Prototype of Diabetic Foot Screening Website Based on Inlow's 60-second Foot-screen: An Effort to Prevent Complications in Diabetes Mellitus Patients at the Sindangwangi Community Health Center

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Abstract.
The increasing prevalence of diabetes mellitus necessitates aggressive preventive interventions, particularly for diabetic foot ulcers that often go undetected in primary care settings. This study aimed to design and develop a web-based prototype for diabetic foot screening using Inlow's 60-second Diabetic Foot Screen integrated with a forward-chaining Clinical Decision Support System. This research employed a Research and Development approach with the Expert System Development Life Cycle framework. Data were collected from 30 patients with diabetes at Sindangwangi Health Center using purposive sampling. The system's usability was evaluated using the Post-Study System Usability Questionnaire (PSSUQ). The developed system successfully automated risk categorization and provided personalized clinical recommendations based on physical foot parameters. Usability testing revealed high satisfaction levels with a grand mean PSSUQ score of 1.34, where System Quality (1.47), Information Quality (1.41), and Interface Quality (1.15) were all rated as excellent. These findings demonstrate that the integrated digital screening tool is reliable, highly usable, and effectively facilitates early detection of foot complications in primary health services. This innovation provides a scalable solution for enhancing preventive care, reducing the burden of diabetes-related complications, and improving health documentation precision in resource-limited settings.
Keywords: *Clinical Decision Support System, Diabetic Foot Ulcer, Forward Chaining, Inlow's 60-Second Foot Screen and Usability Study.*

I. INTRODUCTION

Diabetes Mellitus (DM) has now transformed into one of the most crucial global health challenges, characterized by a consistent increase in prevalence and life-threatening morbidity. The latest report from the International Diabetes Federation (IDF) shows that by 2024, the number of adults living with diabetes has surpassed 500 million, with a projected surge to 853 million by 2050. This surge not only triggers a large economic burden but also increases the risk of significant microvascular and macrovascular complications, including peripheral neuropathy and peripheral arterial disease, which are the main precursors to diabetic foot ulcers.

At the national level, Indonesia faces similar epidemiological pressures, with a rising trend in cases requiring more aggressive preventive interventions. Morbidity projection studies indicate an alarming increase in the prevalence of diabetes in Indonesia, from approximately 18.69 million cases in 2020 to a predicted increase of over 40 million cases by 2045. This high prevalence is directly correlated with an increase in cases of diabetic foot complications in various regions, which are often not detected early in primary health care due to the limitations of a structured and systematic screening system.

Previous research has explored the effectiveness of various clinical instruments and digital interventions to address the burden of diabetic foot complications. Inlow's 60-Second Diabetic Foot Screen has been clinically proven to have high validity and reliability as a rapid screening tool for identifying foot abnormalities in patients with diabetes. Furthermore, the integration of digital health technologies, including behavioral model-based mobile health applications, has demonstrated efficacy in improving patient adherence to self-care and self-efficacy in glycemic management.

However, implementation in the field remains inconsistent, with many digital education programs remaining general and not yet integrated with specific clinical screening tools like Inlow's 60-Second Diabetic Foot Screen. Most previous studies often separate nutrition education or self-management from digital physical risk screening. Consequently, the availability of integrated Clinical Decision Support System (CDSS)-based early detection tools in primary healthcare facilities that can provide risk assessments and measurable follow-up plans for healthcare workers remains limited.

This research gap underscores the urgency of developing a digital screening system that is not only informative but also has strong clinical capabilities. The key issue that needs to be addressed is how to integrate the validity of Inlow's 60-Second Diabetic Foot Screen parameters into a prototype website-based application that is systematic, easily accessible, and capable of providing precise digital documentation for patients and healthcare professionals at the primary care level.

This study aims to design and develop a prototype of a diabetic foot screening application based on Inlow's 60-Second Diabetic Foot Screen by integrating PHP and MySQL technology and the forward chaining method. The urgency of this research lies in the urgent need for technological innovation at the forefront of primary healthcare services to detect the risk of foot ulcers earlier, thereby preventing amputations and significantly reducing the burden on healthcare services. The novelty of this research lies in the combination of validated clinical screening instruments with an integrated digital documentation management system, which provides a practical contribution to strengthening the prevention of diabetes complications in Indonesia efficiently and sustainably.

