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Designing of Aplikasi Pendamping Diabetes (Si-PenDi) as a Control Tool for Type 2 Diabetes Mellitus Patients

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ABSTRACT

Diabetes Mellitus is known as the mother of other diseases such as cardiovascular disease, kidney failure, and blindness. Indonesia ranks 5th in the world in terms of the number of Diabetes Mellitus sufferers in 2014. Non-compliance of patients with therapeutic recommendations can increase the risk of complications. Patient non-compliance is often caused by several factors, including forgetting to use medication, ADR, feeling healthy, and lack of education from health workers. The increasingly widespread use of Android-based applications among the public is an opportunity for patient consultations and reminding patients to be disciplined in using drugs so that they can improve patient clinical outcomes. Therefore, it is necessary to design an Aplikasi Pendamping Diabetes (Si-PenDi) as a control tool for type 2 diabetes mellitus patients undergoing therapy. This research aims to create the Aplikasi Pendamping Diabetes (Si-PenDi) as a tool to help control type 2 diabetes mellitus patients. The research is Research and Development research. The method is used to produce specific products and study the effectiveness of these products. This research reached TKT Level 2, making an Android-based technology application called the Si-PenDi (Diabetes Companion Application). The results obtained are that the Si-PenDi application has quite effective quality but cannot be said to be efficient and meet user satisfaction, so it is necessary to improve the design so that the application is better able to meet user expectations.

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INTRODUCTION

Diabetes Mellitus is a health problem in society whose prevalence is currently increasing. Diabetes Mellitus is known as the Mother of Disease, which is the mother of other diseases such as cardiovascular disease, kidney failure, and blindness (American Diabetes Association, 2017). Type-2 Diabetes Mellitus is the most common diabetes. The number of people with type 2 DM is recorded at around 90% of the total number of people with diabetes throughout the world (World Health Organization, 2011). World Health Organization officially released the ten highest causes of death in Indonesia; Diabetes Mellitus ranks third after stroke and heart ischemia (World Health Organization, 2013).

Furthermore, in 2017, the prevalence of diabetes Mellitus was recorded at 6.7% of the total adults in Indonesia, or around 10 million cases (International Diabetes Federation, 2017). In 2013, Indonesia ranked seventh in terms of the number of Diabetes Mellitus sufferers in the world, namely 7.3 million people, and in 2014, it rose two places to become 5th with a total of 7.6 million people (International Diabetes Federation, 2015).

Based on data from the Lampung Provincial Health Service, the number of cases of Diabetes Mellitus sufferers per district in Lampung Province in 2014 found three districts/cities with the highest incidence of DM, namely Pringsewu Regency with 2630 cases, Metro City with 1130 cases, and Bandar Lampung City with 1076 cases (Dinas Kesehatan Lampung, 2015).

Treatment for Diabetes Mellitus (DM) patients aims to prevent complications and increase the success of therapy. One indicator of the success of therapeutic management is patient compliance with therapeutic recommendations. Patient non-compliance with therapeutic recommendations can increase the risk of microvascular and macrovascular complications

that cause damage to organs such as the kidneys, heart, brain, and eyes (Shams & Barakat, 2010).

Several factors that are the reasons why patients are not compliant are patients forgetting to use medication, feeling healthy, the presence of ADR, and lack of education provided by health workers (Alshehri *et al*., 2020; Araya *et al*., 2020; Nakajima *et al*., 2021). For this reason, it is necessary to provide a control tool that can minimize the factors that cause patient non-compliance in using medication. The development of science in technology has been very rapid, especially with smartphones, which are supported by today's advanced features and are helpful if used correctly. The android operating system usually accompanies smartphones. In the Android system, we can install various applications to support daily activities, such as long-distance conversations (chatting), the internet, or electronic reading, such as e-books. We can also use them to obtain health information (Agustian et al., 2015).

Currently, technology has entered various fields, including the pharmaceutical sector. An example of pharmaceutical science application is pharmaceutical services, which can help pharmaceutical staff and patients who can support the success of therapy (Anderson et al., 2015). One form of application used is in pharmaceutical services, namely an application as a reminder when to take medication that can be installed on a smartphone; this application can increase patient compliance in using medication that has been prescribed by a doctor (Dayer et al., 2013). Apart from that, many health consultation activities have been widely opened online. In this way, health workers can carry out online counseling to increase patient medication compliance.

