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Development of a Health Claim Verification Application using the Agile Method at Hospital X

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Abstract. *Hospital X as one of the referral health facilities in the Cimahi area and its surroundings faces significant challenges in health claims management. This semi-digital process can result in significant financial losses and high operational costs. This research aims to build an application for the health claim verification process with the results of analysis at X Hospital. Developed a web-based health claims verification application with Agile methods that integrates ICD-10 standards and artificial intelligence (AI) to automate document checks, reduce human error, and speed up the verification process. The research uses agile methods with system development through Scrum. Key frameworks include Flask-Python (backend), Bootstrap 5 (frontend), and SQLite/PostgreSQL (database). Data is collected through interviews with medical staff and observation of existing verification processes. Implementation during 4 sprints resulted in a reduction in verification time from 3-5 days to <24 hours. The claim reduction is rejected from 8% to 2.5% through automatic validation. Multi-role system with 4 separate dashboards (admin, medical staff, verifier, participant). Pre-screening AI integration detects 92% of nominal anomalies of claims. This app is proven to improve verification accuracy and faster time efficiency. The success of the implementation of Agile is demonstrated by the ability to adapt to 12 changes in the requirements of the development time.*

Keywords: *Health claims verification, agile methods, flask, python, SQLite*

1. Introduction

Hospital X as one of the referral health facilities in the Cimahi area and its surroundings faces significant challenges in health claims management. The claims verification process that is currently being carried out still relies on semi-digital systems which causes operational inefficiencies. Recording and checking claim documents involving thousands of files every month takes a long time, while the demands for accuracy and speed from BPJS Kesehatan and other insurers are increasing. This condition causes delays in the reimbursement process which has an impact on hospital cash flow (1).

The weaknesses of the current claims verification system lie in the dependence on limited verifiers, difficulties in tracking the status of claims, the high risk of human error in checking the completeness and suitability of files, and the difficulty of integrating data between the electronic medical record system and the billing system (2,3). Discrepancies between diagnoses, medical procedures, and bills often occur and often lead to denial of claims from the guarantor. This problem is compounded by the absence of an automatic warning system for incomplete or suspicious files, so the verification team has to manually and repeatedly check each file (4,5).

The financial impact of the inefficiency of this claims verification system is significant. Based on preliminary analysis, about 15% of claims experienced payment delays due to

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document completeness issues, and 8% of claims were rejected due to diagnostic mismatches with the measures or treatments provided (6). This amount represents a potential loss of up to billions of rupiah every year (7). In addition, human resources and wasted time on manual verification processes and handling problematic claims also add to the operational burden of hospitals (8).

In Indonesia, the development of a similar system is still relatively new and has not been studied in depth, especially in local government hospitals. Several approaches such as a claim tracking dashboard, alert system for incomplete files, and ICD-10 integration with billing systems have begun to be introduced, but there is no comprehensive agile-based solution that combines all these features in a single platform (8,9).

Health claims management has become a strategic issue in hospital governance, especially in referral facilities such as Hospital X which handles a high volume of claims every month. As the complexity of the health insurance system increases and efficiency demands from insurers such as BPJS Kesehatan, many institutions are starting to switch from manual to digital systems. However, this transition is not yet fully optimal. According to Wahyudin et al (2019), most hospitals in Indonesia still rely on semi-digital systems that are prone to inefficiencies, delays, and human error in the claims verification process.

Several studies have proposed the development of automated verification systems that integrate electronic medical records (EMRs) with financial and billing systems (7,11). However, the application of such systems is still limited due to interoperability issues and low adoption of artificial intelligence (AI)-based technologies. In a global context, AI-based approaches, especially natural language processing (NLP), have been used to match diagnostic codes (ICD-10) with medical measures to automatically detect nonconformities (12,13). This system has been proven to reduce the rate of rejected claims and significantly speed up the document verification process.

Previous research has shown that Agile methods are effective in the development of health applications, including claims verification systems. Novantara & Trisudarmo (2025) highlight that this iterative approach improves the efficiency and transparency of public information systems. Boustani et al. (2020) stated that Agile speeds up the development process and makes it easier to adapt to user needs in health applications. Chowdhury (2025) also emphasizes the importance of security and speed in a digital system based on health claims that can be achieved with Agile.