II. METHOD

This study applies the Research and Development (R&D) method to design a prototype of an applicable, information technology-based early detection system for diabetic foot risk. This approach was chosen because it allows for the integration of field problem-finding cycles with the development of measurable technical solutions, in line with the principles of systematic expert system software development (Sugiyono, 2022; Okpatrioka, 2023). The development framework used is the Expert System Development Life Cycle (ESDLC), which includes the stages of assessment, knowledge acquisition, system design, testing, and documentation to ensure the final product is relevant to clinical needs in primary care settings (Durkin, 1994; Turban et al., 2021). The integration of the ESDLC model in the development of this website application is designed to ensure that each medical parameter from Inlow's 60-Second Diabetic Foot Screen is implemented with high accuracy into the forward chaining-based system logic.

The population in this study was all Diabetes Mellitus sufferers in the Sindangwangi Community Health Center (Puskesmas), Majalengka Regency, which was chosen as a strategic location due to its high caseload in the past two years. The study sample consisted of 30 respondents selected based on specific inclusion criteria, namely diabetes sufferers who regularly undergo health checks at the Sindangwangi Community Health Center, using a purposive sampling technique to ensure subject representation capable of providing comprehensive feedback regarding system usability. This sample size is considered adequate for initial field testing of a software system, as recommended in the Borg & Gall (1983) product development standards and is supported by contemporary methodological literature emphasizing participant efficiency in digital health system usability testing (Sugiyono, 2022; Nielsen, 2021).

The main instruments in this study included the Inlow's 60-Second Diabetic Foot Screen clinical questionnaire to assess physical risk variables, and the Post-Study System Usability Questionnaire (PSSUQ) to measure ease of use, satisfaction, and system quality. The validity of the clinical instrument was based on the clinical update guidelines by Blanchette et al. (2022), while the reliability of the usability instrument was guaranteed through the PSSUQ standards, which have been widely recognized in digital user interface design research (Lewis, 2020; Pienkowska et al., 2023). The data collection process was carried out through systematic observation, an in-depth literature review of 67 reference sources, and closely monitored field testing to ensure the collected data were valid and able to reflect the system's functionality.

The research procedure began with an assessment phase through field observations to map specific needs at the Sindangwangi Community Health Center, followed by knowledge acquisition from the latest medical literature to build the system's database. The design phase was carried out by developing a website-based system architecture using the PHP programming language and a MySQL database, where forward chaining logic was integrated as an inference mechanism to detect foot ulcer risk based on patient input data.

After the final design was formed, the testing phase was carried out by providing access to 30 respondents to use the application and complete the PSSUQ questionnaire. The results were then documented as part of the system's technical and sustainability reports (Blanchette et al., 2022; Ikawati, Pahria, & Kurniawan, 2024).

The data analysis technique applied follows a descriptive qualitative analysis model that includes four phases: data collection, data reduction, presentation, and conclusion drawing. The PSSUQ questionnaire data were processed quantitatively by calculating the average (mean) value on a Likert scale of 1-7, where lower scores indicate better system usability, thus facilitating interpretation of the application's effectiveness for healthcare professionals (Miles, Huberman, & Saldana, 2014; Ju et al., 2023). The data processing results were then presented in the form of descriptive narratives, tables, and flowcharts to demonstrate the relationship between physical risk parameters and recommendations generated by the system.

The ethical aspects of the research were upheld by ensuring full transparency to all respondents regarding the purpose and procedures for using the application. Researchers obtained informant consent through an informed consent form that explained participants' rights and guaranteed the confidentiality of informants' identities through anonymity procedures in digital data storage throughout the study. This ethical approach adheres to international health research ethics standards, which aim to protect participant welfare and avoid potential harm resulting from participation in the evaluation of health technology products (World Medical Association, 2013; Firdaus et al., 2023).

