# Dashboard Application For Monitoring Patient Data In Hospitals

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| DATE | ABSTRACT |
|---|---|
| Accepted:<br>Revised:<br>Published: | In the increasingly advanced digital era, the healthcare sector faces significant challenges in effectively managing patient visit data. Monitoring patient visits, both inpatient and outpatient, is a crucial aspect of hospital management. This study aims to develop a dashboard application that can monitor inpatient and outpatient visit data in real-time and in an integrated manner at hospitals in Gianyar City. The problems faced include data inaccuracies, delays in decision-making, and lack of data integration from various sources. The research methods used include needs analysis through interviews and surveys, system design with architecture and prototype design, application development using the waterfall method, as well as testing using blackbox testing and application performance evaluation using usability testing. This application is designed to collect data from various sources, integrate it, and present it in an easily understandable visual form. The results of the study show that this dashboard application can improve the efficiency and accuracy of managing patient visit data, as well as support faster and more accurate decision-making. The conclusion of this study is that the developed dashboard application can help hospitals manage patient visit data more effectively, thereby improving the quality of healthcare services. |
| **KEYWORDS** | |
| | |

## INTRODUCTION

In the increasingly advanced digital era, the health sector faces major challenges in managing patient visit data effectively. Monitoring patient visit data, both inpatient and outpatient, is a crucial aspect in hospital management. Hospitals and other healthcare facilities often face difficulties in efficiently monitoring and managing inpatient and outpatient visit data. Scattered and unintegrated data can hinder the decision-making process, reduce operational efficiency, and ultimately affect the quality of health services. However, many hospitals still use manual or semi-manual systems that are prone to errors and delays. This can result in various problems, such as inaccurate data, difficulties in analyzing visiting trends, and delays in decision-making that have an impact on the quality of health services.

Hospitals in the city of Gianyar have implemented a Hospital Management Information System (SIMRS) that is integrated into each existing unit so that it can speed up the service process to the community and is supported by complete features in supporting hospital services and business activities. The main problem faced by hospitals in managing patient visit data is the large volume of data and the complexity in its processing. This can have a negative impact on the quality of health services provided to patients. In addition, the lack of integration between various information systems in hospitals often results in duplication of data and difficulties in accessing the necessary information. The lack of a system capable of integrating patient visit data in *real-time*, so hospitals still use manual methods or separate systems, which causes difficulties in accessing accurate information, causing delays in decision-making and errors in data recording. This not only makes it difficult for medical personnel to provide optimal care, but also hinders hospital management in planning and allocating resources effectively.

Health data is complex and has a lot of variation because it has transactions that run at all times in its business process, so it takes time to collect data every day.(Kholili, Nuraini, dkk 2022) It is very difficult to get data quickly and accurately in a short time even in realtime (Pujilestari, dkk 2023). Dashboard is a system to display information visually so that it is easier to understand. The data on the dashboard aims to display visuals that present various types of data in one place centrally (Adinegara Lazuardi 2022), dashboard usually refers to the use of a special application that is able to display summary data from various existing data (Adiyaksa Luckyarno, dkk. 2023). In previous research that has been carried out, the creation of an outpatient daily visit dashboard application can help hospitals in monitoring the number of outpatient visits per day and can help management in making non-clinical decisions on patients (Ayu Sekarini, et al. 2023). Further research that has been carried out is the development of an inpatient dashboard application used to monitor or monitor inpatients in hospitals, and can help find out treatment patterns, patient diagnoses and patient billing costs which can help hospitals in making decisions related to patient services and care (Sekar and Yuningsih 2024). From several studies that have been conducted previously, the application dashboard has been effective in monitoring inpatient and outpatient patients and can help improve the quality of health services.

Referring to the research that has previously been carried out and the problems that are being faced by hospitals in Gianyar City, to overcome these problems, this research aims to develop a *dashboard* application that can monitor data on inpatient and outpatient visits in *real-time* and integrated. The app will be designed to collect data from multiple sources, integrate it, and present it in an easy-to-understand visual form. With this *dashboard*, it is expected to be able to present data visually and interactively, making it

easier for medical personnel and hospital management to monitor and analyze patient visit trends. In addition, this application can also help in resource planning and improving the quality of health services.

The solution offered by this dashboard application includes various features designed to improve the efficiency and accuracy of patient visit data management. These features include the ability to integrate data from various sources, data visualization in the form of easy-to-understand graphs and tables, and the ability to generate reports automatically. With these features, it is hoped that the dashboard application can help hospitals reduce data recording errors, speed up the decision-making process, and improve the overall quality of health services.