This study aims to build an application for the health claims verification process with the results of a case study analysis at Hospital X. The focus of the research is limited only to the design stage of a web-based claims verification application with the Agile method. The application is designed by integrating ICD-10 standards and artificial intelligence to support the automation of document checks, reduce the potential for human error, and speed up the verification process. However, this study does not cover the implementation stage or direct integration with the hospital information system.

2. Methods

The Agile method is an iterative and adaptive approach to software development, which is very suitable for health information system projects that require the ability to be responsive to dynamic changing user needs (17). One of the most popular frameworks in the implementation of Agile principles is Scrum, which provides specific structures and practices for managing projects in a gradual and collaborative manner. In Scrum, the development

process is divided into several fixed-time iterations called sprint (generally lasting 1-4 weeks). Each sprint results in an increment of the product—an improved version of the system that can be tested and evaluated immediately. This process begins with the preparation of a product backlog, which is a priority list of features compiled based on the value of benefits to the end user (13,18).

In the context of a health claims verification system, stakeholders such as admins, verifiers, and active participants are involved to ensure that the developed system is truly relevant and usable in the field. Scrum also emphasizes reflection and continuous improvement through retrospective sprint sessions, making the development process more adaptive, efficient, and scalable (19,20).

2.1 Implementation of Scrum in the Project

The development team uses a Scrum framework that consists of 5 main stages:

1. Product Backlog
   The needs of the system were formulated through in-depth interviews with:
   a. Admin for claims and report management needs
   b. Verifier for document inspection workflow
   c. Participants for ease of submission of claims (Multi-document upload feature appears as the main need)
2. Sprint Planning
   Define the scope of each sprint based on priority:
   a. Sprint 1 focuses on user authentication and core models
   b. Sprint 2 develops claim submission forms
   c. Sprint 3 builds a verification module
3. Sprint Execution
   Each sprint follows a flow: Development (To Do) → Testing → Revision. In sprint 2, the claim submission form goes through 3 design literacy after usability testing with participants (12).
4. Sprint Review
   Demonstration of features to stakeholders:
   a. Trial of the claim verification feature by the hospital admin team
   b. Identify additional needs such as automatic nominal validation
5. Retrospective
   Evaluation of the technical process:
   a. Problem Document validation is not yet strict
   b. Solution: Add virus scan and file format validation

2.2 System Data Collection Techniques

1. Structured Interviews
   a. With claims section head: workflow approval needs
   b. With administrative staff: participant data input needs
2. Direct Observation
   a. Manual verification process at RS X
   b. Pain point analysis on legacy systems

2.3 Supporting Technology The actual implementation of this project uses:

1. Frontend: Bootstrap 5 for responsive interface
2. Backend: Flask + SQLAlchemy for flexibility
3. Database: SQLite for development, with migration to PostgreSQL in production
4. AI Integration: Python for claims pre-screening module (18).

3. Results and Discussion

In the research and development process, the author follows the stages in the Agile method. The initial stage begins with the preparation of a Product Backlog which is compiled based on the results of interviews and direct observations that have been carried out by the author.

Table 1. Backlog item

No.	Backlog Item
1	Users can log in according to the role (Admin and Client)
2	Admins can manage data from the master data menu
3	Admins can see a summary of all data through the dashboard page
4	Clients can view a summary of their project data through the dashboard page
5	Admins can manage all project data through project sub-menu
6	Clients can manage their project data through the project sub-menu
7	Admins can manage all payment (billing) data from the entire project
8	Clients can manage billing data from their projects
9	Admins can manage all accounts registered in the system
10	The client can manage his/her account data registered in the system

The next stage is the Sprint Backlog, where you break down the Product Backlog into more detailed sections. Each item is then sorted according to its priority level, complete with an estimated processing time. This process is carried out by compiling a list of backlog of items that have been selected to be worked on in sprints, along with planning and estimating features that will be developed to produce products as needed. Here is the Sprint Backlog table that has been compiled (21).