III. RESULTS AND DISCUSSIONS

1. Assessment Stage

Diabetes Mellitus has become a global health crisis with increasing prevalence, including in Indonesia and the Sindangwangi Community Health Center (Puskesmas) area, which recorded a significant spike in cases in 2023–2024. The risk of serious complications such as diabetic foot ulcers due to neuropathy is a major threat, especially because they often go undetected in their early stages. To address this, a digital screening system based on Inlow's 60-Second Diabetic Foot Screen was developed, designed for practical use in primary healthcare facilities. This system integrates risk detection, severity categorization, and comprehensive education on nutrition, footwear selection, and foot care techniques to support optimal early prevention for sufferers.

2. Knowledge Acquisition Stage

The knowledge acquisition phase serves as the system's foundation for converting medical data into structured computational logic. This process involves extracting information from scientific literature and the Inlow's 60-Second Diabetic Foot Screen clinical guidelines to ensure the accuracy of the application's risk assessment. The acquired data is classified into three main categories that serve as the system's reference: screening parameters, which encompass clinical variables of foot condition; risk levels, which determine the severity of the patient's condition; and educational materials, which serve as the basis for follow-up recommendations for patients. This data integration enables the application to provide objective, systematic screening results that align with clinical standards applicable in primary care settings.

Table 1. Screening Parameter Data

	Parameter
P01	Dry / cracked skin
P02	There is a wound on the leg
P03	There is an infection in the foot
P04	Thickened nails / fungus
P05	Ingrown toenail
P06	The presence of calluses
P07	Foot deformity
P08	Feet feel numb
P09	Feet feel tingling
P010	History of previous leg injuries
P011	History of amputation
P012	Poor foot hygiene

Table 2. Risk Level Data

Code	Risk Level	Information
R1	Low Risk	No significant abnormalities were found
R2	Moderate Risk	There are mild–moderate risk factors
R3	High Risk	There are injuries/high risk of complications

Table 3. Question Data

Code	Symptom	Question	Answer	Reference
T01	Changes in skin color	Is there a change in color on the feet (reddish/pale)?	A. Yes B. No	Inlow's 60-Second Diabetic Foot Screen
T02	Wound on the leg	Are there open wounds on the feet?	A. Yes B. No	
T03	Infection	Are there any signs of infection such as swelling, heat, or pus?	A. Yes B. No	
T04	Dry skin	Do the skin on your feet look dry or cracked?	A. Yes B. No	
T05	Calluses	Are there calluses on your feet?	A. Yes B. No	
T06	Deformity	Are there any changes in the shape of the feet or toes (deformities)?	A. Yes B. No	
T07	Nail problems	Are your toenails thickening or are there fungal infections?	A. Yes B. No	
T08	Numb	Do you feel numbness in your feet?	A. Yes B. No	
T09	Tingling	Do you feel tingling in your feet?	A. Yes B. No	
T10	History of injury	Have you ever had a foot injury before?	A. Yes B. No	
T11	History of amputation	Do you have a history of amputation?	A. Yes B. No	
T12	Use of footwear	Do you always wear footwear when you are active?	A. Yes B. No	

Table 4. Solution

Code	Solution	Reference
S01	Do regular foot care and keep your feet clean.	Inlow's 60-Second Diabetic Foot Screen
S02	Use moisturizer to treat dry skin	
S03	Immediately consult a health professional if there are any wounds.	
S04	Use comfortable and appropriately sized footwear	
S05	Avoid walking barefoot	
S06	Cut your nails properly and not too short	
S07	Perform regular foot checks	
S08	Consume healthy foods according to recommendations for Diabetes Mellitus	

	sufferers
S09	Regularly check your blood sugar levels
S010	Immediately refer to a health facility if the risk is high

Table 5. Forward Chaining

Risk Code	IF	THEN
R1	T01, T04, T12	S01, S02, S07
R2	T05, T06, T07, T08, T09, T10	S01, S04, S07, S09
R3	T02, T03, T11	S03, S07, S10

