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DOI: [10.31965/infokes.Vol22.Iss4.1621](https://doi.org/10.31965/infokes.Vol22.Iss4.1621)Journal homepage: <https://jurnal.poltekkeskupang.ac.id/index.php/infokes>**RESEARCH****Open Access****Development of a Mobile Phone E-Nursing Application Prototype to Improve Self-Care for Heart Failure Patients****Ida Ayu Agung Laksmi^{1a*}, I Made Dwie Pradnya Susila^{1b}, Made Ani Suprpta^{1c}**¹ Department of Nursing, Institute of Health Science Bina Usada Bali, Badung, Bali, Indonesia^a Email address: agunglaksmi41@gmail.com^b Email address: dwiepradnya@gmail.com^c Email address: anikajus@yahoo.co.id

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Abstract

Generally, patients with heart failure will experience activity intolerance resulting in functional limitations and decreased self-care abilities. One of the innovations offered in the Digital era is to develop a mobile phone e-nursing application with mobile technology that can be used by heart failure patients anywhere and anytime. This research aims to create a mobile phone application prototype to improve self-care for heart failure patients. This study is a research and development design. This study involved 32 heart failure patients who had medical records and a history of hospitalization at Mangusada Hospital using a purposive sampling technique. This research produced a prototype the self-care e-nursing application prototype which was developed into 6 main menus including education, weight monitoring, symptom monitoring, diet programs, medication reminders, and rest-activity menus. Then the prototype was evaluated using the System Usability Scale (SUS) and Post-Study System Usability Questionnaire (PSSUQ). The research results show that the average SUS score reached 84.84 and the overall PSSUQ score was above 5. The conclusion is this prototype is classified as acceptable. Thus, this prototype is worthy of being developed into a real application in the future. Future research is needed to investigate the integration of the e-nursing application with electronic medical records (EMRs) within existing hospital systems.

Keywords: Heart Failure, Self-Care, E-Nursing Application Mobile Phone, E-Nursing Prototype.**Corresponding Author:**

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1. INTRODUCTION

Heart failure (HF) is a progressive health problem with high mortality and morbidity rates in developed and developing countries. HF is a rapidly growing public health issue with an estimated prevalence of 64 million people globally (Shahim et al., 2023). In developed countries, the prevalence of known heart failure is generally estimated at 1% to 2% of the general adult population (Groenewegen et al., 2020). Data from the National Health Research of Indonesia in 2018, the number of heart failure cases in Indonesia based on a doctor's diagnosis is estimated at 1.5% or around 29,550 people (Yahya & Herawati, 2021). The increasing prevalence of heart failure (HF) can have several negative impacts on individuals and society as a whole (Pazos-López et al., 2011; Savarese et al., 2022). Not only is associated with a high risk of mortality but also reduces quality of life and ability to perform daily activities. As a result, heart failure can also have an impact on the socio-economic of the community (Arrigo et al., 2020; Robertson et al., 2012)

Heart failure is a complex clinical syndrome that results from any structural or functional impairment of ventricular filling or ejection of blood (Malik et al., 2023). Heart failure occurs when the heart fails to pump blood throughout the body, making the heart work harder to fulfill the body's needs (Putra et al., 2021). It will cause volume or pressure overload or regional dysfunction in the heart which will increase the heart's workload, causing signs and symptoms such as shortness of breath and fatigue during activities. Generally, patients with heart failure often experience activity intolerance, leading to functional limitations that hinder their ability to perform self-care (Laksmi et al., 2020).

Self-care according to Dorothea Orem is an action in optimizing a person's ability to care for themselves independently so as to achieve the ability to maintain their health and well-being (Alligood, 2014). Basically, a person has the ability to care for themselves which is called self-care agency. Self-care agency in heart disease sufferers decreases due to long illness. Most heart failure patients do not carry out proper self-care as taught, such as a low-salt diet, regular physical activity, limiting fluids, and monitoring body weight every day (Britz & Dunn, 2010). The inability to perform self-care can be a factor influencing re-hospitalization in heart failure patients.

