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E-Health as a Service Software of Medical System in UML Modeling

A.Nursikuwagus[1], L. Melian[2], P. Andrianto[3]
Indonesian Computer University, Department of Information System
agusnursikuwagus@email.unikom.ac.id
lusi.melian@email.unikom.ac.id
pra_dikta@email.unikom.ac.id

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***Abstract*--Information system at Clinical health center is an information system that has several activities, such as registration, medical record, health care, and reporting. Day to day operation, Clinical health service, is using process manually. It is cause the stack of service. Sometime, the patient has to wait within several times. For Further, the patient did not know that the queuing is full. In order to help the problem, this paper wants to show about E-Health as service software. The research is completed by conveying the model like UML diagram. The UML diagrams are consisting such as use case, class, activity, and component. The sequence of system construct is using Prototype Methodology. The result is the software which has ability to service patient start from registration, medical check, medical prescription, until reporting. As an impact for Clinical health service is the service more efficiency. The system is able to control the medicine and reporting on day to day operation.**

***Index Terms*—health, services, medical, system, prototype**

I. INTRODUCTION

The districts / municipalities are responsible for health in their working areas. They are known as Clinical health service. Clinical health service plays a role of health efforts to increase the healthy life of every citizen to reach optimal health status.

Every Clinical health service provides two policies that consist of Health Compulsory and Health Development Efforts. Compulsory Health Effort provides enormous leverage to the successful development of public health through the improvement of Human Development Index (HDI), as well as global and national agreements. Compulsory Health Efforts consists of Health Mother and children (KIA), Family Planning (KB), Environmental health and others. Meanwhile, Health Development Effort is a health effort that has been determined based on local Clinical health problems and adapted to the ability of health Clinical service. The services consist of dental and mouth health efforts, mental health efforts, eye health, traditional medicine, and health public care. In order to run all these efforts, Clinical health service needs to be supported by auxiliary units that have specific task and one of them is medical record unit.

E-Health on Clinical Health Service has used application that provided by ministry of health services. The application is an application that supports the service for patient. The application has developed by BPJS (Board of Social Insurance Organizer in Indonesia). The application can be accessed through the internet. However, it is just for patient who have JKN card (Insurance Card) and have permitted to access. In fact, many patients still not have JKN card. Consequently, the registration must be recorded by manual paper. This evidence was made task in frequently.

The problem in existing, the patient did not recorded in insurance program that provided by government. So, it caused trouble when search the data. Meanwhile, the Clinical Health Service must be recording for every patient who has check for his health. The other problem, when they did not recorded in the database on application that provided by government, then it has to register first using the form registering. The form used in registering, can add the time for services. If the occurrences continuous till to the doctor and making the recipe, will cause many papers that have to provide. It is not good to the services, and has to improve the process. The task repeat cannot be avoided in that case. The human error is the other problem that gives the failure in procedure. For example, when documents submitted into reference hospital, the documents can be lost or broken.

Research conducted by Gunawan Susanto in Medical Record Information System at Regional General Hospital (*RSUD*) Pacitan Web-Based aims to design medical record information system with web-based computer technology [1]. So, the system that has built is helping to reduce the duplicate of patient medical record and time for searching of medical record status [1]. Bayu Nugroho, Sri Hariyati Fitriasih, and Bebas Widada in Medical Record Information System at Masaran Public Health Center Sragen, aims to design a system using computer system that can be

used as one in data processing. Data processing of medical record system was developed using Microsoft Visual Basic 6.0 program and Microsoft SQL SERVER 2000 [2]. Gilar Gumilar Ulung Bagja in Building Health Information System of *Puskesmas* Cibaregbeg, aims to facilitate the recording of health service, to determine medical record number on patient registration, to accelerate report making, and to facilitate search process both patient and employee [3]. M. Herdy Ariansyah, Mgs. M. Amran Aulia and Dien Novita in Design of Medical Service Information System at Sungai Dua Health Center, aims to assist the management and retrieval of medical record data, registration data, report, and medicine use. So, it can facilitate the doctor to view of medical record data of patients who have had previous treatment [4]. Jenie Sundari in Web-Based *Puskesmas* Service Information System aims to design an application to solve problems in registration system and queue number retrieval for patient, doctor scheduling and medical record. Thereby, it is increasing the effectiveness and efficiency in terms of service, time and cost at *Puskesmas* [5].

