

# Electronic Medical Records (EMR) Using a Software as a Service (SaaS) with a Single Identity Number at the Polije Polyclinic

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Article

# Electronic Medical Records (EMR) Using a Software as a Service (SaaS) with a Single Identity Number at the Polyclinic of Politeknik Negeri Jember

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**Abstract:** Manual management of medical records at the Polije Polyclinic causes long data retrieval time, misfiling, and requiring a lot of spaces for storage, thus hampering health services. Electronic Medical Records (EMR) are one type of medical record management that can be used to solve the issue. EMR is built based on Software as a Service (SaaS) which enables it to be used by all healthcare providers with minimal infrastructure and optimal data integration. The application used a single identity number for each patient, and it caused less redundancy in patient registration data. Developed using the Waterfall method, it was processed at several stages: analysis, design, implementation, testing, deployment, and maintenance. The EMR system had some features: recording history, diagnosis, and therapy. In the diagnosis section, the system had a disease code related to ICD-10. It can be concluded that the Electronic Medical Record (EMR) is ready to be implemented in the POLIJE polyclinic. The implementation of EMR is important to reinforce the Regulation of the Indonesian Minister of Health Number 24 of 2022 concerning Medical Records.

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**Keywords:** Electronic Medical Record; SaaS; Single Identity Number; Waterfall Method

## 1. Introduction

Information technology in the health sector has been widely used for health planning and data records at the individual and community levels [1]. It can increase the speed and accuracy of data processing to provide more complete and accurate data faster [2]. An example of the information technology used for health services is the Electronic Medical Record (EMR). A systematic review conducted by Holroyd-Leduc et al (2011) showed that EMR is not only useful for clinical decision support systems but also has a significant impact on time efficiency, cost efficiency, availability, and productivity [3].

POLIJE Polyclinic is a unit established based on the Decree of the Director of the State Polytechnic of Jember Number 037/K14/KP/SK/2011. A clinic is a health service facility that provides individual health services with basic and/or specialist medical services [4]. Each health facility is required to create a patient's medical record. A medical record is a file that contains the patient's identity after a patient receives all health examinations [5], [6]. The Indonesian Minister of Health Regulation Number 24 of 2022 concerning Medical Records stated that every health service facility is obliged to maintain electronic medical records no later than December 31, 2023 [5]. This regulation applies to all healthcare facilities, including the POLIJE Polyclinic.

The manual administration of medical records at the POLIJE Polyclinic caused a long time for data retrieval, misfiling, and piling storage space [7]–[11]. Health facilities, therefore, have to use EMR for solving this issue [12]. EMR utilizes information

technology to collect, store, process, and access patient medical records from a database [9], [13], [14]. This system aims to improve the quality of patient data and information, improve service quality, reduce data redundancy and clinical errors, and accelerate access to patient data [15]–[19]. This study aimed to design and implement a Software as a Service (SaaS)-based EMR with a Single Identity Number at the POLIJE Polyclinic. The waterfall method was used in the system development at several stages: planning, system design, programming, testing, and implementation and maintenance [20]. This system used a single identity number (SIN), a unique identification number that is integrated with a combination of data from various government and private institutions [21], [22].

The use of EMR at the POLIJE polyclinic is expected to improve the quality and quality of medical record management, speed up patient registration, recall accurate patients' medical history, and reduce patient waiting time. The patient identification number in this system is valid and can be used in all health facilities without creating a new one.

## 2. Materials and Methods

The EMR system was developed using the waterfall method, which takes a systematic and sequential approach.

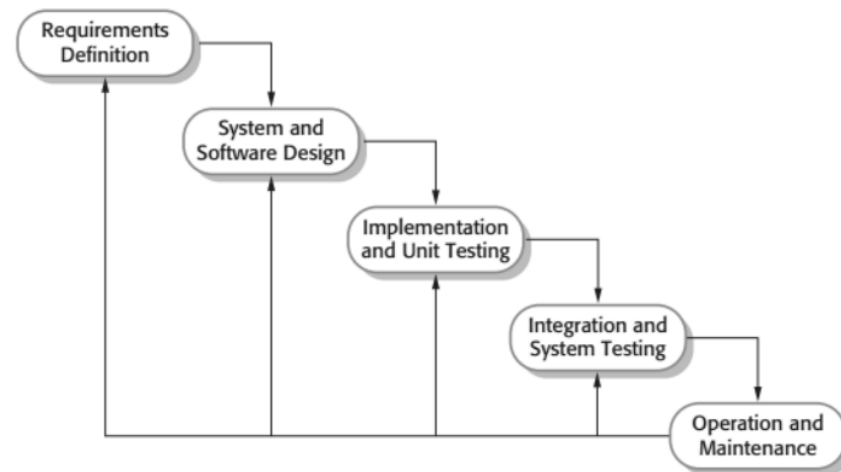


Figure 1. Waterfall Method [20]

Several stages passed in the waterfall method are as follows[20]:

### 1) Requirements Definition

The first stage in the waterfall method is analysis. At this stage, a problem analysis was carried out at the POLIJE Polyclinic by identifying the EMR design. Since the old system was still manual, the proposed solution was to create an EMR using a Software as a Service. Users can use Software as a Service (SaaS) without providing infrastructure such as servers, networks, and so on. Healthcare facilities can use such a software with an integrated single identity number for all purposes to check patient data.

