakitW1Request">
<part name="kodeicdpenyakit" type="xsd:string" />
<message name="LaporanPenderitaPenyakitW2Request">
<part name="kodeicdpenyakit" type="xsd:string" />
.....
</operation>
<operation name="getLaporanLB1RS">
<soap:operation soapAction="urn:LaporanLB1RumahSakit#getLaporanLB1RS"
style="rpc"/>
<input><soap:body use="encoded" namespace="urn:LaporanLB1RumahSakit"
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"/></input>
<output><soap:body use="encoded" namespace="urn:LaporanLB1RumahSakit"
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"/></output>
</operation>
<operation name="getLaporanPenyakitTahunanRS">
<soap:operation
soapAction="urn:LaporanPenyakitTahunanRumahSakit#getLaporanPenyakitTahun
anRS" style="rpc"/>
.....
```

Figure 13 Example WSDL Web Services Hospital System

2.4. Mapping Rule Schema

A data integration techniques, among heterogeneous scheme mainly deal with the problem of the transformation and exchange of data. Mapping rules are middle-ware that is independent and not influenced from various platforms. Mapping rules can also be applied schema in format and values of query results.

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```
// Mapping  value schema dari  hasil query

$SQLcekRow=$this->db->query("SELECT * FROM laporan_penderita WHERE `kode_rekam`='$kdrekam'
                                AND `kode_pasien`='$kdpasien'
                                AND tanggal_kejadian='$tanggal_kejadian'
                                AND kode_instansi='$koders'
                                AND kode_penyakit='$value[kodepenyakit]'");
$cekDataPasien=$SQLcekRow->num_rows();
if($cekDataPasien==$value['jmlpenyakit']){
continue;
}
else{
foreach ($arr['pasienrs'] as $key ) {
$SQLcekRowPasien=$this->db->query("SELECT * FROM laporan_penderita
                                WHERE `kode_rekam`='$key[kode_rekam]'
                                AND `kode_pasien`='$key[kode_pasien]'
                                AND tanggal_kejadian='$tanggal_kejadian'
                                AND kode_instansi='$koders'
                                AND kode_penyakit='$value[kodepenyakit]'");
$cekDataPasienDB=$SQLcekRowPasien->num_rows();
if($cekDataPasienDB==1){
       continue;
              }
       else{
//insert ke tabel laporan data pasien dari hasil query
$this->db->set('kode_rekam', $key['kode_rekam']);
$this->db->set('kode_pasien', $key['kode_pasien']);
$this->db->set('nama_pasien', $key['nama_pasien']);
$this->db->set('alamat_pasien', $key['alamat_pasien']);
$this->db->set('desa_pasien', $key['kelurahan_pasien']);
$this->db->set('umur_pasien', $key['umur_pasien']);
$this->db->set('status_pasien', $key['statuspasien']);
$this->db->set('tanggal_kejadian', $tanggal_kejadian);
$this->db->set('kode_instansi', $koders);
$this->db->set('kode_penyakit', $value['kodepenyakit']);
$this->db->insert('laporan_penderita');
}
...
```

Figure 14. Example Mapping Value Schema From Query

```
class="break"></span>$inkronisasi Data Center</h2>
                    <div class="box-icon">
...
function sinkronisasi($tgl,$bulan,$tahun){
       $tanggal=$tahun."-".$bulan."-".$tgl;
       $url= $_SERVER['DOCUMENT_ROOT']."/tas/dinkes/application/libraries/nusoap/lib/nusoap.php";
       require_once("$url");
       $client=new nusoap_client("http://localhost/tas/puskesmasA/ws/puskesmas_service.php?wsdl");
       $result=$client->call('getLaporanKDPA',array('tanggal'=>$tanggal));
       if(is_array($result)){
       $jmllappuskesmas=count($result);
...
/ -- proses sinkronisasi apakah jum.data penyakit di dbcenter sama dengan jml penyakit dari RS
              if($jmlRec==$value['jmlpenyakit']){
              // echo " | no action ".$i.', ';
                 continue;
              }
/ cek apakah jml record yang ada di dbcenter masih 0, maka akan insert
              elseif($jmlRec==0){
              // echo "insert ke ".$i.", ";
              $this->db->set('kode_icd', $value['kodepenyakit']);
              $this->db->set('jumlah_penyakit', $value['jmlpenyakit']);
              $this->db->set('tanggal_laporan', $row['tgl']);
              $this->db->set('kode_instansi', $koders);
              $this->db->insert('laporan_penyakit');
              foreach ($arr['pasienrs'] as $key ) {
               $this->db->set('kode_rekam', $key['kode_rekam']);
                      $this->db->set('kode_pasien', $key['kode_pasien']);
                      $this->db->set('nama_pasien', $key['nama_pasien']);
                      $this->db->set('alamat_pasien', $key['alamat_pasien']);
                      $this->db->set('umur_pasien', $key['umur_pasien']);
                      $this->db->set('status_pasien', $key['statuspasien']);
                      $this->db->set('tanggal_kejadian', $tanggal_kejadian);
                      $this->db->set('kode_instansi', $koders);
                      $this->db->set('kode_penyakit', $value['kodepenyakit']);
                      $this->db->insert('laporan_penderita');
...
/ cek jumlah laporan yang sudah masuk ke dbcenter
$kon=new PDO("mysql:host=localhost;dbname=db_dinkes","root","timur2000");
$pr=$kon->prepare("SELECT COUNT(*) AS jmlpenyakit FROM `laporan_penyakit`
       WHERE `tanggal_laporan`=:tanggale AND kode_instansi=:kodeinstansi");
$pr->bindParam(":tanggale",$tanggal);
$pr->bindParam(":kodeinstansi",$kdinstansi);
$pr->execute();
$cek=$pr->fetchAll();
foreach ($cek as $key) {
$jmlr=$key['jmlpenyakit'];
...
```