II. METHODOLOGY

Methodology used is prototype method with the several stages and in accordance with the problem manner. At the figure 1 shows steps of prototype development [6]. In modeling, this research has used UML (Unified Modeling Language). UML is way to visualize the system architecture's blueprint in diagram [7]. UML is two parts that can visualize the system through static and behavior concept. The static diagram, we used use case diagram, class diagram, and object diagram. Besides that, we drawn too behavioral diagram such as activity, component diagram. To complete the diagram, we only used three diagram, that is use case diagram, class diagram, and component diagram.

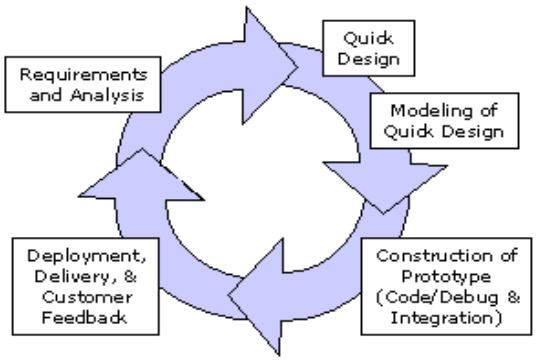

Fig 1. Prototype Methodology [6], this prototype has been taken from Roger S Pressman. It has five stages to transforming the logic into implementation.

A. *Requirements and Analysis*

The first phase is requirement and analysis users. Analysis is done to see the various components that runs include hardware, software, network, and human resources. The requirement users should define the specific system of inputs, outputs, processes, data sources handled, and control. The system requirements are require an evaluation to determine the ability of the system. The evaluation that has been defining, is what should be done by the system, and then determines the criteria that must be met the system. Some of the criteria that must be met are the achievement of objectives, speed, cost, quality of information generated, efficiency and productivity, accuracy and validity, and reliability. On this stage, to receive the requirement, we can use the survey and interview the person in charge. Result on this stage is serial of document and describing the procedural that is running.

B. *Quick Design and Modeling*

The second phase is system design. This step is determined how the system will achieve the goal. The system design consists of design activities that produce functional specifications. System design can be viewed as interface design, data processing, with the aim of producing specifications that correspond to user interface products and methods, database structure and processing, and control procedures. Result of this stage is the shape of interface or menu, Use case diagram, use case scenario, class diagram, and activity diagram. The example for each diagram, it can be seen at figure 2.

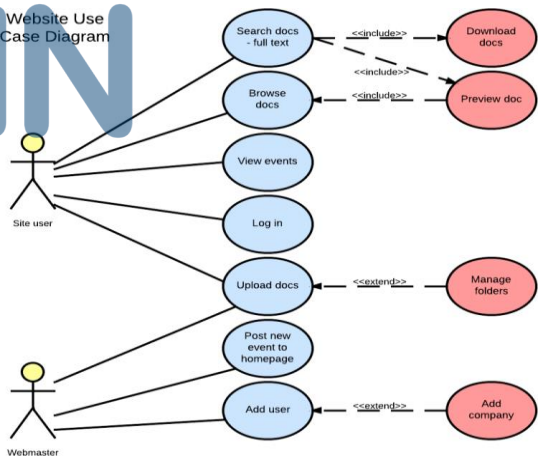

Fig 2. Example of Use Case Diagram [7].

C. *Construction of Prototype*

The fourth phase is constructing the software. This step is done with the report of test, implementation, evaluation, and modification until it is acceptable to the users. System testing aims to find the errors that occur on the system and make system revisions. This stage is important to ensure that the system has been implemented is error-free.

D. Deployment, Delivery, and Customer Feedback

The fifth stage is development, delivery, and customer feedback. This step is run after the prototype is accepted. It means, the software is ready to run without any addition and error. After operated, the software has to maintenance. The software that has provided has to report in order to add some addition and enhance the software ability. The reporting can also give summarize about running of the software used. This activity can give the learning, and make difference between the old software and new software. The weakness and strength the software have to report too. The reporting has to included technology, operational evaluation, user interactions, system, and information technology.