Process

1. Design stage (designing)

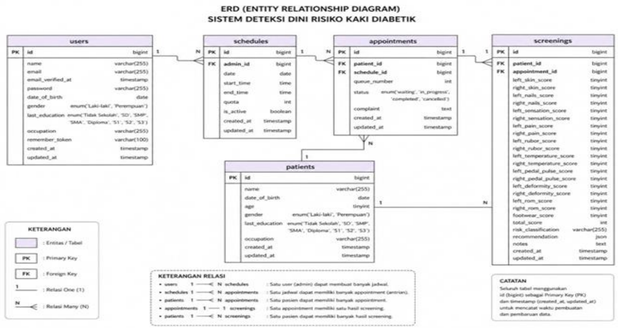


Fig. 1 Database Design

2. Process Design

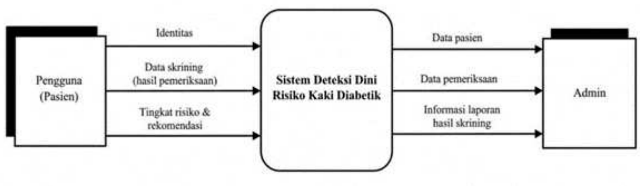


Fig. 2 Context Diagram

The context diagram outlines the functional boundaries of the diabetic foot risk early detection system through the interaction of two main entities, namely the user and the administrator, to ensure efficient data flow. The user, in this case the patient, acts as the input source of identity data and clinical information from foot screening results, which are then processed by the system to produce output in the form of risk level categorization and recommendations for medical follow-up. Complementarily, the administrator has authority in database management, including patient data and recapitulation of examination results, and serves as the recipient of periodic reports for clinical monitoring and evaluation needs. This flow integration emphasizes clear system boundaries while ensuring continuity of information between external entities and the application system in supporting structured diabetic foot risk management.

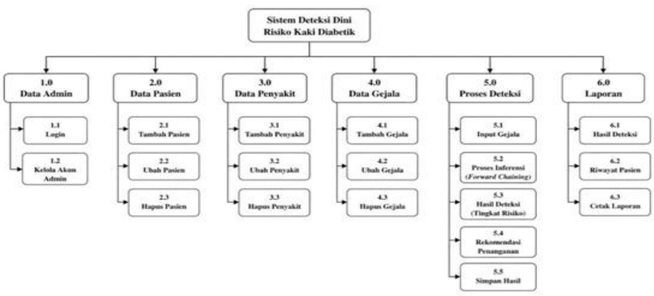


Fig. 3 Functional Decomposition Diagram

This functional decomposition diagram breaks down the system architecture into more specific subsystems to ensure a systematic application workflow. The main component consists of a master data management module—covering admin, patient, disease, and symptom data—which serves as the fundamental database. The core of the system lies in the detection process, which implements a forward chaining method to precisely analyze user symptom input, resulting in output in the form of a diabetic foot risk level and clinically relevant treatment recommendations. The entire process is integrated with a reporting module that allows data storage and tracking of patient examination histories, facilitating ongoing monitoring for healthcare professionals.

Fig. 4 Event Diagram

In this system, the main events include master data management, screening process using the forward chaining method, to storing and presenting the results of diabetic foot risk detection in the form of reports.