One of the previous studies regarding the supportive education system, namely a special self-care program for heart failure patients by providing assistance to patients through modules and videos on daily care for heart failure patients at home, found that the program was effective in increasing patient self-care scores compared to education provided. It was given when the patient returned home from hospitalization (Laksmi et al., 2020). However, the limitation of the research was that when the research ended, there was no monitoring of patient self-care at home (Laksmi et al., 2020). Therefore, innovation is needed in the care of heart failure patients through mobile technology that can be accessed on each patient's smartphone.

Mobile technology such as smartphones can be a useful tool for heart failure patients. Smartphones can provide the health information that patients need to support patient compliance in taking care of themselves at home resulting in better health (Putra et al., 2021). One of the innovations offered in the Digital era is to develop a mobile phone e-nursing application with mobile technology that can be used by heart failure patients anywhere and anytime. The majority of heart failure patients are interested in the activity record feature, recommendations for managing heart failure symptoms, and reminder features from an application on a smartphone (Sohn et al., 2019).

In developed countries, many HF patients are already using mobile apps for heart failure self-management. One integrative review found that of the 18 articles reviewed, there were 26 applications that were commonly used by HF patients (Athilingam & Jenkins, 2018). One qualitative study suggested that the perspective of Mobile Heart Failure application users from

the patient's perspective is very useful for independently monitoring the main parameters in heart failure management (for example, blood pressure and body weight) (Giordan et al., 2022).

A prototype is a prototype of a product modelled by creating a design, sample, or model to test a product concept or work process. A prototype in technological development is defined as an original model, form or example that functions as a basis for subsequent processes (Purnomo, 2017). The E-Nursing self-care application is an application intended to provide nursing care to heart failure patients digitally. Different from the previous heart failure application, this prototype was developed based on the situation-specific theory of heart Failure Self-care by Riegel et al., (2022). The urgency of this research is as a first step in creating a mobile phone E-Nursing application as a solution for self-care maintenance for heart failure patients. This study aimed to develop and evaluate a mobile application prototype to enhance self-care among heart failure patients.

2. RESEARCH METHOD

This study was a research and development design and follows the stages of information system development using the prototyping method. This method adopts a software development approach that is based on experimentation and experience. Prototyping produces an initial version of a software which is a picture of the software that will be developed in the future as a whole, which allows developers to carry out experiments and then make contact with potential users to get input for improvements for production software in the future (Herawati et al., 2022).

Research was divided into 2 phases including phase 1 prototype development and phase 2 prototype evaluation. Phase 1; Prototype development starts with literature study, which needs analysis for system design. It contained several lists of theories that researchers use as supporting tools for this research. The next stage is needs analysis. In the needs analysis, an analysis would be carried out regarding the functional and non-functional requirements of the system or application to be built. After analyzing the requirements of the system, we have been continued with the process of creating use case diagrams and use case scenarios (Ladjamudin, 2013). At this stage, a focus group discussion was carried out by inviting 2 nurses from the Heart Polyclinic at RSD Mangusada and 3 heart failure patients, 2 emergency and critical care nursing lecturers from Institute of Health Science Bina Usada Bali, and 1 IT person from Primakara University.

Stage 2 was carried out system implementation and evaluation. This phase involved 32 heart failure patients who have medical records and a history of hospitalization at Mangusada Hospital using a purposive sampling technique. Based on the preliminary study, it was found that the average inpatient with heart failure cases in the ICU room at Mangusada Hospital for the last three months was 35 people. The sample was calculated using a population formula of less than 1,000 (Sugiyono, 2011). The inclusion criteria for this study included heart failure patients who have a smartphone, are able to access Google Forms, and are willing to participate in this study by signing the respondent's consent form, while the exclusion criteria were heart failure patients with NYHA class 4 classification and having disease complications, others such as kidney failure and diabetes mellitus.

Then the interface was evaluated using a quantitative approach with analytical descriptive design. Evaluation of the interface prototype uses the System Usability Scale (SUS) and Post-Study System Usability Questionnaire (PSSUQ) Versi 3. According to the ISO 9241-11 standard, usability testing is an effort to measure the extent to which a product can be used by certain users to achieve specified goals with effectiveness, efficiency and satisfaction in a certain context of use (Yanti et al., 2021). PSSUQ is a questionnaire designed to assess and evaluate user satisfaction with a system that has been designed by focusing on 4 assessment categories in the usability concept, namely System Usefulness (Sysuse), Information Quality (InfoQual), and Interface Quality (InterQual), and Overall (Sufandi & Aprijani, 2022).

