

Design of Cloud Computing Outpatient Registration Model Through SMS Messages at Hospitals using TOGAF ADM

Faisal Binsar, Nilo Legowo



Abstract: *The queue is one indicator of patient satisfaction at the hospital in addition to the service of getting treatment itself. Uncertainty, when patients will be served, will reduce patient satisfaction. Hospital outpatient poly enrollment services are the most numerous patient queue. Patients who come to the hospital may not necessarily get services directly because they only know the doctor's schedule and practice information after coming to the hospital. There are times when patients have to go home without getting treatment because they did not find the desired service schedule. The Ibnu sina Indrapuri Aceh Hospital has a Hospital Management Information System (HMIS) application that is connected to the Health Social Security Administering Agency (Badan Penyelenggara Jaminan Sosial-BPJS) application to receive outpatient poly referral patients. The reception of outpatient registration has been done in a semi-manual way by officers where patients must come directly to the hospital. It takes a long time to input one patient's registration data, if there are many patient visits, the time for data input will be longer, causing long queues. So that registration can be done well and faster, it requires an easy way of registration that can be done by the patient himself from home without having to come directly to the hospital, which is using SMS messaging facilities. Patients will receive a reply message in the form of information on the availability of service schedules and queue numbers, patients do not need to come again to the hospital if the desired service schedule is not available. A registration model design is needed to illustrate the organization's management to be integrated into the HMIS application. The design of this registration model was created using the TOGAF framework. The use of the stages and phases contained in the TOGAF ADM framework shows results that are acceptable to the hospital management to design the architecture of the outpatient poly enrollment system at the hospital at an affordable cost and very feasible to use.*

Keywords : *outpatient registration, sms message, web service, cloud computing, TOGAF ADM.*

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I. INTRODUCTION

Ibnusina Indrapuri Aceh Hospital is a type D hospital located in an area with a majority population as farmers and registered as a participant in BPJS Health. This hospital has outpatient services with 7 poly. The number of outpatient visits per day ranges from 50 to 90 patients. Patients come from various regions that have a considerable distance. During this time patients come directly to the hospital to get a queue number and service. Outpatient poly services in hospitals have their schedules, some poly does not serve patient visits every day because it adjusts to the schedule of doctors who are on duty in other hospitals. With this condition, patients who come randomly may not come according to the service schedule, so patients who have come all the way have to come back again without getting services.

Outpatient poly is one of the hospital's first points of contact with patients and serves as a storefront to the health services provided to the community. Care in outpatient care shows the quality of hospital services and is reflected by patient satisfaction with the services provided.

Reservation or registration is a plan for the date, time and place of the visit to receive health services. In general, there are 2 types of medical registrations, namely scheduled and unscheduled registrations. Patient registration management needs to pay attention to 3 aspects, namely the arrival of the patient, the service process, and the queue process at the outpatient unit. Registration is considered as an important aspect and can be used as a basis for controlling patient waiting time. Waiting time to visit a doctor is considered one of the most important indicators of patient access to hospital services.

Registering in person or by telephone is the traditional way. This method of registration has many problems, such as long waiting times, poor service quality, a lot of wasted patient and doctor time, patient dissatisfaction, lack of integration of the registration system, inefficient use of human resources, and inadequate management of health care institutions.

One solution to this condition is by utilizing SMS gateway technology where patients who are generally farmers only have mobile devices that are familiar with telephones and sending SMS messages.

Online registration through SMS messages with flexibility in planning and time efficiency is a solution for patients in making health service reservations. This system, has advantages and features, including access to the system anytime and anywhere, allows patients to know the schedule of poly services, doctor's practice schedule, increase the efficiency and effectiveness of visits, reduce costs, reduce the number and number of officers in the hospital, and save patient information for use at subsequent visits.

The application of an online outpatient registration information system helps in managing and processing patient registration data to be able to get immediate medical care [1].

Receiving registration messages via SMS is expected to be integrated directly with the BPJS system so that the validation process can be directly carried out automatically by issuing the Participant Eligibility Letter number (SEP) along with the queue number and estimated time to be served by a doctor. The application of this solution is very possible to do since the hospital already has a Hospital Management Information System (HMIS) that is integrated with BPJS's application system.

With this solution, it is hoped that patient satisfaction will grow in-hospital services. Patient satisfaction shows the attitude obtained by the service recipient, whether the patient's perception (expectations) of the service has been met or not. The quality of medical service delivery shows the expectations and needs of the public, both in terms of interpersonal care and technical care. This could increase patient satisfaction and thereby improve overall patient care [2].