### 2) System and Software Design

At the design stage, the system was designed in a flowchart, ERD (Entity Relationship Diagram) for database design and system interface design. The design at this stage was used as a reference in the next stage.

### 3) Implementation and Unit Testing

At this stage, the system was coded based on its design. This web-based system used the PHP programming language and the Laravel 8 Framework. Laravel 8 is one of the

best frameworks for developing web-based applications, and it has a liable security and fast process.

4) Integration and System Testing

This stage was then tested using the black box method to examine the system functionality and minimize system errors. In addition, system security testing was also carried out by conducting penetration testing against the following threats: SQL Injection, XSS, and DoS (Denial of Service).

5) Operation and Maintenance

At the operation stage, the system was run to test its use. Patients and staff at the POLIJE Polyclinic were educated on how to use this system. System maintenance was the stage where the system was then evaluated after the implementation. If a system error or problem was found on the server, it would be repaired.

### 3. Results and Discussion

1) System and Software Design

Software as a Service (SaaS) does not need a lot of infrastructure such as servers, networks, and so on. System users could use this software with an integrated single identity number across services. An illustration of this SaaS concept can be seen in Figure 2.

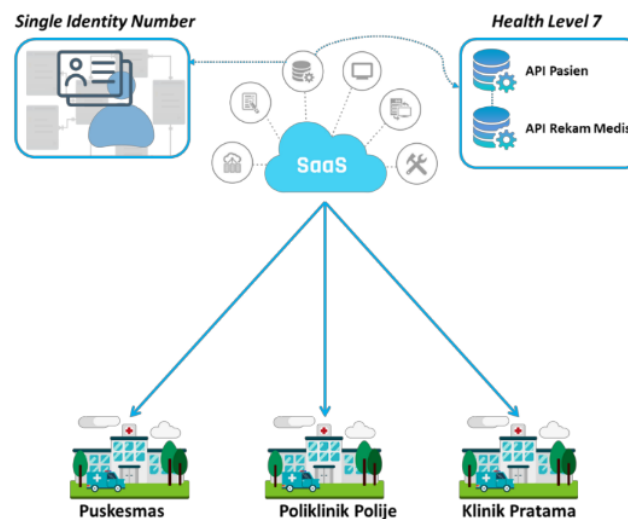


Figure 2. Scheme EMR Based on SaaS

This SaaS-based Electronic Medical Record (EMR) has a cloud-based infrastructure. The patient database in this system could be retrieved using a single identity number, which is unique and permanent.

2) Implementation and Unit Testing

This EMR (Electronic Medical Record) save the patient's examination process after it scans patient registration through a patient card that has been equipped with an RFID. The RFID Scanner reads the patient number as shown in Figure 3. Unit testing using blackbox testing method.

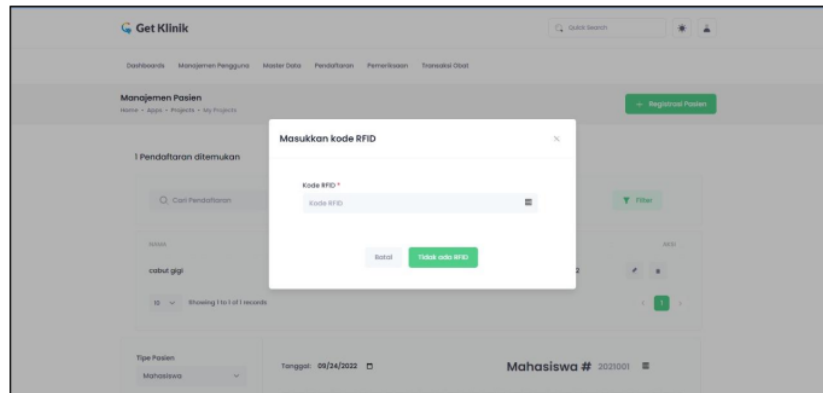


Figure 3. Scan Patient Card Based RFID

Patients could choose the type of visit, either examination or consultation, and the clinic.