In addition to filling out the SUS questionnaire, participants also assessed the prototype

of the E-Nursing self-care application by rated on a scale from 1 (strongly disagree) to 7 (strongly agree). At this stage, data analysis will be carried out by presenting descriptive data from the evaluation results of the interface prototype. This research was conducted in accordance with ethical principles and was approved as ethically sound by the Health Research Ethics Commission of STIKES Bina Usada Bali, under approval number 098/EA/KEPK-BUB-2023.

3. RESULTS AND DISCUSSION

The application prototype development process was carried out using the Focus Group Discussion method by inviting 2 nurses from the Mangusada RSD Heart Polyclinic 3 heart failure patients, 2 emergency and critical care nursing lecturers from STIKES Bina Usada Bali, and 1 IT person from STIMIK Primakara. The aim of the FGD is to analyze and design the system to produce a flow chart. Then this flow chart is used as a guide for developing the E-Nursing application prototype.

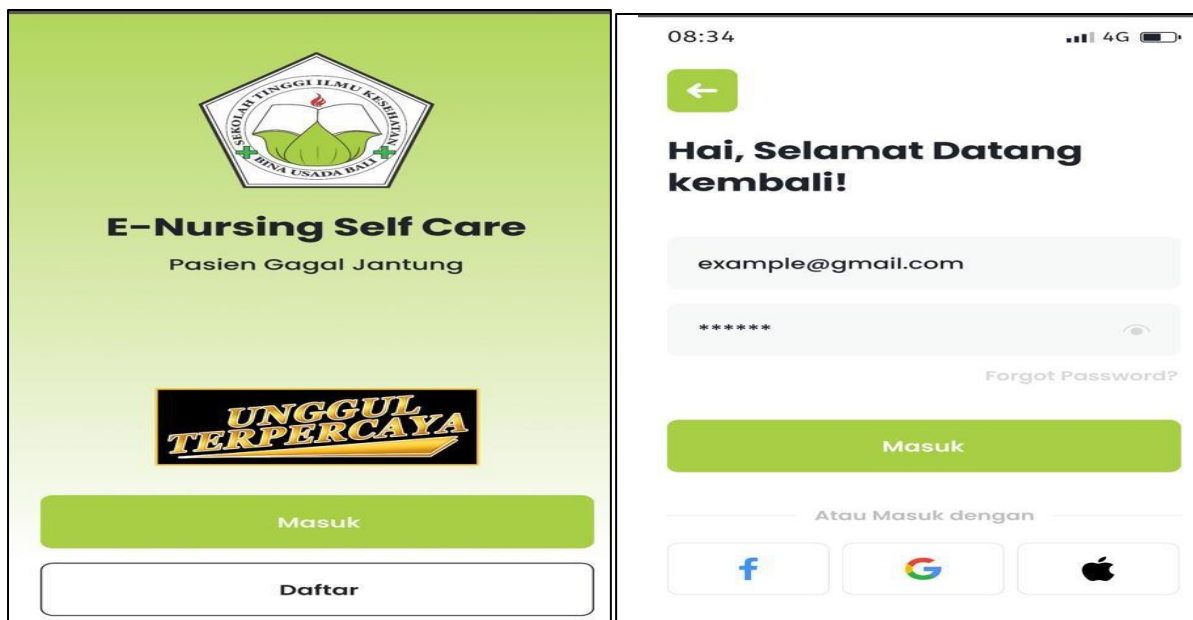
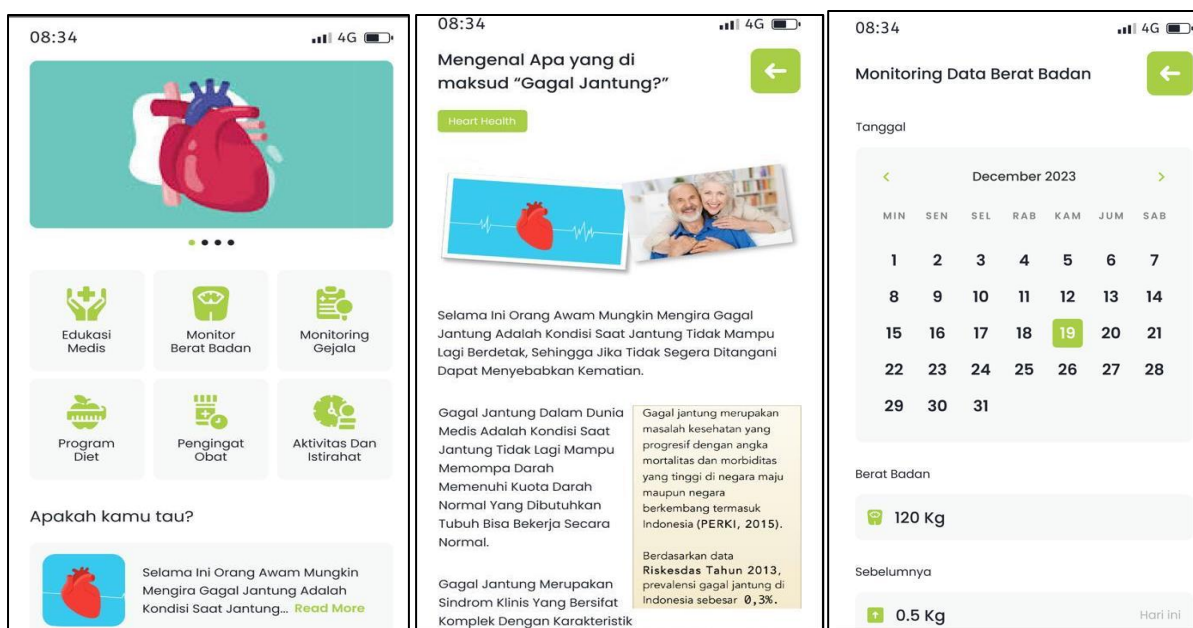