Patients who actually spent longer periods of time receiving care services did not perceive that they had spent more time in those activities, and they were no more satisfied with the service they received than those who spent less time receiving such services [3].

The implementation of the comprehensive reservation service for non-emergency registration in the hospital shortened patient waiting time and improved patient satisfaction, and the outpatient volume was effectively controlled [4].

II. LITERATURE REVIEW

There is a lot of research that has been done regarding online registration or reservation services that patients can do on their own because many patients expect not to waste too much time waiting to be served. Long waiting times for registration in the health care system have become more common in hospitals, and registration waiting times are generally much longer than waiting times for consultations. Reducing outpatient waiting times has been the focus of a large number of studies because waiting time and treatment are usually considered indicators of service quality. Outpatient waiting times can be further divided into two subcategories: waiting before consultation and waiting after consultation [5]. The waiting time is the time period between the moment that a patient arrives at the registration lobby and the moment this patient is being served by a registration clerk. Sometimes, a patient needs to fill some forms and paperwork before seeing the clerk. In this case, the

time period to fill the paperwork is not considered as waiting time and is subtracted from the waiting time calculation. Clearly, long waiting time will cause patients dissatisfaction and tarnish the image of the VA medical center. [6].

Regarding online registration, research [7] shows that most outpatient population (patients and registration staff) prefer Online Registration System (ORS) for a range of reasons including time consumption, cost benefit, patient comfort, data sensitivity, effortless, easiness, accuracy, and less errors.

Short message service reminders in health care settings substantially increase the likelihood of attending clinic appointments. SMS reminders appear to be a simple and efficient option for health services to use to improve service delivery, as well as resulting in health benefits for the patients who receive the reminders [8]. For hospitals, the registration system can optimize medical procedures, and reduce economic costs. In the past decade, the registration system has become increasingly important in hospitals that seek to improve efficiency and reduce operational costs.

The use of cellular and wireless devices to support medical and public health and public (mHealth) practices and research is increasingly gaining attention because it provides opportunities to connect patients quickly, reducing delays in making health decisions, and positively affecting the lives of millions of people. mHealth, based on the most ubiquitous and widely accepted technology, offers an unprecedented opportunity to serve the unserved by right time medical information services. There is growing evidence that it has already transformed healthcare delivery in many resource poor settings through its low cost, high reach and versatile applications [9].

Short Message Service (SMS) appointment reminders may provide a wide-reaching, low cost approach to reducing operational inefficiencies and improving access to care. Patient satisfaction with text messaging ranged from 77 percent to 96 percent. Implementation challenges included a low rate of inaccurate reminders due to non-standard use of the scheduling system across clinical departments [10].

The ease with which large numbers of messages can be customised and sent by SMS text messaging, along with its availability and comparatively low cost, suggest it may be a suitable means of improving patient attendance [11].

This study aims to create a model of outpatient poly-day care system design that can be done by patients themselves by utilizing the method of sending SMS messages that are relatively easy to use so that patients directly get a queue number or service schedule information. Researchers used the enterprise architecture (EA) approach in designing the model.

Enterprise architecture is used to realize the alignment of information technology with the business of the organization. The framework used in the design of EA is TOGAF ADM. TOGAF ADM is a complex method that can meet all the needs of EA development.

TOGAF-ADM (Architecture Development Method) is a logical methodology from TOGAF which consists of several stages to develop and maintain the technical architecture of an organization.

TOGAF has provided a wealth of experience and detailed methods on how to build and manage and implement enterprise architecture and information systems [12].

Many researchers have implemented TOGAF ADM in creating a system design model. Hospital medical record applications are designed using enterprise architecture to maximize the utilization of the application itself [13].

With enterprise architecture design, it can help to align business needs with various applications that are business process support services. The same research was also carried out to build a design model for outpatient installations at the Surabaya Menur General Hospital [14].

III. METODOLOGY

A. Enterprise Architecture

By viewing the outpatient poly registration system as an organization, in its design, an organizational or company architecture approach will be carried out. In general, Corporate Architecture must be managed in a way that supports reasons about the structure, nature, and behavior of the system. By defining the components that make up the whole system and providing a blueprint from which the system can be developed. Enterprise Architecture (EA) provides the primary components of an organization and illustrates how these components interact with each other. EAs usually include an overview of all information systems in a company; including software, hardware, and information architecture.