Figure 15. Example GAV As Mediator Schema Synchronization Between Local And Global Schemes

2.5. Design Gav (Global as View) as a mediator schema synchronization.

Is a global schema as mdiator that serve to help synchronize data items in the form of unit surveilas local schema LAV (Local as View). The mediator scheme is temporary shelter data reception with local schema defines techniques (reformulated) to match the structure of the global scheme. Scheme mediator also helps the process of reformulating the query with the data request through the local schema global scheme.

3. RESULTS AND DISCUSSION

Prototype integration of the data center that was developed at health office surveillance is an integration of two units, namely health centers and hospitals. By designing XML Web Services data from two units of surveillance data can be unified into a single integrated system (data warehouse model) although derived from the system and dbms different applications (multi-platform). The figure below shows the number of data reports information derived from epidemiological surveillance units (health centers and hospitals) both daily (w1), weekly (w2) or monthly (LB1).

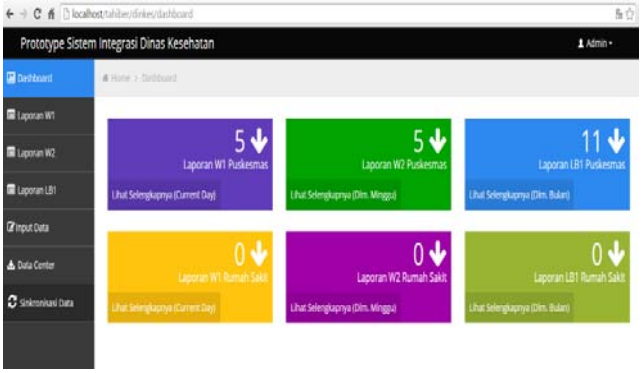

Figure 16 Monitoring And Analysis Of The Results Of The Integration Of Data Center Epidemiological Data On Health Office

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For monitoring epidemiological data transmission from the surveillance unit shipment data can be be synchronized from each surveillance unit each day continuously, so that it can automatically in the monitoring. With daily monitoring of this system will can be ensure the surveillance unit anywhere that does not perform epidemiological data transmission so that it can be done a certain action, it is very important to monitor the outbreak, particularly for infectious disease outbreaks.