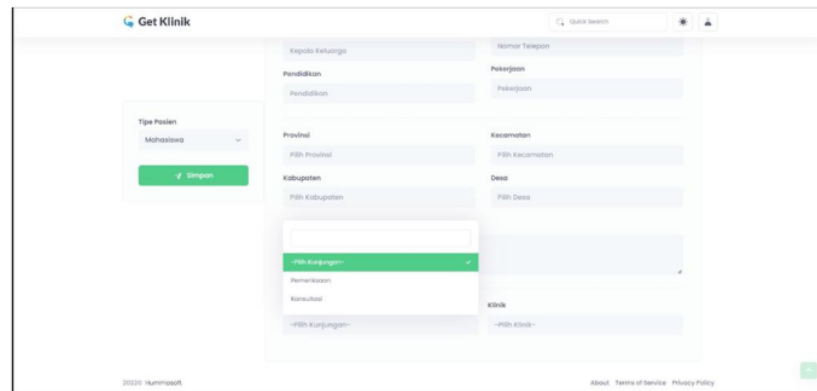


Figure 4. Registration Page for Patient to Choose Type of Visit

The POLIJE Polyclinic used paper-based medical records and thus experienced a lot of administrative problems. The Indonesian Ministry of Health stated that every health service facility is required to maintain an Electronic Medical Record (EMR) no later than December 31, 2023 [5]. EMR is a medical record created using an electronic system intended for the administration of medical records [5]. The EMR contains patient health records collected by and for doctors for diagnosis and health treatment [23]. EMR is a great challenge of information and communication technology in healthcare facilities [24].

This study found SIN could be useful as a unique identification number to integrate data from various institutions [21], [22]. Every health check requires patient card equipped with an RFID which could be a patient identifier. In EMR, patient data were recorded by the health worker users such as nurses or doctors. All records would be displayed in the examination page as shown in Figure 4.

The screenshot shows the 'Pemeriksaan' (Examination) page in the 'Get Klinik' application. The page is organized into several sections for data entry:

- Anamnesis (Keluhan Utama):** A text input field for the main complaint.
- Vital Sign:** Fields for Blood Pressure (mmHg), Status Blood Pressure (Normal/Abnormal), Temperature (C), Pulse (x/min), Respiration (x/min), and Blood Type.
- Physics:** Fields for Weight (Kg), Height (Cm), and BMI (Normal/Abnormal).
- Pemeriksaan Fisik dan Diagnosis:** Fields for Physical Examination, Diagnosis, Cause, and Notes.
- Tindakan:** Fields for Action and Price, with a '+ Tambah Tindakan' button.
- Resep:** Fields for Drug Name, Dose, and Quantity, with a '+ Tambah Obat' button.
- Resep Racikan:** Fields for Recipe Name/Drug, Dose, and Quantity, with a '+ Tambah Obat' button.
- Dokter & Penanganan Lanjutan:** Fields for Doctor Name and Further Treatment.

At the bottom of the page, there is a copyright notice: '© 2023 Hummasoft' and links for 'About', 'Terms of Service', and 'Privacy Policy'.

Figure 5. Patient Examination Page

On the examination page, the nurses or doctors had to enter eight types of information related to health diagnosis and complaints: (1) anamnesis which is the main complaint of the patient such as fever, cough, or runny nose; (2) vital signs such as blood pressure, temperature, heart rate, respiration, and blood type; (3) condition of physical body such as weight and height; (4) physical examination and diagnosis, such as eye conditions, teeth, or others. In this page, the doctors or nurses also added certain notes to the results of the examination. (5) They chose actions that contain treatment management for patients, whether by giving drugs or injections, and others. (6) They informed patients about prescription and (7) concoction prescription for patients who require special drug treatment; (8) They also added information related to further treatment or referrals to certain specialists if needed.

The EMR in healthcare facilities can increase the efficiency of health services such as cutting long waiting time. Saputro's research (2020) showed that the EMR improves the quality medical records available in clinics up to 98.75% [25]. EMR is also easy and fast to access and helpful for doctors because it can be accessed jointly by different authorized users [26]–[29]. The EMR can increase the cost efficiency with

no need for massive procurement [25]. In addition, it can reduce medical errors by up to 55% as it can record warnings for drug allergies, inappropriate doses or interactions, suggested treatments for certain conditions, or suggested preventive treatments [30]. In conclusion, EMR can improve patient safety [30]–[34].

#### 4. Conclusions

Based on the research, the Electronic Medical Record (EMR) is ready to be implemented at the POLIJE polyclinic. It is essential for actualizing the Regulation of the Indonesian Minister of Health Number 24 of 2022 concerning Medical Records.

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#### Conflicts of Interest

The researcher declares that he has no conflict of interest in this study

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