The results of this enterprise architecture consist of documents such as drawings, diagrams, models, and documents in the form of text that will explain what kind of information system an organization needs. Enterprise architecture will be used as a reference for the development of information systems. System development without having a good architecture will be difficult to achieve maximum results [15].

There are several benefits obtained in building an EA, including:

- Streamlining business processes: the basic advantage of building an EA is to find and reduce repetition in business processes. The reason for this repetition is due to different organizational views on data or business processes. The basic approach to building an EA is to focus on data and processes.
- Reducing the complexity of information systems: a framework reduces the complexity of information systems. This was achieved through an identification process.
- Enabling integration via data sharing: EA identifies data standards for sharing. For example, most companies have customer and market data, but the data is stored in different databases. EA forms the compatibility of the data used (share). Data compatibility provides a standardized data store in a data warehouse for market research and analysis. A good architectural design not only facilitates the company's value chain but also can provide the infrastructure needed to connect the value chain

between companies.

- Speed up the evolution of new technology: client/server technology revolves around understanding data and the processes that shape and access it. As long as the EA is structured based on data and processes and there is no repetition on the same thing, the client/server technology can run well in an information system in a company/institution.

The EA model for outpatient poly service registration system was designed using the ADGA TOGAF approach with stages consisting of phases : *Preliminary, Architecture Vision, Business Architecture, Information Systems Architectures, Technology Architecture, Opportunities and Solutions, Migration and Planning, Implementation Governance, Architecture Change Management, and Requirements Management*. Although the developmental phases are explained sequentially, this sequence can be run according to the context, especially in the form of iterations in the ADM cycle [12].

The outpatient poly registration system is designed with regard to the gap analysis (current Gap Analysis) with the expected system and the proposed value chain needs.

The scope and technical design of this outpatient poly registration system was carried out in phases C and D of the TOGAF ADM. Where in phase C is explained about the application and platform used and the data requirements that must be provided. While phase D explains the choice of storage infrastructure and information connection.

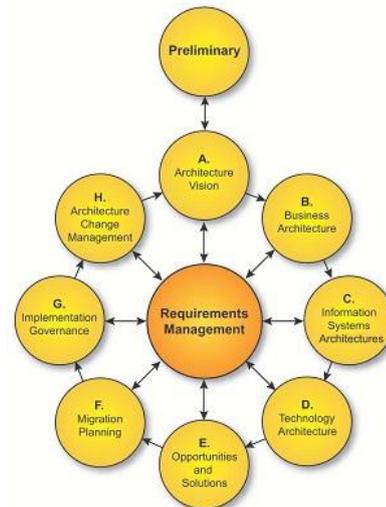


Fig. 1. Architecture development method (ADM) - TOGAF9 [16]

To build EA design in the TOGAF framework there are 4 architectural domains, including:

- **Business Architecture** defines key business, government, organizational, and business process strategies.
- **Data Architecture** describes the organizational structure of logical and physical data assets and data relating to the management of enterprise resource data.

- **The application architecture** provides a blueprint for individual applications to use, interactions and relationships between application systems as well as relationships with the organization's core business processes.
- **Technology architecture** that illustrates the capabilities of software and hardware that can support the development of a business service, data, and application, including IT infrastructure, middleware, networks, communication, processing, standards.

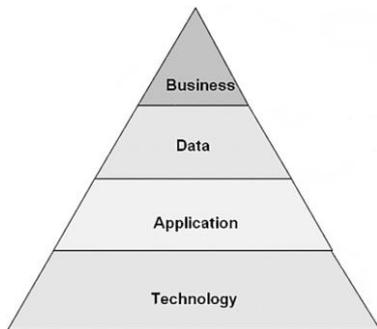


Fig. 2. Layers of the Enterprise Architecture [17]

B. SMS Gateway and Web Service

The technology used for this registration is the SMS gateway and web service. The SMS gateway is used as a system interface in the hospital with patients, where patients send SMS messages to submit requests for registration and receive SMS messages in response to their requests. While the web service is used as a method of data communication between the system at the hospital (HMIS) with the system owned by BPJS, in this case, the vClaim application for processing and validating registration data. The output from this outpatient poly enrollment system is information on service acceptance or rejection. Service acceptance information consists of a queue number, the doctor who will serve as well as service time. While the rejection information can be in the form of error messages or unavailability of doctor's practice schedule on that day.

HMIS and vClaim application are cloud computing-based applications. The outpatient poly registration application via SMS message will be embedded in HMIS.