Previously, there was a reminder application for taking medication. The presence of this reminder application for taking medication can increase patient compliance, namely by implementing SMS Gateway in the Schedule Reminder Application (Utama et al., 2021). It is hoped that patients will be compliant in using the medication so that the therapeutic effect can be achieved (Vervloet et al., 2012). To further increase patient compliance, of course, an application must be designed that can be used not only as a tool to remind you when to take medication but also as an application that can be used for consultations and other activities. By increasing patient compliance, it is hoped that patient clinical outcomes will improve. This research aims to produce a product in the form of an Android-based Aplikasi Pendamping Diabetes as a control tool for type 2 diabetes mellitus patients.

METHOD

The research is Research and Development (R&D) research. This research method is used to produce specific products and study their effectiveness. Research and Development (R&D) is a process or steps to develop a new product or improve an existing product that can be accounted for. The application developed in this research is for diabetes mellitus patients. The application structure design is shown in Figure 1.

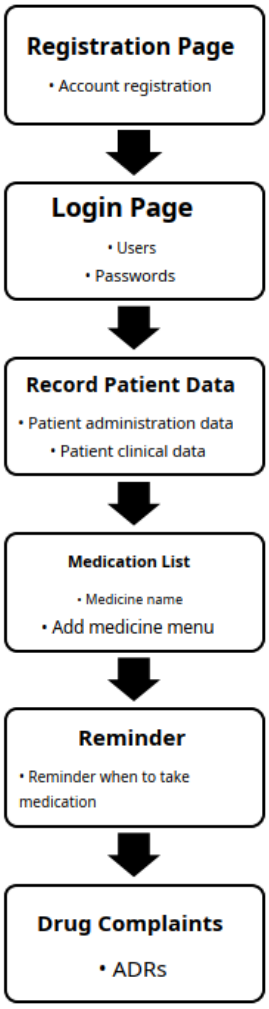

Figure 1. The application structure design of Si-PenDi

This research will be carried out from April to July 2023 at the Rajabasa Indah Community Health Center, Bandar Lampung City. Ethical approval has been obtained from the Health Research Ethics Committee of Health Polytechnic of Tanjungkarang with approval number 344/KEPK-TJK/V/2023.

The population in this study were all patients with Type 2 Diabetes Mellitus outpatient at the Rajabasa Indah Community Health Center, Bandar Lampung City, from April to July 2023. The sample in this study were patients suffering from Type 2 Diabetes Mellitus who met the

inclusion and exclusion criteria at the Indah Health Center in Bandar Lampung City from April to October 2023. The number of samples taken in this study was 30 people. The sample inclusion criteria in this study are:

1) Patients diagnosed with type 2 diabetes mellitus
2) Have an Android-based smartphone

Meanwhile, the sample exclusion criteria in this study are:

1) Not willing to be a respondent
2) Cannot operate a smartphone

Observation, task scenarios, and interviews were carried out during the data collection process in this research. Observations are carried out by observing and looking closely at how the application is used by the respondents so that researchers can discover the problems that arise. A task scenario is a set of tasks that respondents must carry out when using the application to be evaluated. Interviews were conducted to collect data directly to obtain more in-depth information.

Data analysis was carried out using three methods:

a. Performance measurement

The Performance Measurement technique is used to measure the effectiveness and efficiency of the Aplikasi Pendamping Diabetes when used by users. Effectiveness can be calculated based on the success or failure of each respondent's tasks.

Table 1. The task of work instruction of Si-PenDi Application

Code	Work instruction
IK1	Account Registration
IK2	Login again
IK3	Entering drug data in the "Medicine List" menu
IK4	Set the time to take medication in the "Reminders" menu

Effectiveness is calculated by assigning the number "1" if the respondent succeeds in completing the task and "0" if the respondent fails. The formula used to calculate the level of respondent success can be seen in equation (1), while the formula used to calculate the level of respondent failure can be seen in equation (2).

$$\text{Succeed} = \frac{\text{The number of tasks successfully performed}}{\text{Total number of tasks}} \text{ X } 100\% \quad (1)$$

$$\text{Fail} = \frac{\text{The number of tasks that failed to be performed}}{\text{Total number of tasks}} \text{ X } 100\% \quad (2)$$

Efficiency was measured by calculating the average time (in seconds) for four work instructions carried out by 30 respondents. The work instructions could have been more efficient if they had required a longer processing time than the average.