This research aims to develop a dashboard application that can monitor inpatient and outpatient visit data in real-time and integrated. The main purpose of this study is to address various problems faced by hospitals in managing patient visit data, such as data inaccuracy, delays in decision-making, and lack of data integration from various sources. By identifying user needs through a comprehensive needs analysis, this research will design and develop an app that is intuitive and easy to use. This application will integrate data from various sources and present it in an informative visual form, as well as to support the improvement of the quality of health services in hospitals through the use of innovative information technology, so that hospitals can be more proactive in managing patient visits and optimizing existing resources.

## METHOD

This study uses an analytical descriptive design to describe the research object based on the data or samples that have been collected. The applied software development method is the Waterfall method, one of the oldest SDLC approaches in software development. The stages in the Waterfall method are carried out sequentially, starting from the planning, analysis, design, implementation, to system maintenance stages.
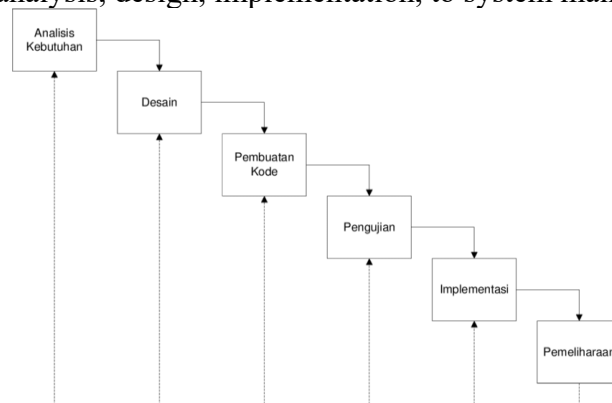
**Picture 1.** Method *Waterfall*

**Needs Analysis**

The needs analysis stage aims to find out what needs the system needs with the results of the data collection that has been carried out. In this section, the discussion will be divided into 2 (two) parts, namely the analysis of functional needs and non-functional needs. Functional needs are types of needs that contain about what processes will be carried out by the system. Non-functional requirements refer to the quality attributes that a system must possess in order to operate properly (From Lenawati 2019)

**System Design**

The system design stage is the stage of channeling ideas and thoughts of the viewer which is outlined in the form of system design in accordance with the results of the needs analysis that has been obtained. The system design stage is an important phase in software development that aims to design technical solutions based on the needs that have been identified. (The 2023 Edition). The system design that will be produced is a usecase diagram, activity diagram, sequence diagram, class diagram and deyployment diagram.

**Program Code Generation**

The program code writing stage is the implementation stage of the system design in the form of an application. Writing program code using the PHP (Hypertext prepocessor) programming language is a script that is integrated with HTML and is located on a server. PHP can also be defined as a dynamic website page builder, meaning that the page to be displayed is created when the page is requested by the client (Setiawan, et al. 2022). and Javascript and uses MySQL databases. MySQL is an RDBMS (Relational Database Management System). Relational databases store data in separate tables, rather than storing data in large storage spaces. This adds speed and flexibility. MySQL is an open source software (Wulandari and Nurmiati 2022).

**System Testing**

All stages of system testing are carried out by testing *blackbox testing* and testing *usability testing*. Testing *black box* is a test that only tests the outside of the software (Fikri et al. 2024). Testing *black box* is a testing technique that focuses on the functional requirements of the software, based on the specifications of the software requirements (Monsya Juansen, 2024) .

*Usability testing* is a method for evaluating user experience (*user experience*) of a product. This method is done by observing the user when interacting with the product (Walhidayah 2022). *Usability Testing* is a very important method in measuring the extent of the quality of the user experience in interacting with the website. There are 5 usability factors possessed by the Nielsen Model, namely *efficiency, learnability, memorability*, *errors, dan satisfactions* (Supriyono and Ardillah 2023).

*System Usability Scale* (SUS). is a method of measuring user satisfaction that involves filling out a formal questionnaire by the user after using an application. SUS is useful for quickly evaluating the user's view of the usability of the system they are using (Mu'min Azis, dkk 2024). The SUS questionnaire uses a Likert scale with 5 assessment scales. Scale 1 shows a high level of disapproval from respondents, while scale 5 shows a high level of disapproval. From the results of the questionnaire, SUS will produce a single number that reflects *usability* system as a whole. The score generated for each item does not represent the item itself.