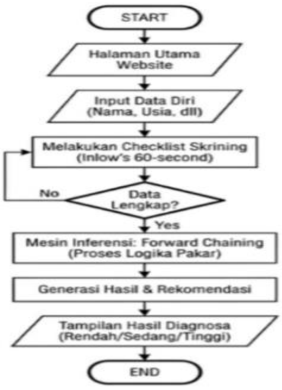


Fig. 5 Flowchart

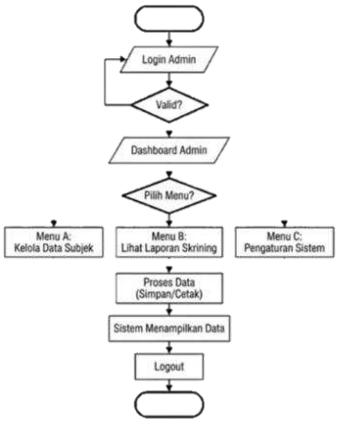


Fig. 6 Admin Flowchart

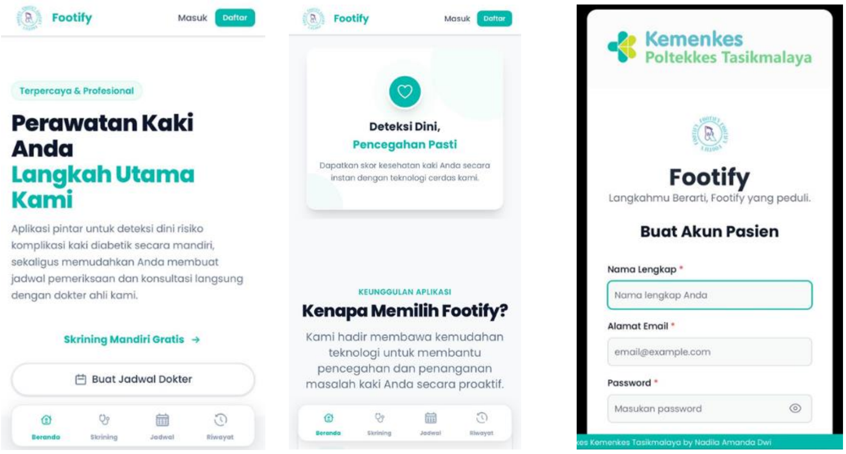
The operational flow of this system is divided into two main procedures designed to ensure data security and diagnostic accuracy for users. The admin procedure begins with a login authentication process to ensure secure access to the main dashboard, which allows for efficient patient data management, screening results monitoring, and system configuration, before concluding with a logout process to disconnect the system. This flow ensures that all managed data remains protected and accessible for monitoring and structured clinical reporting.

The user procedure focuses on a systematic interaction, starting from entering personal information to completing the Inlow's 60-Second Diabetic Foot Screen questionnaire. The system automatically validates data to ensure completeness, which is then processed by a forward chaining-based inference engine to match clinical conditions with established expert rules. The final result, a risk level diagnosis along with personalized health recommendations, is displayed directly to the user, providing appropriate follow-up directions according to the detected diabetic foot risk profile.

3. System implementation

Footify is a web-based application that integrates Inlow's 60-Second Diabetic Foot Screen method to facilitate early detection and monitoring of diabetic foot risks quickly and systematically. With an intuitive interface, this application functions as a clinical screening tool and an educational tool to raise awareness among people with diabetes mellitus about the importance of preventive foot care. This innovation enables accurate risk assessment in primary care facilities, allowing for more timely and measurable measures to prevent complications.

a. The homepage display is the initial display when opening the website for early detection of diabetic foot risk based on the Inlow's 60-Second Diabetic Foot Screen method.

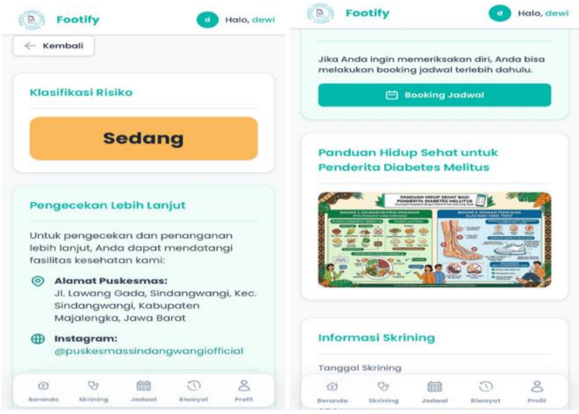


Footify's homepage is designed with a clean and intuitive interface to make it easy for users, including seniors, to access early detection services. The informative landing page allows users to easily understand the app's purpose before beginning the screening process using the "Start Screening" button. This process begins with a systematic completion of a basic identity and health history form, which serves as the initial step to ensure data accuracy before proceeding to the clinical risk assessment stage.

b. Screening view

Footify is a web-based application that integrates Inlow's 60-Second Diabetic Foot Screen method to facilitate early detection and monitoring of diabetic foot risks quickly and systematically. With an intuitive interface, this application functions as a clinical screening tool and an educational tool to raise awareness among people with diabetes mellitus about the importance of preventive foot care. This innovation enables accurate risk assessment in primary care facilities, allowing for more timely and measurable measures to prevent complications.

c. display of screening results



The final user page of the application displays the risk diagnosis results (low/medium/high) in a visually striking manner after the "Process" button, along with a narrative of preventive medical recommendations. Admins/researchers can access a dedicated dashboard via login to summarize all subjects' screening data in a downloadable/printable table.