III. Result

Research, in accordance with the study and analysis of existing systems, can be obtained from business processes that are translated into web applications. The business processes can inheritance from the procedural activity in that Public Health Services. Process has defined such as business process of registration, business process of medical check, business process of medical record, business process of receiving medicine. In order to align between design and implementation, so we have to design the whole process. This research is aided by several UML diagram. There are several diagrams like use case diagram, activity diagram, class diagram, and component diagram to shape the software activity [7].

A. Use case Diagram

Use case diagram is a diagram showing the relationship between actors and use cases. The use case diagram has taken from enrollment the business process. In the process of analysis, the modeling has been found many business processes in medical process. In practical, the research cannot implement whole business process, because limited by the problem boundary. Mainly business process can be seen at the table 1. Drawing diagram for use case was intended to focus in business process and their inheritance. In the other hand, use case diagram must have the actor who can trigger the case and receive the case. At the table 2, shows the amount of case and actor that inter correlate between them. Afterward, the use case diagram can be seen at figure 3.

Table 1. Correlation between Business Process of Medical System and Implementation in PHP Language

Business Process	Name Of Component (PHP[a] Language)
Registration Process	*Dashboard_admin.php*
Medical Check	*Dashboard_dokter.php*
Medical prescription	*Dashboard_petugas_obat.php*
Report	*Menu_laporan.php*

[a] Programming Hypertext Processor (PHP) as a software generator for web application. The software has to run in the server mode or localhost. We have built every modul in business process by writing code in PHP Language [8].

Table 2. Actor and Case in Use Case Diagram

Actor Name[a]	Use case Name
Pasien	*Cek Kartu Berobat* *Pendaftaran Poliklinik* *Pemeriksaan* *Pengambilan Obat*
Petugas Admin	*Pendaftaran Pasien* *Pembuatan Laporan*
Tenaga Medis	*Pemeriksaan* *Menambah rekam medis* *Pembuatan Resep Obat*
Petugas Obat	*Pengambilan Obat*

[a] Actors who interact to the system directly are admin officers, medical officers and medicine officers. For the patient is only questioned by other actors and does not interact to the system directly.

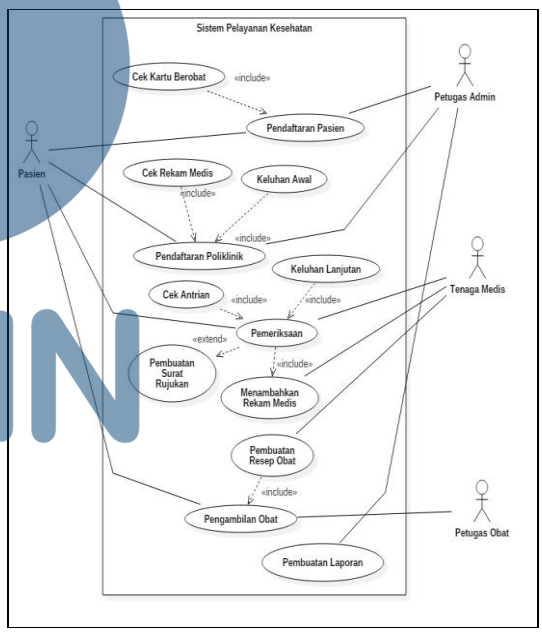

Fig. 3. Use case diagram. The diagram was taken from logical analysis at table 1 and table 2. The diagram has drawn is follows rule of UML [7]

B. Activity Diagram

Activity diagrams are flow diagram that describes the various streams of activity on the system designed. The flow will give the meaning like start activity, the decisions that may occur, and finished actitvity [7]. The following shape at figure 4 is an example of activity diagram.