**System Implementation and Maintenance**

The implementation stage is carried out by implementing the system in related units by supervising and assisting in the application implementation process. Meanwhile, maintenance aims to carry out inspections so as to ensure that the application program continues to run well without obstacles and in accordance with desired expectations.

**Results and Discussion**

This section presents the results and discussion of the research topics that have been carried out. Before presenting the results, the research methodology is explained first to provide context and a clear understanding of the approach used. The results of the research are presented in the form of a detailed narrative, complemented by images, tables, and other visual representations to clarify the findings obtained. This section also includes in-depth analysis that links research results to relevant theories or literature.

**Results of Needs Analysis**

System needs analysis is a crucial first step in the development of an information system. This stage aims to understand in depth what the user actually needs from the system to be built. By conducting a careful analysis, we can ensure that the resulting system is completely in line with user expectations and can solve existing problems. The results of the system needs analysis in this study are related to the analysis of functional and non-functional needs and describe the actors and their roles.

**Functional Needs**

a. *Login* : Ensures only authorized users can access the system. Login functions as authentication, which is to check the user's identity through username and password. Outpatient Visits

b. Outpatient Visits: Manage data on patient visits for outpatient treatment and display information in the form of an outpatient dashboard.

c. Inpatient Visits: Manage patient visit data for outpatient treatment and display information in the form of *an inpatient* dashboard.

d. Payment Information: Manage patient payment data and can display information about patients who are being treated along with the patient's temporary bill and the number of patient dependents if BPJS patients.

**Non-Functional Needs**

a. Performance: The app must be responsive and fast in loading pages and processing transactions.

b. Security: User data must be protected from unauthorized access.

c. Availability: Apps should be available 24/7 with minimal *downtime*.

d. *Usability*: The user interface should be intuitive and easy to use, so that users can easily find the features they need.

e. Scalability: The system should be able to accommodate the number of outpatient and inpatient visits per day. The system must be able to display patient billing, deposit and patient dependency information.

f. Integration: The app must be able to integrate with the hospital management system (SIMRS)

g. Portability: The system should be accessible through a variety of devices (*desktops, laptops, smartphones, tablets*).

**Requirements System Design Results**

System design is carried out with the aim of understanding the sequence of information and processes that take place in an application before it is built. In the design of this system, an overview of the overall system will be made through usecase diagrams, context diagrams and data flow diagrams level 1, conceptual databases and system interface design.

*Usecase Diagram*

Use case diagrams are tools used in software engineering to illustrate the interaction between users (*actors*) and systems. This diagram provides a visual representation of the system's functionality from the user's perspective.
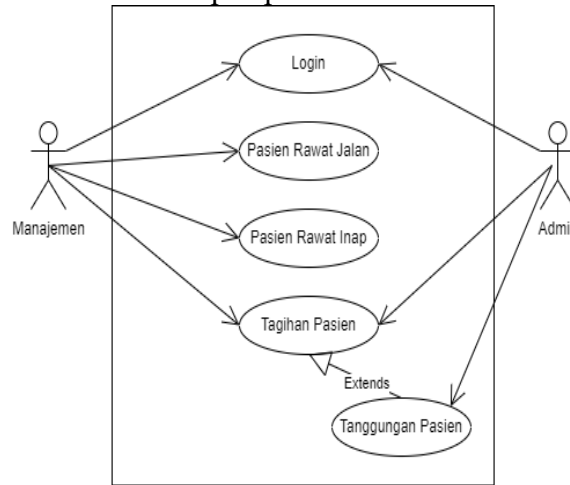


**Picture 1.** *Usecase Diagram*

Context Diagram

In the context diagram image below, it is explained about the overall process that occurs from the patient monitoring dashboard application. There are two *external entities* , namely hospital management and admin, where there are several data streams that enter the patient dashboard application process  .
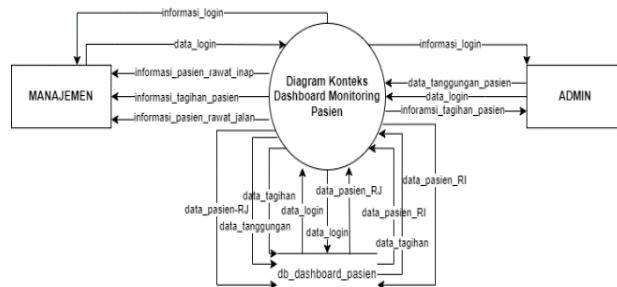