b. Retrospective think aloud

Retrospective think aloud data was obtained by interviewing respondents while reviewing the recorded videos. Interviews were conducted to determine the respondents' experiences and opinions using the diabetes companion application. Data was processed by collecting the results of verbalizing respondents' thoughts. This verbalization includes impressions of messages or difficulties expressed by respondents and suggestions given when the testing session is completed.

c. Likert model scale

The application's ease of use and attractiveness of the application display were measured using a Likert scale. The Likert scale is a scale used to measure the attitudes, opinions, and perceptions of a person or group of people about social phenomena. In research, the researcher has precisely determined this social phenomenon, referred to as the research variable. The scale that will be used to measure the application's ease of use is 1=very difficult, 2=difficult, 3=quite difficult, 4=easy, 5=very easy. Meanwhile, the scale used to measure the attractiveness of the application display is 1=very not interested, 2=not interested, 3=quite interested, 4=interested, and 5=very interested.

RESULTS

The test results in this section show the results of the data processing procedures obtained. Data processing results come from testing using performance measurement techniques, retrospective think aloud, and likert scale models. performance measurement and retrospective think aloud techniques can assess user effectiveness, efficiency, and satisfaction during application use. The Likert scale model measures the application's ease of use and attractiveness of the application display (Luh et al., 2019).

Most of the respondents in this study were female, over sixty-five years old, had a high school education, and were employed.

Table 2. Characteristics of respondents

Characteristics	n	%
Gender		
Woman	18	60
Man	12	40
Age		
≥ 65 Years	2	6.67
< 65 Years	28	93.33
Educational Level		
Not in school	2	6.67
Elementary school	4	13.33
Junior High School	6	20
Senior High School	13	43.33
University	5	16.67
Employment		
Not Employed	2	6.67
Employed	28	93.33

Performance measurement

Testing using Performance Measurement techniques is used to measure the effectiveness and efficiency of application use. The results of the effectiveness and efficiency test of the Si-PenDi application are as follows:

Effectiveness

Effectiveness was measured by calculating the average success and failure on four work instructions carried out by 30 respondents. The average value of the work instructions successfully carried out by respondents can be seen in Table 3.

Table 3. Effectiveness test results for using the Si-PenDi application among respondents

Respondent Code	Number of Work Instructions successfully completed	Total Tasks	Succeed (%)	Average (%)
R1	4	4	100	100
R2	4	4	100	
R3	4	4	100	
R4	4	4	100	
R5	4	4	100	
R6	4	4	100	
R7	4	4	100	
R8	4	4	100	
R9	4	4	100	
R10	4	4	100	
R11	4	4	100	
R12	4	4	100	
R13	4	4	100	
R14	4	4	100	
R15	4	4	100	
R16	4	4	100	
R17	4	4	100	
R18	4	4	100	
R19	4	4	100	
R20	4	4	100	
R21	4	4	100	
R22	4	4	100	
R23	4	4	100	
R24	4	4	100	
R25	4	4	100	
R26	4	4	100	
R27	4	4	100	
R28	4	4	100	
R29	4	4	100	
R30	4	4	100	

Table 1 shows the average value of the work instructions successfully carried out by 30 respondents. The average score was 100%, meaning that all respondents successfully completed all work instructions on the Si-PenDi application.

Efficiency

Efficiency was measured by calculating the average time (in seconds) for four work instructions carried out by 30 respondents. The data on the length of processing time based on respondents can be seen in Table 4.

Table 4. Efficiency test results for using the Si-PenDi Application on respondents

Work Instruction Code	Work Instruction Completion Time (seconds)															
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16
IK1	60	120	180	120	60	60	60	170	120	120	180	120	60	60	180	170
IK2	50	60	50	60	60	50	60	50	60	60	50	60	50	60	60	50
IK3	110	120	290	120	120	180	120	180	120	120	230	180	110	120	240	180
IK4	60	60	120	60	60	50	60	60	60	60	60	60	60	60	60	60

Work Instruction Code	Work Instruction Completion Time (seconds)														Average (seconds)
	R17	R18	R19	R20	R21	R22	R23	R24	R25	R26	R27	R28	R29	R30	
IK1	60	60	110	60	60	110	60	110	170	60	120	60	60	60	100
IK2	50	60	50	60	50	50	60	50	60	60	60	50	60	60	55.6667
IK3	180	120	110	120	180	170	120	110	230	120	120	180	120	120	151,333
IK4	50	60	50	60	50	50	60	50	60	60	60	50	60	60	59.6667
AVERAGE															91.6667

The average time to successfully carry out each work instruction was 92 seconds.