C. Data Collection

This research was conducted by collecting data directly at the hospital. Data collection techniques are done through:

- Interview, used to get information and an overview of the problem of the outpatient poly registration process that occurred at the hospital. Interviews were conducted both with patients and with the reception staff at the hospital.
- Observation, the process of data collection is done by directly observing the stages and conditions of the registration service activities that occur in hospitals.
- Literature study, collecting data through secondary data to support the preparation of this research, collecting data and information that is a reference in the preparation of this enterprise architecture. References are obtained from books, journals, articles,

and various sources from the internet related to the TOGAF ADM enterprise architecture and the registration process using SMS messages.

IV. DISCUSSION RESULT

A. Preliminary Phase

Data for outpatient poly visits throughout 2019, monitored in November at the Ibnu sina Indrapuri Aceh Hospital, presented in Figure 3, shows the number of visits continues to increase, this is indicated by the increasing difficulty of staff at the hospital serving the process of registering patients who come directly with long queues.

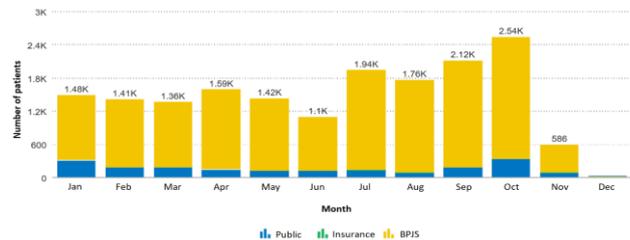


Fig. 3. Outpatient poly visit in 2019

The registration for outpatient visits so far has been done directly through the registration service counter, with the patient bringing a referral letter inputted by the officer. If the intended doctor has a schedule of services on the day of arrival of the patient, then the patient will be received by giving a queue number of services, but if there is no doctor's practice schedule on that day then the patient registration is refused and required to visit the hospital on another day. Of course this condition is undesirable, especially for patients who come from far away.

A way of outpatient registration that utilizes technological advances specifically SMS gateways and web services that have interconnected with many application systems can automate processes that occur effectively, and can provide results of the registration process quickly to patients. Patients can register at any time and from home without first having to come to the hospital, so patients only come to the hospital if they have certainty there is a schedule of doctor's intended destination and with more definite service time information.

Table- I: Principle Catalog

<i>Architecture</i>	<i>Princip</i>
<i>Business Architecture</i>	<ul style="list-style-type: none"> ▪ Safety and healing of patients ▪ Increase patient satisfaction ▪ Availability of service schedules ▪ Speed of service ▪ Quality of service
<i>Data Architecture</i>	<ul style="list-style-type: none"> ▪ Data as an asset ▪ Source of accuracy and determination of diagnosis ▪ Data sharing and integration ▪ Data validation ▪ Data security to maintain patient privacy

<i>Application Architecture</i>	<ul style="list-style-type: none"> ▪ Easy to use for anyone ▪ Quick response ▪ Provide complete information ▪ Integrated with other applications ▪ Cloud computing ▪ Flexibility in development
<i>Technology Architecture</i>	<ul style="list-style-type: none"> ▪ Easy and inexpensive acquisition ▪ Interoperability ▪ Security of technological infrastructure ▪ Availability ▪ Connectivity ▪ Server backup ▪ The use of technology that is real time

<i>Stakeholder</i>	<i>Involvement</i>	<i>Concerns</i>
	<ul style="list-style-type: none"> ▪ Check the doctor's schedule and outpatient clinic ▪ Issue Participant Eligibility Letter (SEP) connected to the BPJS vClaim application system ▪ Issue a queue number 	
Hospital clerk	<ul style="list-style-type: none"> ▪ Print Participants' Eligibility Letters (SEPs) that have been processed by the system ▪ Receive physical files from patients (manually) 	Reference letter, SEP

The design of the registration system requirements is explained through the Preliminary phase. Preliminary phase describes the stages in the design process by compiling a framework in the form of architectural vision and also the architectural principles of business processes, application data and technology used.

Preliminary phase has Principle Catalog artifacts that function to find out general principles in hospitals, which are associated with the Enterprise Architecture domain. Table I explains the hospital Principle Catalog and its application to this registration service system.

B. Architecture Vision

Ibnusina Indrapuri Aceh Hospital has a Hospital Management Information System (HMIS) that manages patient data, visit data and complete medical records. The HMIS used already has the ability to interconnect with BPJS's vClaim application using web service technology and cloud computing. Every recording of BPJS participant patient visits inputted through HMIS will be validated to BPJS.