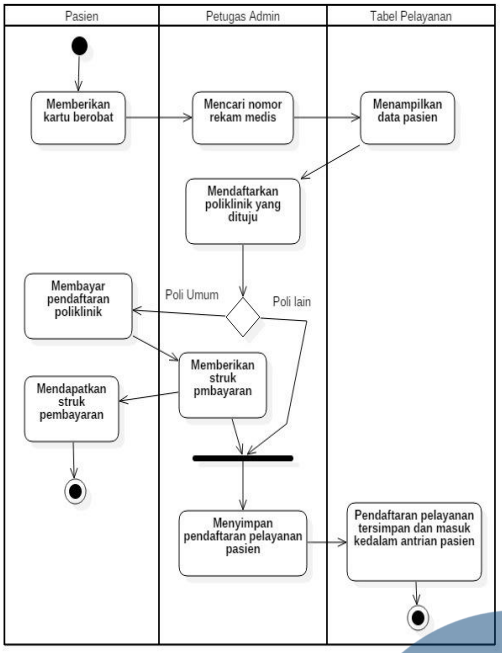

Fig. 4. An Example activity diagram about the process of registration patient in polyclinic. The diagram is following rule of UML [7].

C. *Class Diagram*

Class diagrams describe the structure of the system. Classes have what are called attributes (variables belonging to a class), methods, and operation/method (functions belonging to a class). The classes that exist in the system structure must be able to perform the functions in accordance with the needs of the system. At figure 5, we can be seen the result of class diagram.

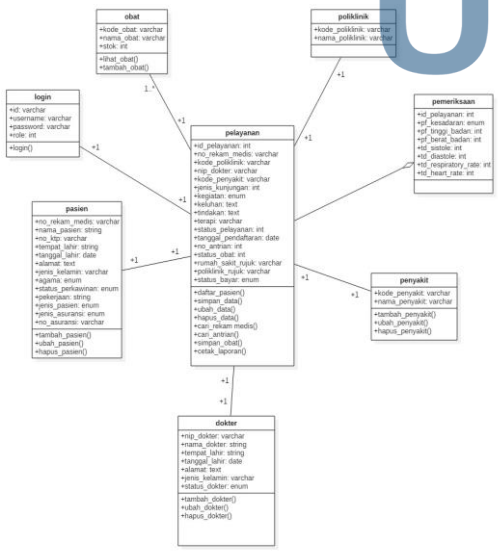

Fig. 5. Class diagram Medical System. The rule depicting diagram is taken form UML structured [7].

D. *Component Diagram*

At the figure 6 shows component diagram among components. This component was built inherentance from business process on the medical system. The components are classified by activity among doctor, officers, and nurse.

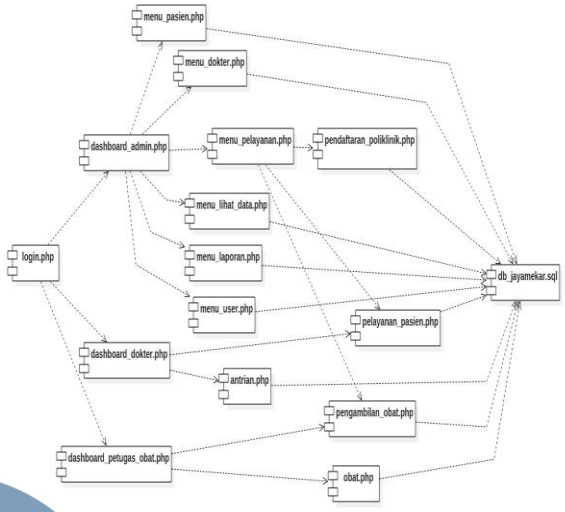

Fig 6. The implementation of Business Process is visualized by Component Diagram Model UML. The component diagram shows application link among component which has built in PHP language. The components are consisting of 16 applications that transforming from logic into application [7].

E. *Construction Prototype*

In the fourth stage of the prototype, the designer is required to create a prototype to see which software is implemented. In the following figure 7, 8, 9, and 10 are examples of interfaces that have been done and used.