Retrospective think aloud

This section shows the test results using the Retrospective Think Aloud technique. Testing using the Retrospective Think Aloud technique is used to explore problems or difficulties experienced by users while using the Si-PenDi application. The test results using the Retrospective Think Aloud technique can be seen in Table 5. Table 5 shows the data results from respondents using the Retrospective Think Aloud technique.

Table 5. Retrospective think aloud test results on respondents' use of the Si-PenDi Application

Respondent Code	Problems/ difficulties experienced	Criticism and Suggestions given
R2	The order of dates and months on the reminder menu is still confusing	It is best to sort them by date, month, year.
R4	There is no click on the medicine list menu yet	Add a "click +" sign
R6	*Fonts*The app is too small, especially for elderly users	It is best to increase the font size
R16	Patients are still confused regarding the meaning of "frequency" on the medication list menu.	Language can be simplified/often heard by patients (e.g., rules of use)
R20	The account registration menu is less prominent	It would be better if the registration feature were more emphasized
R22	The frequency of "milli" referred to in the drug list menu is still unclear, whether mg or ml.	Clarify mg or ml again
R25	The "+" sign on the medicine list menu is less visible if placed at the bottom.	It is recommended to be placed in the right corner to be easily visible when using it.
R27	Entries in the reminder menu cannot be saved	It is recommended that it be updated/improved

Likert model scale

The application's ease of use and attractiveness of the application display were measured using a Likert scale. The Likert scale is a scale used to measure the attitudes, opinions, and perceptions of a person or group of people about social phenomena. In research, this social phenomenon has explicitly been determined by the researcher and is now referred to as the research variable. The test results for the application's ease of use and the attractiveness of the application menu display can be seen in Figures 2 and 3.

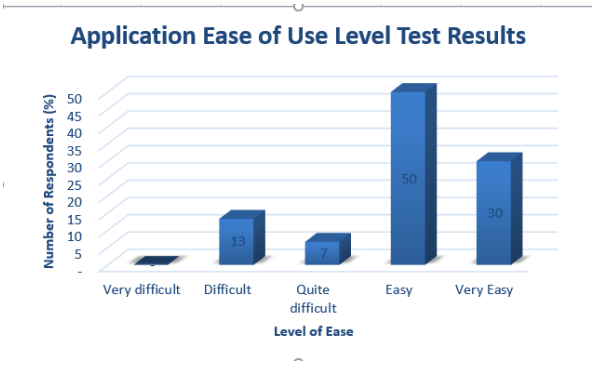

Figure 2. Test results for ease of use of the Si-PenDi Application

The test results for the application's ease of use show that the majority of respondents, 15 (50%), said it was easy, and 4 (13%) respondents said it was difficult to use the application.

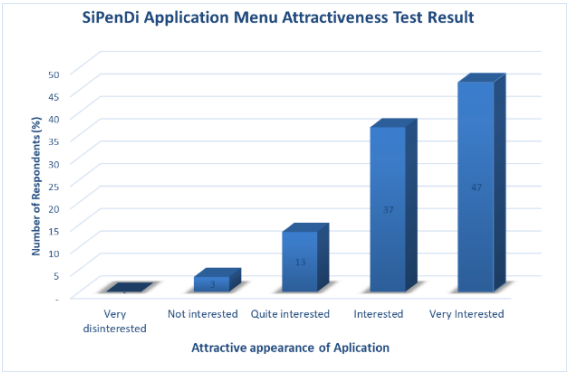

Figure 3. Attractiveness test results of the Si-PenDi Application menu display

The application menu display attractiveness test results showed that most respondents, 29 (97%), stated they were interested in the Si-PenDi application.

DISCUSSION

The usability testing method is applied by measuring the effectiveness, efficiency, convenience, and attractiveness of the Si-PenDi application. Test results using the Performance Measurement technique show the level of effectiveness and efficiency of the Si-PenDi application. The effectiveness test results show that, on average, respondents succeeded in carrying out work instructions, namely 100%. The absence of failure experienced by respondents shows that the Si-PenDi application has qualities that can be effective because respondents have completed the work instructions given.

The efficiency test results show that the average time to carry out each work instruction for each respondent is 92 seconds. The average obtained shows that work instructions IK2 and IK4 are work instructions that require time to complete more quickly than average work instructions. This shows that IK2 and IK4 have higher efficiency values than the efficiency values for other work instructions. The IK1 and IK3 work instructions still do not have a quality that can be considered efficient when used by skilled category respondents because respondents need a longer time than the average work instruction to complete the work instructions (Nurkholis & Saputra, 2021).