**Picture 2.** Context Diagram

*Data Flow Diagram* Level 1

Based on the context diagram,  a *Level 1 Data Flow Diagram* (DFD) was created to provide a more detailed and clear picture of the data flow that occurs in the system. Below is an illustration of DFD Level 1 which is an evolution of the context diagram. The level 1 DFD diagram is a derivative of the counter diagram above where there are 2 *external entities*, namely management and admin, who have data flow in several processes such as the login process, outpatients, inpatients and patient billing. And each existing data process has its  own *data store*. Each element contained in DFD level 1 has a relationship with several components in it so that it can be used as a reference in making a patient dashboard application so that the creation of *a dashboard  application* will be in accordance with the results of the system design made.
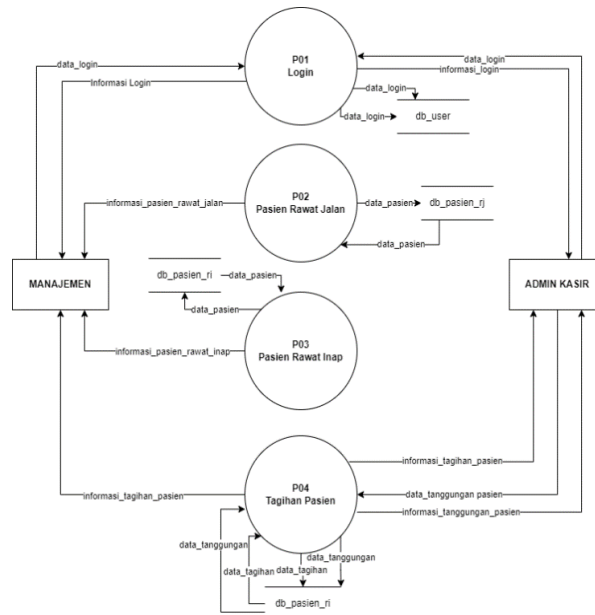
**Picture 3.** DFD Level 1

**System Coding Results**

      This system implementation stage is a step to apply the system design that has been made into program code that meets the needs of system users. The following are the results of the extracurricular application design that has been carried out.

Login Page

      The login *page interface* is the authentication page of the patient monitoring dashboard application. The *login* page will display the *username* and *password* columns and there is a *login button*. Enter your *username* and *password* then select *the login in button*, to enter the dashboard application.
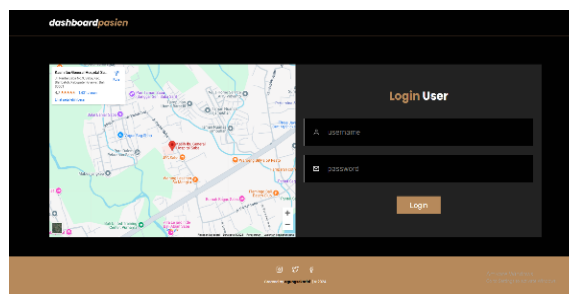


**Picture 4.** Login Page

Home Page

      The *home* page interface is the main page after the login process is carried out by the application user. On the home page there are pictures and brief information about the application. On the home page, there are 4 main menus, namely Home, Outpatient, Inpatient and Payment.
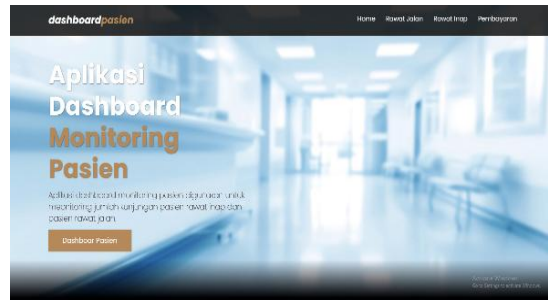
**Picture 5.** Home Page

Outpatient Page

The *outpatient page interface* is a page that contains information related to the number of visits to the outpatient unit. Outpatient units included are the Emergency Unit, *Emergency Room*, and all Polyclinic services.
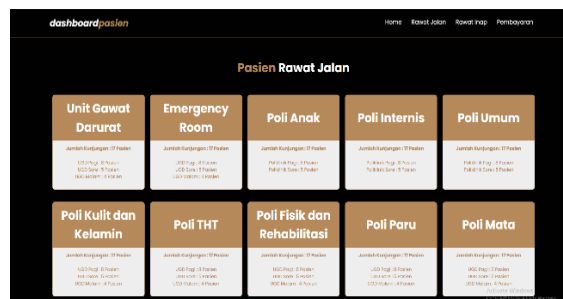