Under these conditions, the hospital has readiness to implement an online registration system through an integrated SMS messaging service. The registration system is expected to provide satisfaction to patients, because patients do not need to come all the way to the hospital before there is certainty in the schedule of practicing poly doctors.

The method of registration via SMS message is the right way to use it in hospitals, considering that in general patients already have mobile devices that only have telephone facilities and send messages, not many use smartphones. In addition, how to operate it is also very easy and can be done by anyone with a cellphone owner.

By providing accurate service information to patients, there will not be a buildup of queues so that staff at the hospital can receive patients in good and good conditions. All registration messages received via SMS are received directly by the application system, then validated and issue the registration queue number. This method does not require manual activity by officers in the hospital. So that the number of officers serving does not need to be in greater numbers.

The main activities that occur in the registration process generally consist of 5 parts, namely: identifying and receiving SMS messages, validation of incoming SMS messages and their writing format, checking the schedule of doctors and outpatients, issuing Participant Eligibility Letters (SEP) connected to the system BPJS's cloud computing application vClaim, and issues a queue number. These activities routinely carry out data communication with supporting activities that are available at the hospital. Supporting activities available are cloud computing-based application systems that can be accessed using web service methods. The activities and activities required in the online registration model using SMS messages are explained in the value chain shown in Figure 4.

Table- II: Stakeholder Map Matrix

<i>Stakeholder</i>	<i>Involvement</i>	<i>Concerns</i>
Patient	<ul style="list-style-type: none"> ▪ Send registration SMS messages based on referral letter number or patient identification number (NIK KTP number or BPJS Participant Number) ▪ Receive registration response information ▪ Receive queue numbers, doctors who will serve, as well as service time 	Material: Reference letter, KTP, BPJS Participant Card, queue number
System	<ul style="list-style-type: none"> ▪ Identify and receive SMS messages ▪ SMS validation and writing format 	SEP

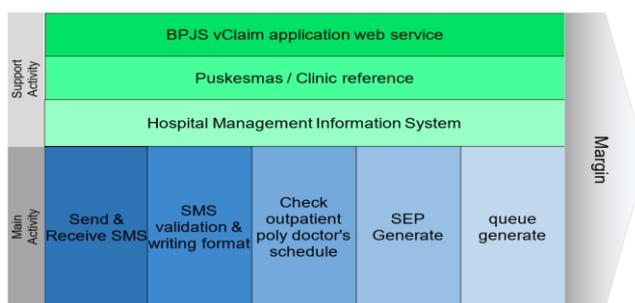


Fig. 4. Value chain : Outpatient Registration

The patient registration process can use one of the following information as a basis for identifying data:

- The reference number listed on the reference letter is obtained from both the Health Center and the Clinic that has worked closely with the BPJS
- BPJS membership number, the system will check this number on the BPJS vClaim cloud computing if there is information on patient referral to the intended hospital.

- Resident Identification Number (NIK) KTP, with this number BPJS membership number will be known, then the patient's referral data will be known.

C. Business Architecture

Business architecture is done in several ways, namely Business Architecture Targets, and Gap Analysis. The basis for improving business architecture, Peraturan Menteri Kesehatan No. 82 Tahun 2013 about Sistem Informasi Manajemen Rumah Sakit.

Business Architecture Targets

Based on previous business processes that are less than optimal, so that the business process plan utilizes information technology more so that one part with the other is integrated. Proposed business process plan in the form of patient registration through an SMS message service. Patients only send SMS messages containing the referral number or patient identification number to the registration service number provided by the hospital. Table II Stakeholder Map Matrix explains in detail the models that can be carried out by each stakeholder on the required registration system.

Gap Architecture Business Analyst

Gap analysis is useful to explain the activities contained in the system that is being used.

These activities compare current activities with proposed architectural targets as in Table III. There is a reduction in the number of officers in the registration section and the impact is also a reduction in the capacity of the waiting room and parking area.