Figure 1. Login page interface



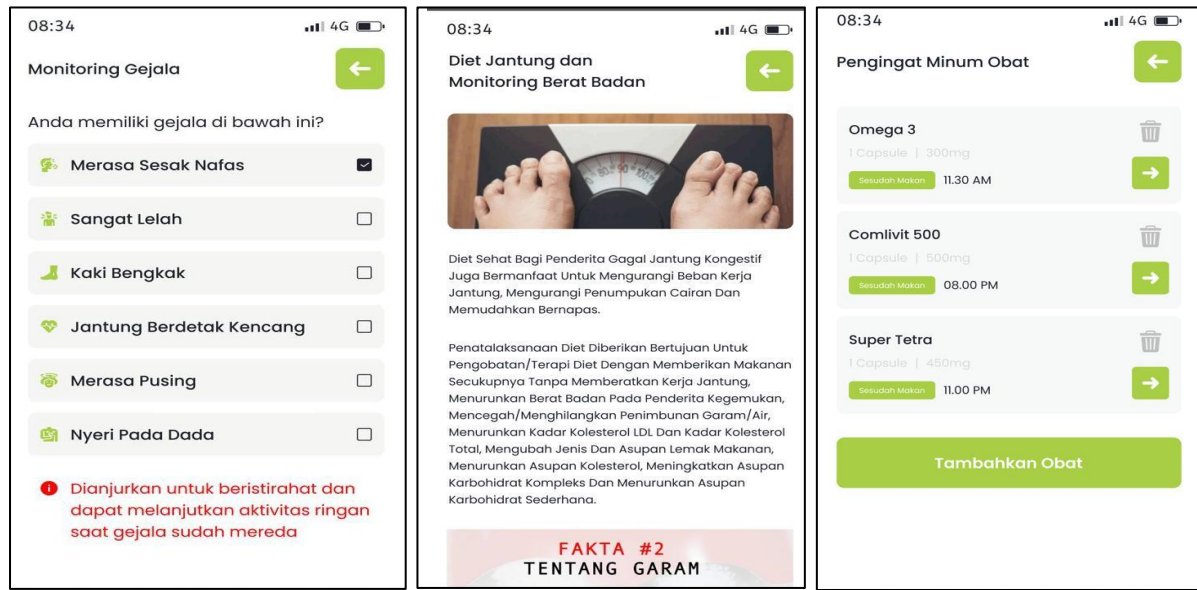


Figure 2. Menu page interface

The Self Care E-Nursing application prototype has 6 main menus including education, weight monitoring, symptom monitoring, diet programs, medication reminders, and rest-activity menus (fig 2). These six menus are adapted from previous research (Laksmi et al., 2020). The educational menu contains all information related to heart failure, in this menu it is possible to be developed into a forum for updating health articles related to heart failure. The weight monitoring menu became the focus of this prototype. Increasing body weight is one indicator of excess fluid volume in patients. Symptom monitoring is intended as a decision consideration for patients when to come to the hospital or other health care centers. Adherence to taking medication is also the key to improving the quality of life of heart failure patients, so this prototype provides a container as a reminder to take the patient's medicine. The last menu of activity and rest is also no less important, heart failure patients often have activity intolerance so activity and rest must be controlled.