**Picture 6.** Outpatient Yard

Inpatient Page

The inpatient page interface is a page that contains information related to the number of patients who are being hospitalized in the special care unit and inpatient. The intensive care and inpatient units include maternity wards, ICUs, hemodialysis, operating rooms, as well as ayodya, sinta, and admiral inpatient rooms.
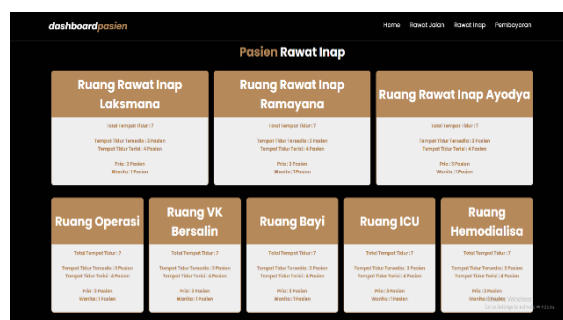


**Picture 7.** Inpatient Page

Payment Page

On the payment page interface, it is a page that displays a summary of inpatients. The information presented is information on the list of inpatients along with the amount of temporary bills, desposits, and also the number of dependents from those who use insurance specifically for px who have insurance/guarantee.

**Picture 8.** Payment Page

Admin Home Page

The admin home page is the page when the admin successfully logs in and will enter the home page. On the *dashboard page*, provide information on the number of outpatients and information on the number of inpatients.
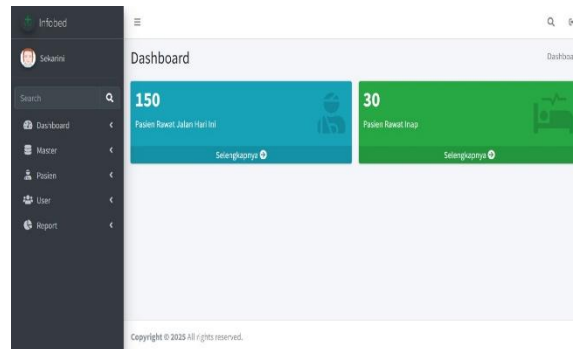


**Picture 9.** *Admin Home Page*

Pasin Bill Page

The patient billing page contains information related to the list of patients who are being hospitalized along with detailed information related to patient billing during treatment. The patient list can be downloaded in various types of files needed.



**Picture 10.** *Patient Billing Page*

Patient Dependents Input Page

The patient dependents page is used by the admin to input the number of patient dependents who use health insurance. Patient dependent information is used to monitor bills so that they can take appropriate action.
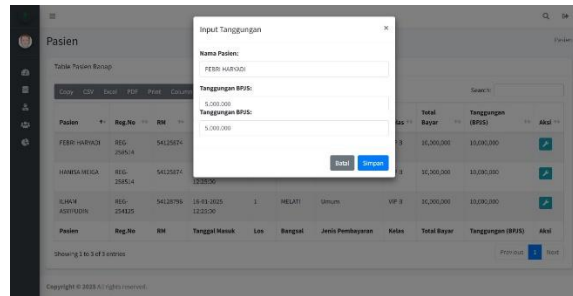

**Picture 11**. Patient Bill Input Page

**System Test Results**

Testing of the patient monitoring *dashboard* application is carried out using *the Black Box Testing* method. Testing with *the Black Box Testing* method is carried out by providing a number of inputs to the program. The input is then processed according to its functional needs to see if the application program can produce an output that is in accordance with the desired and also in accordance with the basic functions of the program. If from the input provided the process can produce an output that is in accordance with its functional needs, then the program made is correct, but if the output produced is not in accordance with its functional needs, then there is still an error in the program, and then a search for improvements is carried out to correct the errors that occur.

**Table 1. Test Results *Black Box Testing***

| It | Test Scenarios | Test Case | Test Results | Conclusion |
|---|---|---|---|---|
| 1 | *Blank username* and *password* , then login | *Blank username* & *password* | As expected | Valid |
| 2 | *Username* and *password* are filled in correctly, then log in | Username is filled. Password filled in | As expected | Valid |
| 3 | Select the Home menu | Menu Home | As expected | Valid |
| 4 | Select the Outpatient menu | Outpatient Menu | As expected | Valid |
| 5 | Select the Hospitalization menu | Inpatient Menu | As expected | Valid |
| 6 | Select the Payment menu | Payment Menu | As expected | Valid |

**System Implementation Results**

The implementation of the patient monitoring dashboard system in the field is an important step in improving the quality of health services and operational efficiency. However, this implementation process does not always run smoothly, especially due to resistance from medical personnel who are used to manual systems.