Table- III: Gap Analysis

Current activities	Activity Plan	Gap Analysis
Patients come directly to the hospital to register	Patients can register from home	Replace
Registration is done during service hours	Registration can be done at any time, there is no time limit	Replace
Served by many officers	The number of officers is reduced	Replace
The clerk fills the registration form through the system	The patient sends an SMS message for registration	Replace
Queue number printed	Queue numbers are sent via SMS	Replace
The doctor and poly schedule is known at the hospital	Doctor and Poly's schedule is known from home	Add
Patients who come to the hospital may not necessarily receive services	Patients come to the hospital if it is certain to be served	Replace
Patients come from the beginning	Patients only come when will be served	Add
The clerk creates new patient data	The system automatically retrieves data from BPJS to the system	Add
Long queues in the waiting room and full parking	The waiting room without atrian and the parking lot is filled with only a few vehicles	Replace

The development of business architecture to support the desired outpatient poly enrollment system model in hospitals is also done using the Unified Modeling Language (UML) tool.

Using UML, a use case diagram is modeled to explain the outpatient poly enrollment activities carried out both by patients, hospital staff and by the system. This activity can be demonstrated based on stakeholder relationships with each business process carried out. This relationship is explained using the use case modeling shown in Figure 5.

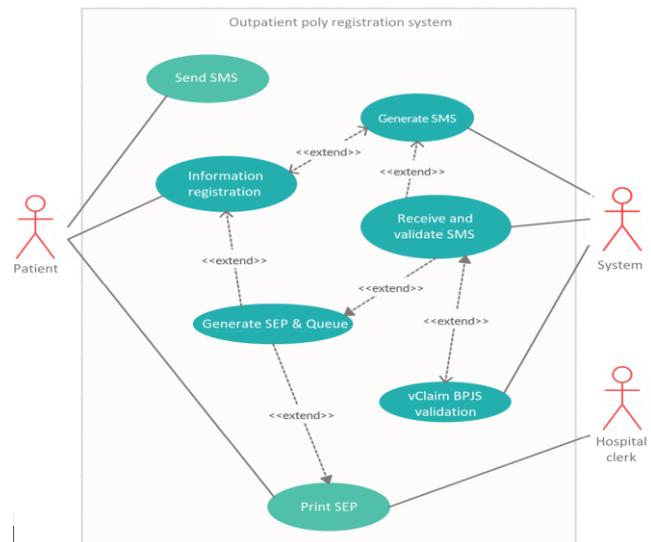


Fig. 5. Use case : Outpatient Registration

D. Information System Architecture

There are two major parts defined in this stage, which include the data architecture and application architecture that will be used in the outpatient poly registration model that is made. Data architecture focuses more on how data is used for the needs of business functions, processes, and services. This stage does not design the database structure, but defines data entities that are relevant to the enterprise. Data entities used include patient data, referral data, SMS message data, registration data, poly data and schedules, doctor data and practice schedules and queuing data.

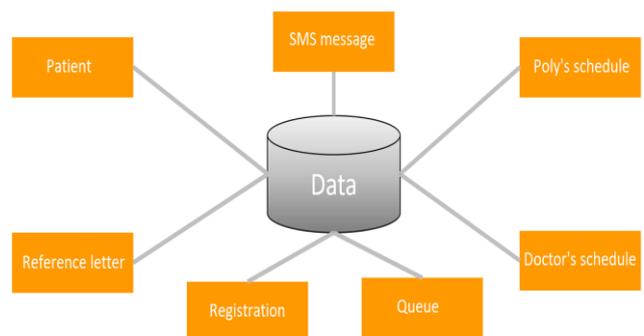


Fig. 6. Data Architecture : Outpatient Registration

The second is the application architecture that defines the types of modules that are important for processing the above data and support the registration process. In general, the application design is modeled in a platform that can be used easily by each patient in the form of writing SMS messages.

*** reference_number * patient_identification_number #**

reference_number : Number of referral letter
patient identification number : NIK of KTP or BPJS card

Fig. 7. Writing SMS Registration format

The functions of each business process are not stored on the device used by the user, all stored on the server or cloud. From the patient's side, the format of writing an SMS message for registration is shown in figure 7.

Processes or activities that occur on the application side are grouped into 3 categories: SMS application, validation application and SEP generation on BPJS vClaim and queuing application. The SMS application manages all incoming messages received via SMS, checks the message writing format to identify the purpose of delivering SMS messages, sends messages containing information that needs to be delivered to patients whether error messages or service schedule information and queues. Valid SMS messages will be followed by the validation of the referral_id or patient_identification_id carried out through the vClaim application on the BPJS cloud server. The validation output of the vClaim application will determine the queue number of patient services managed by the queue determination application.

The relationship of the types of modules or functions of the application to the transaction requirements of the data entity used is shown in the application matrix table which is equipped with information on how to access it.