Tabel 2. Sprint backlog

Work	Estimate (Days)
Create a 1 menu view	1
Differentiate between admin, verifier and claim requester access rights	2
Create an admin Dashboard page	1
Create a Verifier Dashboard page	2
Create a medical dashboard page	1
Create a claim requester's Dashboard page	2
Create a Claim history page and list requester verifier history	1
Create medical patient referral submission forms , invoices and prescriptions	1
Create a submit claim page	1
Create a Login Dashboard page	1
Create a landing page	1

Create a user management page for admins	1
Create a referral page	1
Create an invoice page	1
Creating a prescription page done by a medical	1

The third step is to prepare Sprint Planning, which includes planning the system workflow in the form of a flowchart as well as designing the database structure to be used.

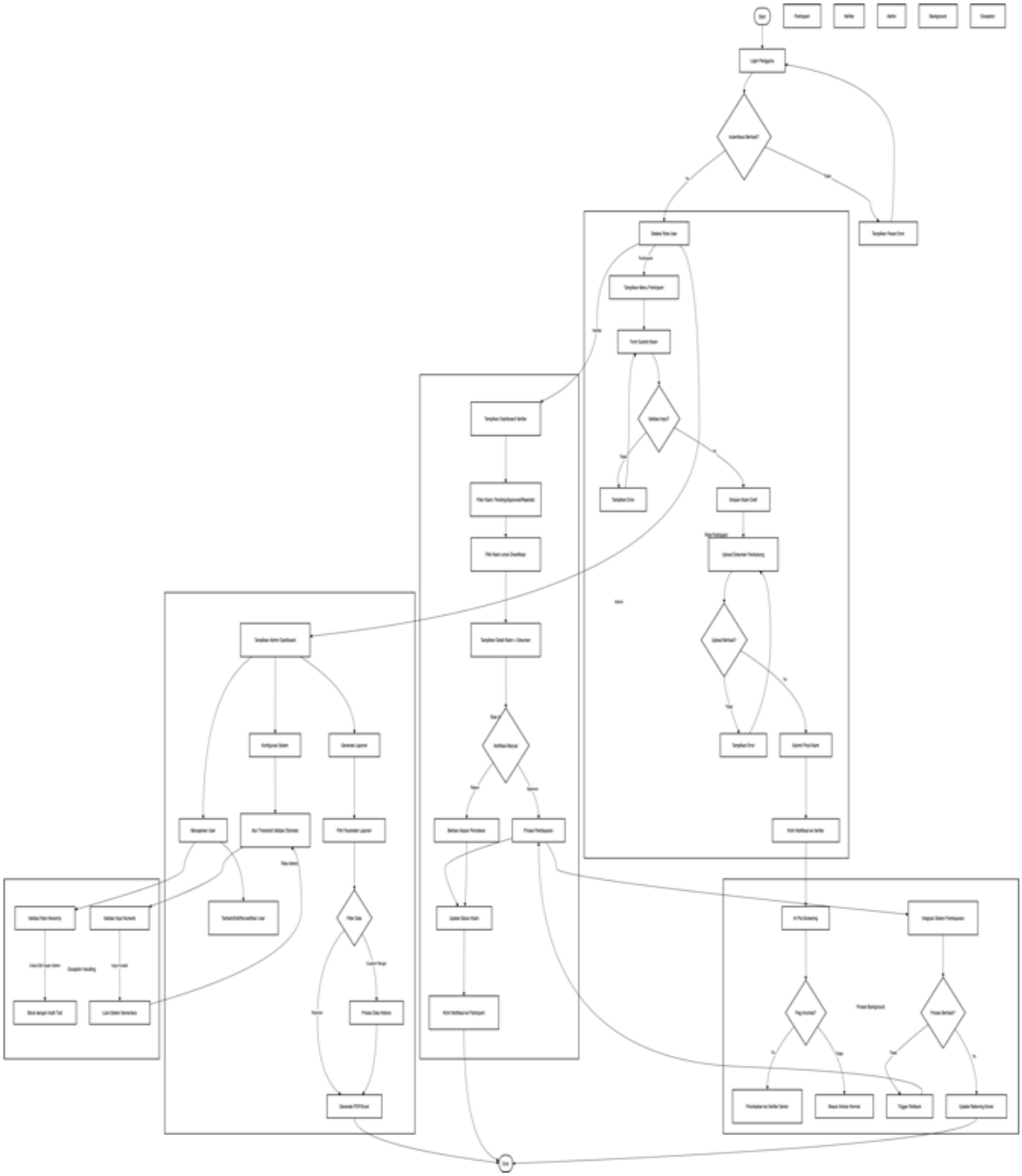

Figure 1. Flowchart system

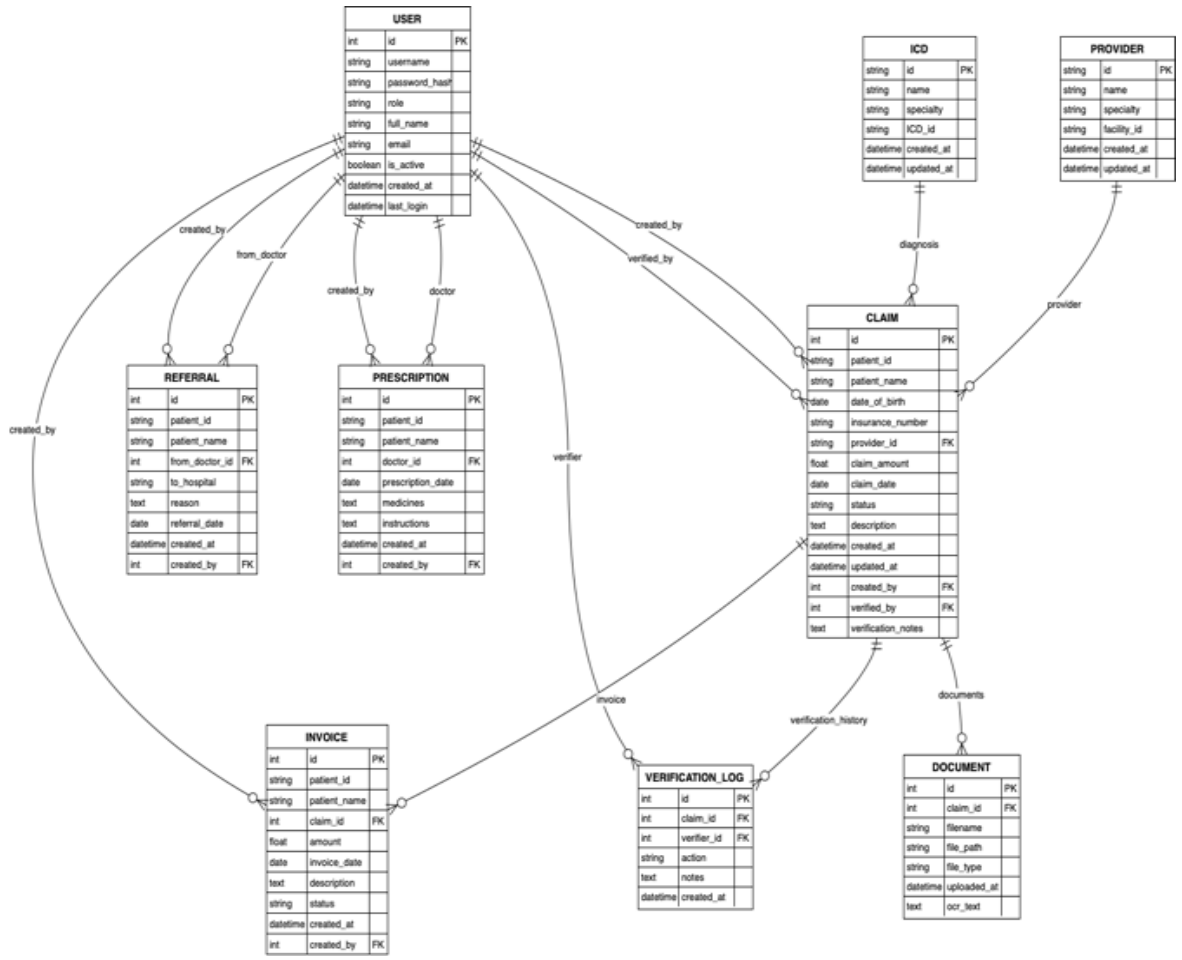

Figure 2. ERD system

After completing the Sprint Planning stage which includes designing the system workflow, designing the database, and selecting the framework to be used, the next stage – the fourth stage in the development process of the health claims verification application – is the implementation of Sprint. At this stage, the previously prepared backlog items begin to be implemented with the determination of the agreed work deadline.