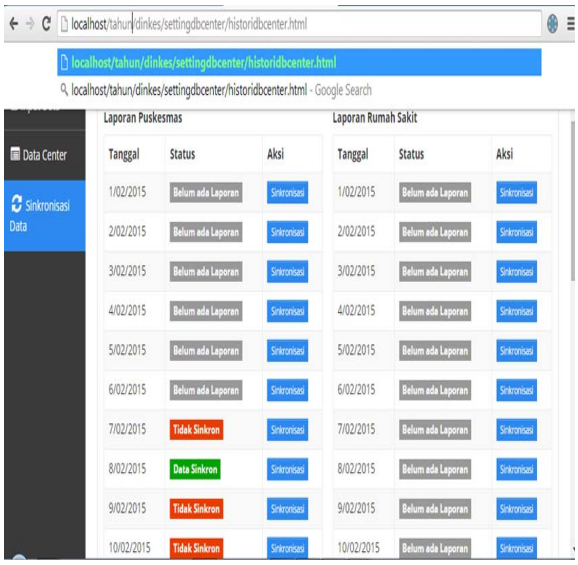

Figure 17. Results Of The Data Synchronization Process

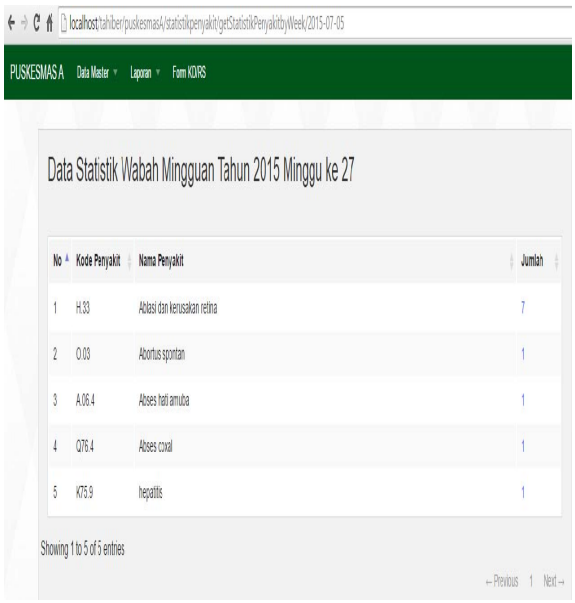

Figure 18. Monitoring Statistics Epidemiological Surveillance In Outbreak Of Certain Health Centers.

4. CONCLUSION

In this research has been done web design development servives with XML and has conducted testing of prototype data center where the health agency epidemiological data sources epidemiology derived from epidemiological data reporting health centers and hospitals with a daily format (W1), weekly (W2) and monthly (LB1). From the results of prototype testing of the epidemiological data center, web design service successfully integrated reporting system of units surveilas although epidemiological data sources come from different applications and dbms (MySQL and PostgreSQL) as well as different data structures. This shows the communication protocol middleware web service that is able to exchange epidemiological data as messege by utilizing HTTP protocol via a computer network between web-based and database apikasi between surveillance unit with database data center health office epidemiology. Integration between surveillance unit with web technology services in computer networks also showed communication between the provider and the services requester sevices can be used for monitoring real-time data delivery, so that it can be designed monitoring and synchronization of application data delivery effectively. Thus every event an outbreak of a particular region can be monitored continuously in order to program the eradication and control of diseases.

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REFRENCES:

[1] Al-Otaibi Noura Meshaan1, Noaman Amin Yousef, “Biological data integration using SOA”, Proceedings of World Academy of Science, Engineering and Technology, WASET, vol.73, pp.920-925, 2011.

[2] Chung C. Chang, Kou-Chan Hsiao, “A SOA-Based e-Learning System for Teaching Fundamental Information Management Courses”, Journal of Convergence Information Technology, Advanced Institute of Convergence Information Technology,vol.6,no.4,pp.298,2011.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

[3] Karande, Aarti M., "Working of web services using BPEL workflow in SOA", 2nd International Conference on Advances in Computing, Communication and Control, pp.143-149, 2011.

[4] Gouwei W, Guangming X.,"research On Data Synchronization and Integration Platform Based SOA" Journal of Convergence Information Technology JCIT, Vol. 7, pp. 223-224, 2012.

[5] Zhanmin Xu, Haoran Zhang, "A Solution for Integration of Enterprise Legacy Systems Based on SOA", the Seventh Wuhan International E-Business Conference, pp.777, 2008.

[6] Chatla S., Kadam S., "Complex networks and SOA: Mathematical modelling of granularity based web service compositions", Sadhana, Springer India, vol.36, no.4, pp. 441-461, 2011.

[7] A. M. Riad, Q. F. Hassan, "Service-Oriented Architecture - A New Alternative to Traditional Integration Methods in B2B Applications", Journal of Convergence Information Technology, Advanced Institute of Convergence Information Technology,vol.3,no.1,pp.31-32,2008.

[8] JIAN Jie, WU Jian-jun, "Design for general interface of community information foundational database based on SOA", Computer Engineering and Design, Computer Engineering and Design, vol.31, no.16, pp.3612, 2010.

[9] Erl T, "Services Oriented Architecture : Concepts, Technology and Design", Indiana, Prentice Hall PTR, 2005.

[10] Sciore et al., "Using Semantic Values to Facilitate Interoperability among Heterogenous Information System", ACM Trans. Database System, pp. 254-290, 1994.

[11] Lenzerini M., "Data Integration : A theoretical perspective", In Simposium on Principles of Database System, 2002.

[12] Chawathe et al., "The TSIMMIS project : Integration of Heterogenous Information Resources", In Proceedings of 10th Meeting of the Information Processing Society of Japan,1994.

[13] Haase P., "Heterogenous Data Replication", In BTW Studierenden-Program, 2001.

[14] Rajpathak Dnyanesh1, Chougule Rahul, "A generic ontology development framework for data integration and decision support in a distributed environment", International Journal of Computer Integrated Manufacturing, Taylor and Francis Ltd., vol.24, no.2, pp.154-170, 2011.

[15] HuDerek Hao, ZhengVincent Wenchen, "Cross-domain activity recognition via transfer learning", Pervasive and Mobile Computing, Elsevier, vol. 7, no.3, pp. 344-358, 2011.