Table- IV: Application Matrix

Module	Data	Patient	Reference	Schedule	SMS	Regs
Receive & Validate SMS					CR	CR
Check poly schedule				R		
Check doctor's schedule				R		
Referral validation			R			
Patient identity validation	R					
Generate SEP	R	R	R	R		C
Generate queues	R	R	R	R	CR	CR
Generate & Send SMS					CR	R

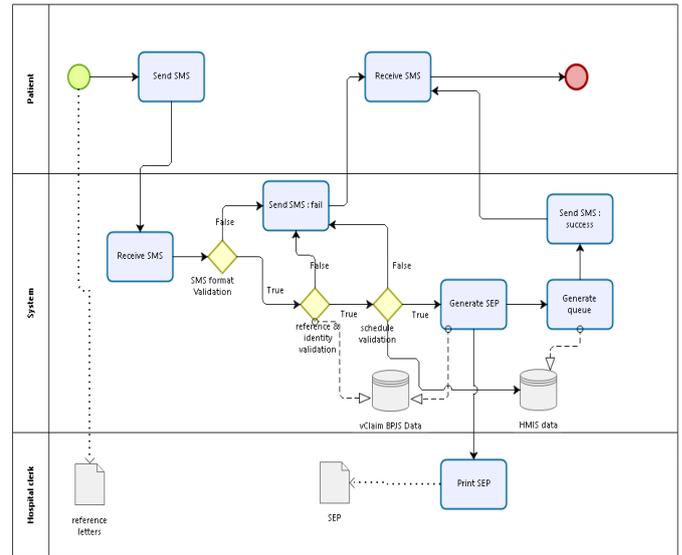


Fig. 8. Process Business : Outpatient Registration

The business process diagram of the above activity is illustrated using the Business Process Modeling Notation (BPMN). The business process that illustrates the registration via SMS message is shown in Figure 8.

E. Technology Architecture

In this Architecture technology phase, the software and hardware requirements of the server are used as storage units. The server has 2 main functions that must be separated from each other, consisting of an application server and a database server. The database server stores data structures that are managed internally by the hospital. Data is stored tabularly and with special consideration does not save in Blob format. The application server stores all the following programming coding files with their configurations. While the BPJS vClaim application server is outside the hospital infrastructure and is accessed through cloud computing services. The entire server device is connected to the internet by hosting or cloud computing. This interconnection configuration is shown in figure 9.

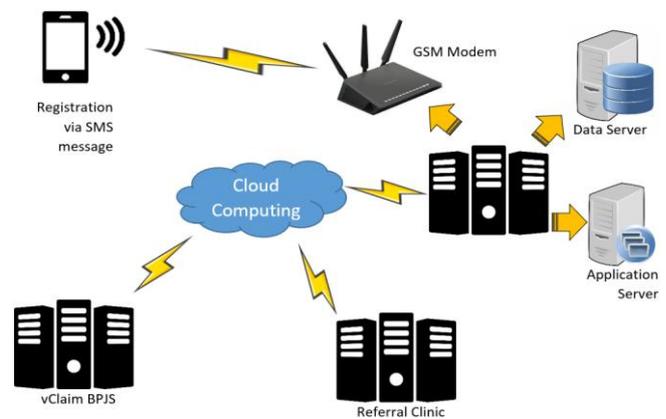


Fig. 9. Network Topology

Technically, there are no special modules that are designed and modeled as an interface on the patient's side as a service user.

On the patient side, they only utilize SMS messaging services with the specified writing format and are sent to the registration service number at the hospital. Modules are only a back end process that is embedded on the server side. Thus, the results of the design of this model can be applied easily and is not a hassle on the side of patients in agricultural areas which are generally unfamiliar with the use of technology.

To realize the application of this design model, there are several specifications that need to be set on the server side, which consists of software and hardware specifications. Software uses the Linux operating system, Linux is an open source operating system and has excellent capabilities for server capacity. Many other application software can run stable in a Linux environment with a very adequate level of security. Web server uses Apache which has become a standard package owned by Linux Server, namely LAMP (Linux, Apache, MySQL and Perl / PHP / Python).

LAMP Is a free software package that is used to run a complete application. Components of LAMP:

- Linux – operating system
- Apache HTTP Server – web server
- MariaDB atau MySQL – database system
- PHP– programming language used

Some software that uses LAMP configuration include MediaWiki and Bugzilla.