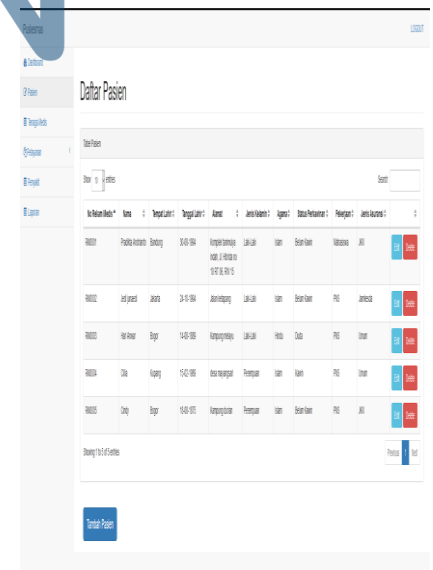

Fig 7. Form Registration for business process of registration patient. Registration form is used for registering medical check the disease.

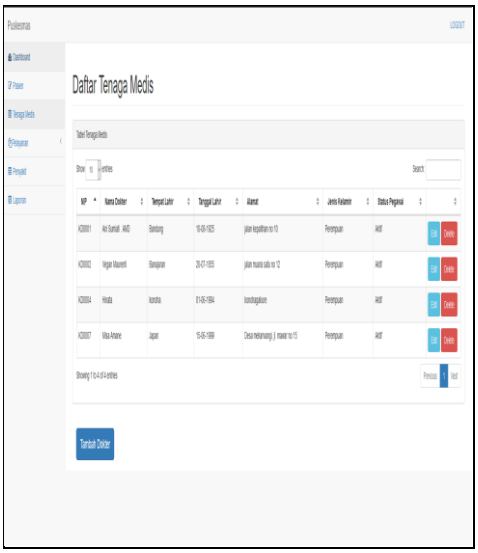

Fig 8. Form of doctor list. This form is available to see the responsibility doctor in special manner. The doctor is person who has strong knowledge about disease. The different of disease will handle to the doctor responsibility.

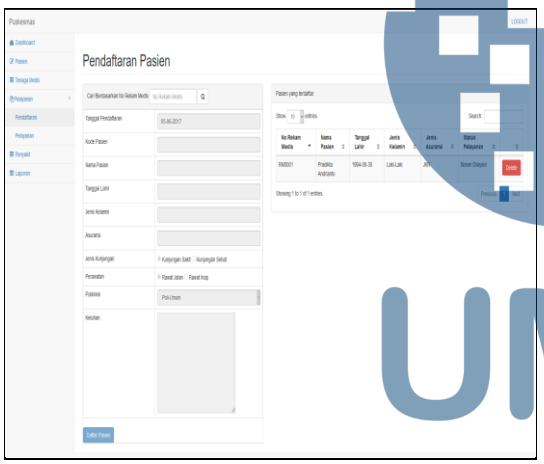

Fig 9. Form Medical Record for business process Medical Check. Its form used for recording every patient who has completed the medical check. The doctor must manually entry into medical record file by this form.

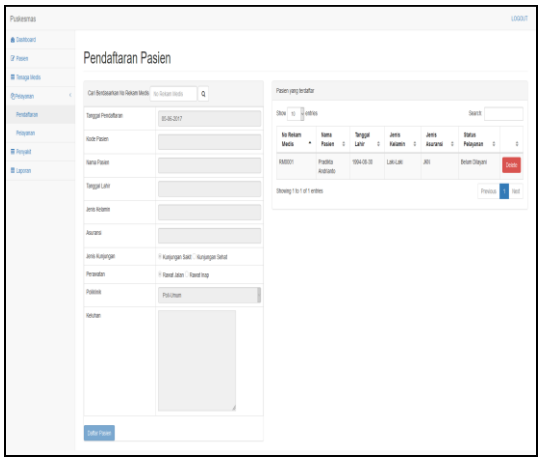

Fig. 10. Form Registration Patient. There are two registrations. First for BPJS Member, and second for Non BPJS Member.

IV. DISCUSSION

In the results of research that has been shown, it can be seen that the business process on medical checks consists of four major business processes. In studies [1, 2, and 3] about medical checks or medical information systems, it is known that the main business processes must involve patient registration, polyclinic registration, and physician checks. In the stage of analysis and design of prototype, the results are shown in the form of use case diagram as in Figure 1. Other results are activity diagrams, class diagrams, and component diagrams in figure 3, 4, 5, and 6 [7].