In the context of development at Hospital X, the duration of this sprint is adjusted to the ongoing internship period. This allows developers to clearly monitor the work that needs to be done, the completion deadlines, and the current status of each health claims verification application development process (22). The details of the sprint are presented in the next section.

Table 3. Sprint weekly 1

Sprint	Work	Estimation
Sprint 1	Backend project setup and folder structure (MVC/Blueprint/Modular)	1
	Implementation of login and register endpoints	1
	Implementation of admin dashboard endpoint (dummy data/test data)	1
	Verifier Dashboard endpoint implementation	1
	Create a Verifier Dashboard page	1
	Total Estimate	**5 Days**

	Backlog related: 1, 3, 4

Table 4. Sprint weekly 2

Sprint	Work	Estimation
Sprint 2	Setup middleware/guard for roles: admin, verifier, requester	2
	implementation of medical dashboard endpoint	1
	Implementation of the Claims Dashboard endpoint	2
	Total Estimate	**5 Days**
	Backlog related: 1, 4	

Table 5. Sprint weekly 3

Sprint	Work	Estimation
Sprint 3	Implementation of claim submission endpoint (POST claim))	2
	Endpoint list history klaim (filter by user/verifikator)	1
	Endpoint for prescription input by medical	2
	Endpoint for submitting referral patient data, invoices, and prescriptions	1
	Invoice creation endpoint (automation of physician claims/responses)	1
	Total Estimate	**7 Days**
	Backlog related: 5, 6, 7, 8	

Table 6. Sprint weekly 4

Sprint	Work	Estimation
Sprint 4	Endpoint for creating and managing patient referrals	2
	CRUD endpoint for user management by admin	1
	User account management endpoints (profile update, password reset, etc.)	2
	Role-access-based endpoint testing & validation and dashboard integration	2
	Total Estimate	**7 Days**
	Backlog related: 1, 4	

The fifth or last step is the process of reviewing and testing the system. The system that has been implemented will be reviewed by the author. After going through the evaluation and testing stages, the system is declared ready for operational use.

3.1 Sprint Web App System Implementation Process

Based on the preparation of the sprint, the system is implemented as follows

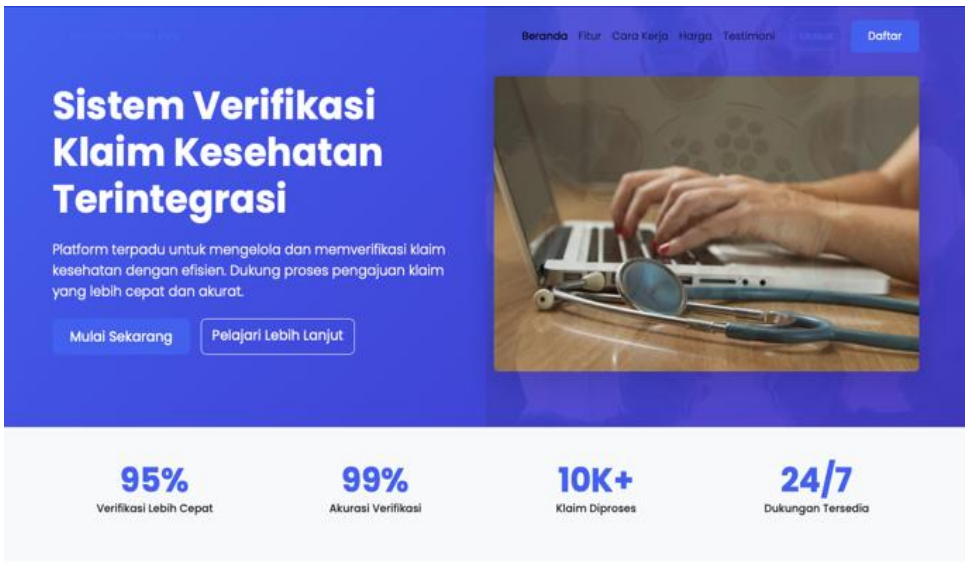

Figure 3. Landingpage

3.2 Implementation on mobile flexibility

The system is also implemented on mobile so that this project management becomes a web app design that can be accessed through smartphones.