Output

1. Testing stage

Table6 Stages of testing

PSSUQ Subscale Score				
Respondents	*System Quality*	*Information Quality*	*Interface Quality*	*Overall*
R1	1.50	1.67	1.25	1.47
R2	1.33	1.17	1.75	1.42
R3	2.17	2.17	2.25	2.19
R4	1.00	1.00	1	1.00
R5	1.67	2.00	1.25	1.81
R6	1.67	1.67	1	1.44
R7	1.33	1.67	1	1.42
R8	1.00	1.50	1	1.17
R9	1.17	1.67	1	1.28
R10	1.50	1.17	1	1.22
R11	1.50	1.00	1	1.17
R12	1.33	1.17	1	1.17
R13	1.50	1.17	1	1.22
R14	1.50	1.33	1	1.28
R15	1.83	1.33	1.75	1.39
R16	1.67	1.50	1.5	1.39
R17	1.67	1.33	1	1.58
R18	1.33	1.33	1	1.39

R19	1.33	1.33	1	1.22
R20	1.67	1.33	1	1.33
R21	1.83	1.67	1	1.50
R22	1.33	1.50	1	1.28
R23	1.17	1.67	1	1.28
R24	1.33	1.50	1	1.28
R25	1.17	1.17	1	1.11
R26	1.67	1.17	1	1.28
R27	1.33	1.50	1	1.28
R28	1.50	1.33	1	1.28
R29	1.50	1.17	1	1.22
R30	1.50	1.00	1	1.17
Average	1.47	1.41	1.15	1.34

PSSUQ data processing from 30 respondents showed that the usability of the Footify application was consistently excellent. The average score was overall: 1.34; System Quality: 1.47; Information Quality: 1.41; Interface Quality: 1.15—all excellent.

Dimensions	Mean (Average)	Lower Limit (-1 SD)	Upper Limit (+1 SD)	Interpretation
System Quality	1.47	1.19	1.75	Very good
Information Quality	1.41	1.13	1.69	Very good
Interface Quality	1.15	0.82	1.48	Very good
OVERALL (Grand Mean)	1.34	1.08	1.60	Very good

The descriptive analysis table of the PSSUQ (30 respondents) shows that Footify's usability is very good: mean System Quality 1.47 (range 1.19–1.75), Information Quality 1.41 (1.13–1.69), Interface Quality 1.15 (0.82–1.48), overall 1.34 (1.08–1.60). Low standard deviations indicate high consistency, all below the norm of 2.00—with no significant difficulties.

2. Documentation Stage

The following are the steps to access the website for early detection of diabetic foot risk:

a. Open the application via a web browser such as Google Chrome, Mozilla Firefox, Microsoft Edge, Safari, or Opera.

b. Enter the website address, namely https://footify.dewantara.cloud, in the browser search field.

c. Once the main page opens, users can log in (if as admin) or directly use the screening feature (if as user/patient).

d. Users fill in the required data and answer screening questions according to the conditions they are experiencing.

e. The system will process the entered data and display the results of diabetic foot risk detection along with treatment recommendations.

This documentation stage aims to make it easier for users to operate the system so that the early detection process can be carried out effectively and efficiently.

Discussion

1. Assessment Stage

The assessment stage is the initial stage in research that aims to identify problems and determine the needs of the system to be developed.43 Based on the research results and data obtained, Diabetes Mellitus shows a significant increase both globally and at the local level, especially at the Sindangwangi Community Health Center, Majalengka Regency. The increase in the number of cases in 2023 to 324 cases and an increase in 2024 to 375 cases is an indicator of the need for more optimal preventive efforts, especially in detecting complications early.