The results of exploring the difficulties or problems faced by respondents using the retrospective think-aloud method show that respondents still experience difficulties or problems with five features when using the Si-PenDi application. The problems or difficulties found made respondents dissatisfied with using the Si-PenDi application. This was because the features in the application were complex for respondents to find. After all, the layout was difficult to find, and the icons were considered inappropriate for the content.

Respondents provided suggestions for 25 features in the Si-PenDi application. Suggestions given by respondents will be used as recommendations to improve the application so that it is even better and meets user satisfaction and needs for the Si-PenDi application. Most respondents welcomed the Si-PenDi application because they felt they needed this application. This shows that digital health applications are a new form of media that can answer several health problems. This cannot be separated from social groups with similar relevant needs in forming a new media technology in digital health applications. The wide range of health services through digital applications helps provide health information regularly, providing online doctor consultation services, drug services in the form of online pharmacies, as well as ordering hospital appointments online (Novianti & Irwansyah, 2021; Fathoni et al., 2016).

The test results for the application's ease of use show that the majority of respondents, 15 (50%), said it was easy, and 4 (13%) respondents said it was difficult to use the application.

The application menu display attractiveness test results showed that most respondents, 29 (97%), stated they were interested in the Si-PenDi application. Respondents' interest was partly due to respondents' needs regarding the Si-PenDi application, which could provide more comprehensive access. This aligns with research conducted by Ebner et al. (2020), which shows that mobile health can produce real-time data even

in areas where access is limited by seasonally impassable roads and unreliable cellular coverage.

Other research shows that controlling diabetes mellitus patients using Android without having to meet face-to-face with a doctor is much more effective in terms of time and more accessible than having to come directly to the Tanrutedong District Health Center. Duapitue, Kab. Sidrap (Febriyanto, 2020).

Research limitation

This research still has limitations, including the fact that the application still needs to be improved and still needs further improvement. Some respondents still need assistance When using the application, so they cannot measure its effectiveness and efficiency. This study has yet to measure the extent of the application's influence on patient compliance in using antidiabetic drugs, so further research is needed.

Improvement recommendations

The recommendation given is in the form of a mockup design. The basis used to make recommendations for improvement uses the Eight Golden Rules theory by Benn Shneiderman and the results of usability testing that has been carried out. Recommendations for improving the design of the Si-PenDi application from this research are as follows:

1. Login and Register Page

Figure 4. The login and register page display

The recommendation for improving the appearance of the login and registration pages is to simplify the appearance to make it simpler to use and designed to be even more attractive.

2. Registration Page

The recommended improvements to the registration page are feature improvements. The height section can only be entered when the user has registered and entered in the person (account) image feature section so that everything is filled in according to weight, height, and address. Respondents also suggested changing the format from year – touch month – touch date (more practical). Moreover, if the application continues to use the feature configuration as before (initial), it is best to change the date/month/year order first.