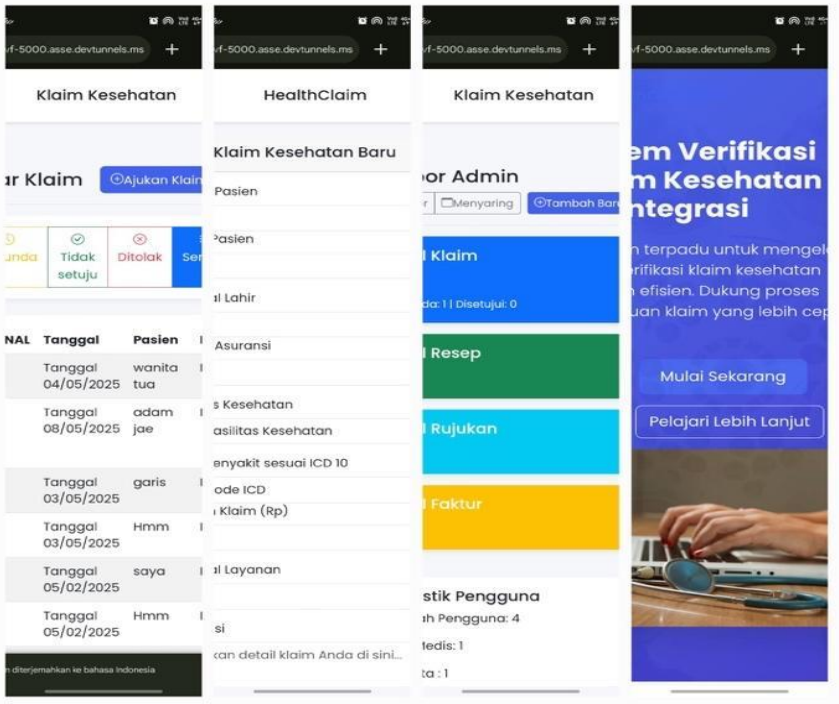

Figure 4. Implementation results on mobile

The test was carried out using the blackbox method, which focuses on the input and output of the system without looking at the program code directly.

Table 7. Blackbox testing results

Module	Test Case	Example Input	Status
Login	Login with valid username and password	Username: verifier Password: 123456	valid
Login	Login with invalid data	Username: wrong Password: wrong	valid
Dashboard	Access dashboard after login	-	valid
Claim Input	Add new claim with complete data	Medical Record No., Name, Diagnosis, Service Date	valid
Claim Input	Add claim with incomplete data	Only fill in patient name	valid
Claim Document Upload	Upload claim documents (SEP, medical resume, bill)	Upload PDF file	valid
Claim Verification	Verify claim data and documents	Click "Verify" button	valid
Claim Verification	Verify claim without documents	Incomplete data	valid
Claim Approval	Claim approved after verification	Click "Approve" button	valid
Claim Rejection	Claim rejected due to invalid data	Click "Reject" button, provide reason	valid
Claim Status Tracking	View claim list by status	Filter: status = verified	valid
Claim Report	Download claim report (PDF/Excel)	Select date range, click "Print"	valid
Logout	Logout from the system	Click logout button	valid

The main features tested include login, claim input, document upload, verification, claim approval, and report creation. Each row in the table describes one test scenario, including the inputs provided and the expected results from the system. The status column states that the system is running well and has been successfully built as needed.

This study still has several limitations. The application developed is currently only at the design stage and has not yet been tested directly with users. In addition, the study has not measured the effectiveness of the application in a real-world context. Therefore, further research is needed that focuses on development through the implementation stage and performance evaluation, so that a more comprehensive understanding of its benefits and long-term impact can be obtained.

Conclusions

Based on the limited implementation over six development sprints, this study concludes that the designed application system has the potential to integrate the claims verification workflow at Hospital X into a centralized platform, thereby reducing reliance on manual processes; features such as automatic ICD-10 validation, nominal anomaly checks, and mobile-first design integration are expected to reduce claim rejection rates and provide flexible access for field staff, while the application of the Agile method allows for step-by-step testing of critical features as well as the identification of technical debts, some of which have been addressed; nevertheless, the application is still at the design stage and has not yet been directly tested with users, so further research is required up to the implementation and

performance evaluation stages to provide a more comprehensive assessment of its long-term benefits and impacts.

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Conflicts of Interest

The authors declare no conflict of interest.

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