One common complication is a diabetic foot ulcer, which begins with diabetic neuropathy. Patients often go unnoticed, putting them at risk of developing a serious infection. 12 This condition can lead to further complications such as osteomyelitis, gangrene, and even amputation of the lower extremities, as well as increasing morbidity and mortality rates in patients with diabetes mellitus. 68 Therefore, a fast, easy, and effective screening system is needed. Inlow's 60-Second Diabetic Foot Screen method was implemented because it can systematically assess diabetic foot risk in a short time. 16 The results of this stage became the basis for developing the Footify application system, which is equipped with screening features, risk assessments, and health education.

2. Knowledge Acquisition Stage

The knowledge acquisition stage is carried out to collect and compile information that will be used as a basis for system development.43 Knowledge sources are obtained from scientific literature, journals, and diabetic foot examination guidelines using the Inlow's 60-Second Diabetic Foot Screen method.

At this stage, the knowledge collected includes screening parameter data, risk level data, question data, and solution data. Screening parameters include physical foot conditions such as skin, nails, deformities, sensation, and injury history. Risk level data is classified into three categories: low, medium, and high risk. Furthermore, screening questions are developed to serve as system input, as well as solutions or recommendations to be provided to users.

All of the data is then processed using the forward chaining method, which is a reasoning method that starts from facts or symptoms entered by the user to produce conclusions in the form of risk levels and recommendations.48 This stage is the core of building the system's knowledge base.

3. Design Stage

The design phase is the process of designing a comprehensive system before implementation. At this stage, researchers use several design tools, including flowcharts to illustrate the system flow, Data Flow Diagrams (DFDs) to show data flow, and Entity Relationship Diagrams (ERDs) to design the database structure.60

Database design is carried out by defining key entities such as users, patients, schedules, appointments, and screenings, along with their attributes. Relationships between entities are designed using primary and foreign keys to maintain data integrity. Furthermore, the system process design is also structured through context diagrams, functional decomposition diagrams, and event diagrams that illustrate the interactions between users, administrators, and the system. This stage aims to ensure the system being built has a clear, organized structure and meets user needs.

4. Testing Phase

The testing phase was conducted to determine the usability of the developed system. Testing was conducted on 30 respondents at the Sindangwangi Community Health Center using the Post-Study System Usability Questionnaire (PSSUQ).

The test results show that the average value for each dimension is in the very good category, namely System Quality of (1.47) Information Quality of (1.41) and Interface Quality of (1.15) The overall value of 1.34 also indicates that the application has a very good level of usability. This indicates that users consider the system easy to use, informative, and has a good interface display.

In addition, the range of values that are below the threshold indicates that respondents' assessments are relatively consistent without any significant difficulties in using the system.57 Thus, it can be concluded that the Footify application is easy to use, informative, and has a good interface.

5. Documentation Stage

The documentation stage is the final stage which aims to compile a system usage guide so that it can be operated easily by users.43 This documentation includes information related to device requirements, how to access the system, and steps for using the application.

The Footify system can be accessed via internet-connected devices using a web browser such as Google Chrome, Mozilla Firefox, Microsoft Edge, Safari, or Opera by accessing the address https://footify.dewantara.cloud Users can then carry out screening by filling in their personal data and answering the available questions, while the admin can manage the data via the login feature.

With this documentation, it is hoped that users can utilize the system optimally so that the early detection process for diabetic foot risk can be carried out effectively and efficiently.

IV. CONCLUSION

This research successfully developed a web-based Footify application that integrates Inlow's 60-Second Diabetic Foot Screen method with forward chaining technology to systematically detect early diabetic foot risks. Test results showed that this application has an excellent level of usability with an overall average score of 1.34, which includes the dimensions of System Quality, Information Quality, and Interface Quality with high assessment consistency among 30 respondents. Practically, this application makes a significant contribution to first-level health facilities, such as the Sindangwangi Community Health Center, in providing measurable risk detection tools, precise digital documentation, and personalized health education to support the prevention of serious complications such as amputations.

However, this study has limitations due to the limited field testing, so generalization of the results to a more diverse population of diabetics with clinical characteristics requires further validation. Future research is recommended to conduct trials with a larger sample size and longer follow-up duration to evaluate the long-term impact of the application on changing patient self-care behavior. Furthermore, developing integration features with hospital electronic medical records or secondary healthcare centers is highly recommended to create a more efficient and sustainable referral pathway for high-risk patients.

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