One of the biggest challenges in the implementation of the patient monitoring dashboard system is the resistance of medical personnel who are used to manual systems. To overcome this, several strategies can be implemented, such as:

1. Socialization and education: Conducting socialization and education to staff and hospital management about the benefits and advantages of the patient monitoring dashboard system. This is done through socialization and also assistance during the use of the system.
2. Comprehensive training: Provide comprehensive training to hospital staff and management on the use of the patient monitoring dashboard system. This training must be adjusted to the level of knowledge and experience of staff and hospital management.
3. Involve staff and hospital management in system development: Involving staff and hospital management in the development of a patient monitoring dashboard system can increase their sense of ownership and participation in the implementation of the system.
4. Adequate technical support: Provide adequate technical support during the transition period from manual systems to patient monitoring dashboard systems. This can be done through a hotline, email, or discussion forum.

### Hasil *Usability Testing*

After testing 55 respondents, it was found that the highest score obtained was 100, the lowest score was 48.5, and the most frequently appearing score was 100 then an average score of 89 was obtained. After getting the average, the next thing is to interpret the results of the calculation of the SUS score into several forms of SUS assessment:

Based on the SUS *Score Percentile Rank*, a score of 89 gets a grade of A, which indicates that the application implementation is successful and has excellent performance.



**Picture 12.** SUS Score in SUS Scale *Score Percentile Rank*

Based on *Acceptability*, the SUS score obtained from this study is 89, which is in the range that is considered acceptable. This shows that the use of the patient monitoring dashboard application has been accepted by users.
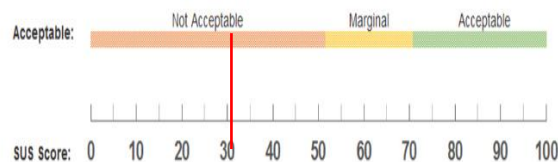


**Picture 13.** SUS Score in Scale *Acceptability*

Based on *the Adjective Rating*, the SUS score obtained from this study is 89, which on the Adjectives scale is included in the *Excellent* category. This shows that the use of the patient monitoring dashboard application is excellent, which means that it is worth using and all the menus in the application are working properly.
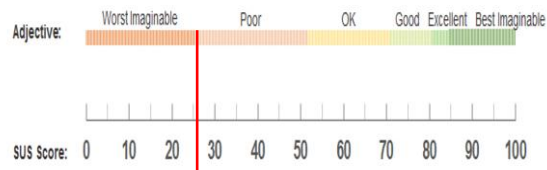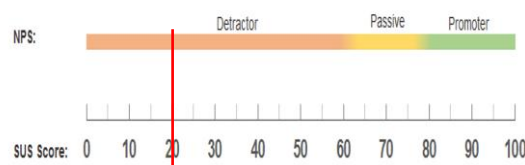
**Picture 14.** SUS Score in Scale *Adjective Rating*

1. Based on *the Net Promoter Score*, the SUS score obtained from this study is 89, which when associated with the NPS classification, is included in the Promoter category. This shows that respondents in this study are very likely to recommend the patient monitoring dashboard application.



**Picture 15.** SUS score in *Skala Net Promoter Score*

**CONCLUSION**

The conclusion of this study shows that the dashboard application developed is able to increase efficiency and accuracy in the management of inpatient and outpatient visit data in hospitals in Gianyar City. The app successfully integrates data from various sources and presents it in an easy-to-understand visual form, supporting faster and more informed decision-making. The results of the study show that this application can reduce data recording errors and speed up the decision-making process, which ultimately improves the quality of health services.

The advantages of this application include the ability to present data in real-time and integrated, as well as automatic notification and report features that can be customized according to user needs. However, the study also found some shortcomings, such as the need for training for users to maximize the use of the app and potential technical issues that may arise during implementation. The recommendation of this study is to provide intensive training for users, as well as perform regular system maintenance and updates to ensure that the application runs optimally. Thus, this dashboard application is expected to continue to support the improvement of the quality of health services in hospitals.

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