Table 1. Characteristics of Participants

Age (year)	N	%
21-30	0	
31-40	1	3.1%
41-50	2	6.2%
51-60	11	34.4%
>61	18	56.3%
Gender		
Male	9	28.1%
Female	23	71.9 %
Occupation		
Not in occupation / Pensionary	21	65.7%
Civil servant	4	12.4%
Private employees	2	6.2%
Entrepreneur	5	15.7%
Total (N)	32	100%

Based on Table 1 above, it can be seen that the majority of respondents (71.9%) are women. The occurrence of HF increases with advancing age, and women at older age are at greater risk than men (Lindenfeld & O'Connor, 2019). Female sex was more reported to be associated with preserved left ventricular function and the risk for HF was dramatically more

elevated for women with systolic hypertension (Azad et al., 2011). It is also caused by an increase in fibrosis in old age which is caused by decreasing estrogen levels in women (Regitz-Zagrosek, 2020).

Table 1 also shows that based on age, the majority of respondents (56.3%) were > 61 years old and (65.7%) were not working or were retirees. It showed that most heart failure patients are elderly or not of productive age. Previous studies revealed that HF is primarily a disorder of the elderly increasing from 1% among those aged 45–55 years to over 10% in the over 80 years old (Coats, 2019). In older people, HF is caused most commonly by coronary artery disease and hypertension, which are often present together (Warner et al., 2022). However, in fact, this research found young respondents ranging from 31-40 years old. This shows that heart muscle failure is not only caused by aging but also by other factors such as lifestyle. The American Heart Association announced that there are several additional factors that increase the risk of heart failure at a young age, such as smoking, overweight, alcohol or drug abuse, and certain types of radiation and chemotherapy (AHA, 2023).

Table 2. Descriptive Data of System Usability Scale (SUS) (N=32)

Question Items	Strongly Disagree (1)	Disagree (2)	Uncertain (3)	Agree (4)	Strongly Agree (5)
I think I will use this app	1	7	0	17	7
I feel that this application is unnecessarily complicated	8	11	7	4	2
I think this application is easy to use	6	1	3	14	9
I need help from others to use the application	5	10	6	5	6
I think the various functions/features in the application have been integrated well	2	6	8	10	6
I think there are a lot of things that are not consistent or harmonious in this application	7	7	7	6	5
I think many people will learn to use this app quickly	2	2	8	16	4
I find the App impractical to use	4	16	8	4	0
I am very confident using this App	2	1	6	15	8
I need to learn many things before I can use this application	9	9	7	4	3
Score of SUS					
Score of SUS	1068				
Total score (Score SUS*2.5)	2715				
Average Score of SUS	84.84				

Table 2 shows descriptive data on the System Usability Scale (SUS). There are 10 question items consisting of positive statements except for 2 items number 6 and 10 which include negative statements. Table 2 shows the frequency of the number of respondents who chose the option of each statement item from the range of 1 (strongly disagree) to 5 (strongly agree). SUS is a questionnaire that can be used to measure the usability of computer systems according to the subjective point of view of the user. One of the reasons this SUS questionnaire is worth using because, in addition to being proven to be valid and reliable, SUS uses agnostic

technology, which means it can be widely used and evaluate almost any type of interface, including websites, smartphones, interactive voice responses (Sidik, 2018). The SUS scores were interpreted with a cutoff of 68. A score above 68 indicates average performance, whereas a score below 68 is considered to be below average (Jamal et al., 2021). Based on Table 2, it can be seen that the average SUS score reaches 84.84, which means that the prototype of the E-Nursing application is classified as acceptable.