In the use case diagram, the actor who defined was proposed by previous research [1]. Existing actors are admin officials, medical officers, patients, and medicine officers [2, 3]. So, in this study, the actors used are actors who already exist in the governance of Clinical health service. Each actor is defined, has the task according to the name. The prototype created is the result of analysis and design on the results already delivered. This result is not only an application, but in the form of tables as a storage of transaction data and master data. The following tables describe about data that created by SQL language.

Table 3. An Example of SQL Language

Table name	SQL[a]
dokter	CREATE TABLE (`*dokter*` `*nip_dokter*` varchar(10) NOT NULL, `*nama_dokter*` *varchar(50) NOT NULL,* `*tempat_lahir*` *varchar(50) NOT NULL,* `*tanggal_lahir*` *date NOT NULL,* `*alamat*` *text NOT NULL,* `*jenis_kelamin*` *varchar(10) NOT NULL,* `*status_pegawai*` *enum('Aktif','Tidak Aktif')* NOT NULL, `created_date` datetime DEFAULT NULL, `updated_date` datetime DEFAULT NULL, `created_by` int(11) DEFAULT NULL, `updated_by` int(11) DEFAULT NULL, PRIMARY KEY (`nip_dokter`)) ENGINE=InnoDB DEFAULT CHARSET=latin1

[a]SQL language as a standard query language in database

As continuously activity to the implementation of the software, a test is required. Testing is an important part of software development. Testing is employed to ensure the quality of applications that have been made. Another purpose in this test is that the application runs properly without error and allows it to be rebuilt. Testing for this application is using black box testing method. Black box testing is not necessary to knowing how the application was made. Testing only rely on input and output process. The test used in this software is the equivalence partitioning method which is an ideal test case in expressing an application error. The table 6 shows about testing that has been done with equivalence partitioning. [6].

Table 4. An Example Testing with True Case and Data Test

Testing scenario[a]	Test case	Expectation result	Testing Result	Conclusion
Fill all attributes correctly and press the login button	Username ="admin"	Log into the dashboard menu	Displays the dashboard menu	Accepted

[a] Testing scenario is needed to try and check about attribute which enter into login form. Every login, we must have an username and password. After login, the process will deliver information what the entry is correct or wrong. If correct, we can be concluded this string is accepted by the system [6].

V. CONCLUSION

On the research that have completed; we are concluded that the e-health software can consist of several process. The process is collecting of activities in the Clinical health services. We had found some process like registration, polyclinic process, medicine, recipe, and schedule of doctor. All the process is integrated with other process. So, every patient who will take medical check can register with only one registration. Next, the patient just waiting until called. In the prototype modeling, we had successful applied the steps. We concluded that prototype modeling is the appropriate and simple model to construct the software. We did not wait until the end of step to get the software. Even, in early step, we can deliver the software, so the client can be seeing the software. Thus, the building of software can be supervised by the owner aims directly. In sequence, we can conclude, is the software is aligned within owner aims or not.

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First Author A. Nursikuwagus received his Bachelor degree in informatics in 1998. He also graduted in informatics magister at Bandung Institute of Technology in 2005. Many research have published in international and national journal. His paper was published in international journal with scimago journal rank on Q2 and Q3. He has awardee in scholarship when school at ITB. The major field in research is artificial intelligence, data mining, and information system. The several research has been published in fuzzy system. He is also awardee in applied reasearch from west java government at BP3IPTEK. He one member of Lecturer at Ministry Research and Higher Education since 2005.

Second Author, L. Melian. Her graduated from Padjajaran University in 2000. She focused on Linear Programming and Information System. She is lecturer at Indonesia Computer Univerisity in Bandung. She has responsibility to manage information system department as secretary. She has published several paper in International and National Journal. She also received shcolarship from Ministry of Education in 2001. The research interest is Information System.

Third Author, P. Andrianto. He graduated from Indonesia Computer University. He has supported in Implementation System Clinical Health Service. He was one of student with honorouble distinction from Indonesia Computer University. He focused implementation system with web flatform. His activity is contribute on government and private project in web technology. He is assistant in our project including this reaserch.