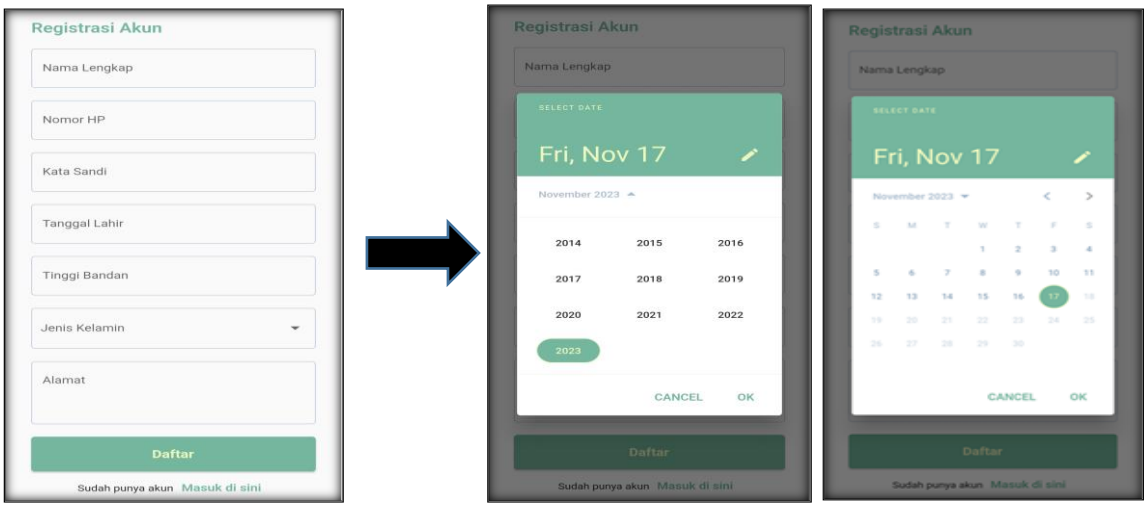

Figure 5. The registration page display

3. Home Page

Figure 6. The appearance of the home page

Respondents suggested adding home, history, and accounts separately on the home page display.

4. Drug list

Respondents suggested designing the drug list page so that more than one type of drug can be added at a time. Respondents also suggested adding mg (solid dosage) as a differentiator besides milliliters (liquid dosage).

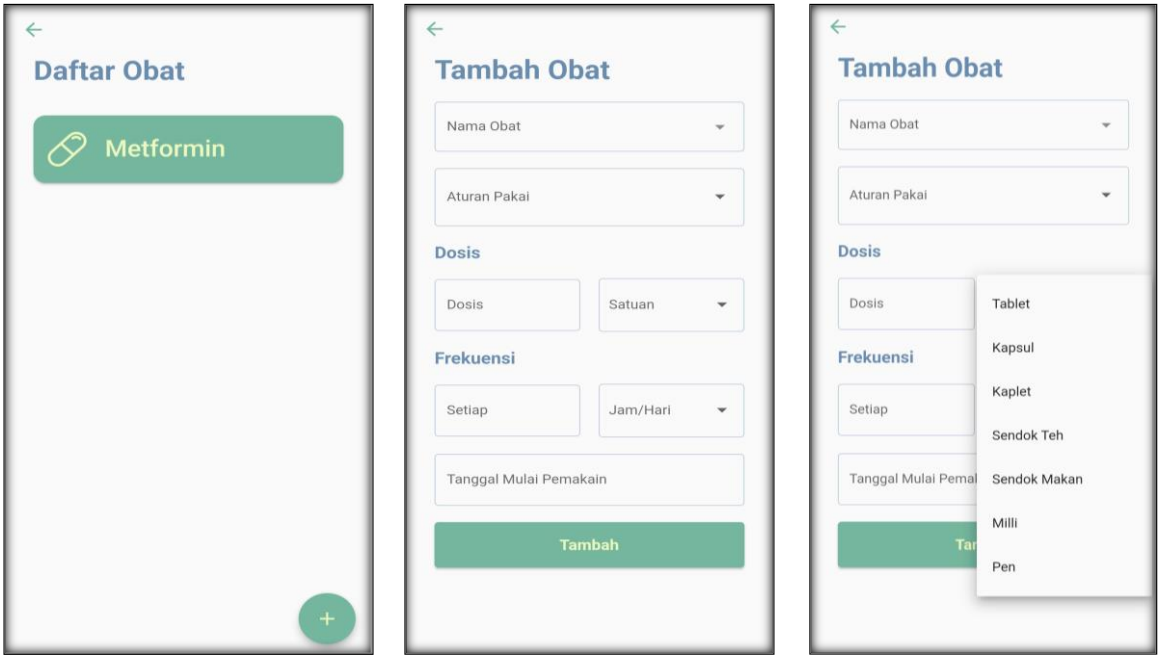

Figure 7. The medication list page display

5. Reminder

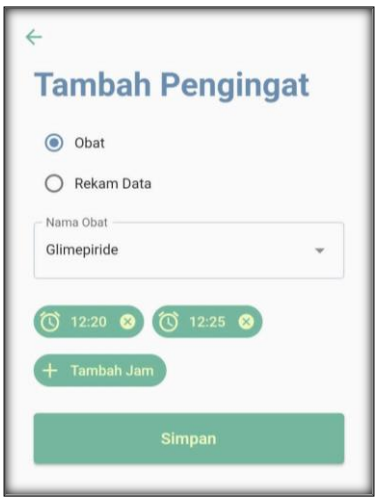

Figure 8. The reminder page display

Respondents suggested making the menu display for medication reminders more attractive and easier to use.

CONCLUSION

Based on the research data, the Si-PenDi application design still needs improvement for future use and must be re-tested. Some respondents were interested and felt they needed the Si-PenDi application.

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