Value Chain outpatient registration services described in Architecture Vision have main activities and support activities. All modules contained in the main activity are built using PHP, which is equated with programming on HMIS. Management of SMS messages and interconnection with GSM Modem devices using the Gammu package. While communication with the BPJS vClaim application uses a web service with a SOA (Service Oriented Architecture, service oriented architecture) approach. The use of web services is also done to connect to various other applications through the API (Application Programming Interface) provided by each application.

F. Opportunities and Solution

The need for an information system is a statement to come out of the analysis of the current situation and business needs, which is derived from the strategy and gathering of requests from current business activities. it also contains needs arising from an analysis of the external business environment. There are so many gaps between current resources and competencies and those needed to meet future platform demands [18]. This gap is defined as the Gap Analysis that occurs in this phase. In the context of this study, these gaps generally occur in the scope of data and information access as well as the necessary infrastructure, including:

- The need for integration of the registration service system that offers convenience and interactive communication. This process requires simplification and redesign of the existing system.
- New information resources or can be linked to other sources. The list of information needs can be compared with the current system and database to determine where new information will come from or whether new sources should be found. Quite often, new information needs can be met by relatively small modifications of existing

systems or databases. Obviously, this can be dealt with in the short term. Other information needs can only be met by developing new applications, and it will take longer to implement.

- Changes in the way information technology connections, changes from intranet to internet, local to global, dedicated servers to cloud computing.

V. CONCLUSION

How to register for outpatient poly services at the Ibnu sina Indrapuri Hospital in Aceh is currently done in a semi-manual way. Manual in the data input process by checking the completeness of the files in the form of a referral letter, family card, identity card (Kartu Tanda Penduduk-KTP) and BPJS membership card. From the entire file submitted to the hospital staff, it is then entered into the outpatient poly registration module in the HMIS application. The method of registration such as requiring patients to come directly to the hospital by bringing all the complete documents to be verified. Patients who come to the hospital do not necessarily get services because the poly service schedule and doctor schedule are unknown, so patients must go home without getting services and patients must come back to register on another day.

An alternative solution is to make the HMIS application accessible to patients online, but this solution is considered inappropriate for the social conditions of hospital patients in agricultural areas who are not accustomed to accessing the internet using a browser either from a computer or using a smartphone.

The most appropriate solution for this condition is of course using SMS gateway technology. Generally people already have mobile devices and are accustomed to using SMS facilities to communicate, send messages and receive messages. In this way, the patient simply writes a message in accordance with the standardized writing format for the registration service using a combination of reference numbers and patient identification numbers. Then the message is sent to the outpatient poly service number provided by the hospital.

Validated messages received on the server application at the hospital are processed for the need for registration, the output will send a reply message to the patient informing them of the service schedule and queue number so that patients can come to the hospital at a time close to the service schedule.

There are so many benefits and benefits obtained both for hospitals and for patients. Patients do not need to come faster to the hospital just to get a queue number of services, because the queue number has been obtained. Patients can come to the hospital near the time of service. While the Ibnu sina Hospital with a relatively small waiting room capacity can accommodate only patients who will be served shortly, this also benefits the availability of a small parking space. Also, because the registration service application via SMS message is integrated with the BPJS v Claim application, all data validation and verification processes are carried out automatically through the web service used,

the staff at the hospital do not need to manually open all registration SMS messages and process them manually. Thus, the number of officers in the hospital registration section can be reduced.

The need for an outpatient registration service application system solution needs to be planned by first designing the model. The design of an application model that is suitable for the needs of the Ibnu Sina Indrapuri Aceh Hospital is to use the Enterprise Architecture approach with the TOGAF ADM framework. The TOGAF ADM Framework through the stages described in the discussion section of this study provides very complete and detailed information for developing service modules in the HMIS application so that it becomes easier to use both on the hospital side and for patients.

The resulting design model has considered the effectiveness and efficiency of many factors such as social conditions surrounding the hospital, communication accessibility, hospital human resources, internal applications in hospitals, the interconnection of other external applications, infrastructure in hospitals, costs and time. Evaluation of the results of this study shows that the output in the form of blueprint designs conducted using the TOGAF framework can be accepted by hospital management. The solution provided is very feasible to implement immediately because it does not require large costs, even some budget sources for the procurement of new human resources can be substituted into the cost of developing this registration application.

The output of each phase of the TOGAF ADM produced in this architectural design can provide an understanding that is easily accepted at both the hospital management level and the technical level to be implemented and integrated with HMIS.

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