Descriptively in positive statements most respondents chose to agree which is worth 4, and in negative statements more respondents choose disagree which is also worth 4. However, out of 32 people, it turned out that a number of 8 people did not agree to use this application. This can be caused by various factors, one of which is due to age versus technology. In a previous study, it was found that less than 40% of the elderly were not aware of the existence of a technology product, but only 50% of the population said they used the technology product (Restyandito & Kurniawan, 2017). This is in accordance with research data from almost half of the elderly (46.79%) using cell phones but less than 15% of the elderly accessing the internet (Augia et al., 2022).

In addition to using SUS In addition to using SUS as a data collection instrument, this prototype was also evaluated using the Post-Study System Usability Questionnaire. as a data collection instrument, this prototype was also evaluated using the Post-Study System Usability Questionnaire. Post Study System Usability Questionnaire (PSSUQ) is a questionnaire designed to assess and evaluate user satisfaction with a system that has been designed (Suwandy et al., 2022). PSSUQ is specifically designed for scenario-based usability testing. PSSUQ is used to assess user satisfaction based on usability aspects by grouping into four categories, namely system usefulness, information quality, interface quality, and overall satisfaction (Paramitha et al., 2022). Table 3 shows the frequency of the number of respondents who chose the option of each statement item from the range of 1 (strongly disagree) to 7 (strongly agree). Table 4 shows the level of significance of the usability test results of the prototype of the Self Care E-Nursing application using PSSUQ. The higher the average rating, the better the app rating (Van Der Weegen et al., 2014).

Table 3. Descriptive Data of Post-Study System Usability Questionnaire

Question Items	Strong-ly Agree (7)	Agree (6)	Some-what Agree (5)	Neutral (4)	Some-what Disagree (3)	Diss-agree (2)	Strong-ly Disagree (1)
Overall, I am satisfied with how easy this app is to use	10	14	5	1	0	2	0
The application is simple to use.	9	17	2	1	0	2	1
I can complete assignments and scenarios quickly when using this application.	6	18	2	3	1	2	0
I feel comfortable using this application	7	16	4	1	1	2	1
Easy to learn to use this app	10	12	3	3	2	2	0
I believe that I can be productive quickly using this application	9	16	4	3	0	0	0
The application gives me clear error messages to fix the problem	7	18	3	4	0	0	0

Question Items	Strongly Agree (7)	Agree (6)	Some-what Agree (5)	Neutral (4)	Some-what Disagree (3)	Diss-agree (2)	Strong-ly Disa-gree (1)
When I make a mistake while using the app, I can recover easily and quickly	6	17	5	4	0	0	0
The information (online help, on-screen messages, and other documentation) included in the application is clear.	7	20	3	2	0	0	0
Easy to get the information I need	9	19	2	2	0	0	0
The information has been effective in helping me complete assignments and scenarios	10	17	3	2	0	0	0
The information in the application has been arranged clearly	9	19	2	2	0	0	0
The interface screen of this application is comfortable to use. (the things you use to interact with applications. For example, some of the components of a face-to-face interface are the keyboard, mouse, microphone, and screens (including graphics and language)	0	0	0	1	3	19	9
I love using the interface screens of this app	0	0	0	2	4	18	8
This application has the functions and capabilities that I expected it to have	9	17	2	4	0	0	0
Overall, I am satisfied with this application	9	16	3	1	1	1	1

Based on Table 3, it can be seen that most respondents tend to agree and strongly agree. This indicates that the prototype of this application can be accepted by potential users, namely heart failure. This is also strengthened by the average value in the four domains in PSSUQ including overall satisfaction, satisfaction with system quality, satisfaction with informational quality and satisfaction with interface quality described in Table 4 below.

Table 4. Satisfaction of Usability Aspect on PSSUQ

Usability Aspect on PSSUQ	Average
Overall (1-16)	5.2
System Quality (1-6)	5.7
Information Quality (7-12)	5.6
Interface Quality (13-15)	4.1

Table 4 above shows that overall, the system quality and information quality of the Self Care E-Nursing application prototype has an average value above 5, but is different from the quality of the interface which is still at number 4. This is because the prototype cannot provide face-to-face services such as online consultations.

With both evaluations from the SUS and PSSUQ questionnaires, the prototype Self Care E-Nursing application can be measured by prospective users. An overview of user response when interacting with the application can also provide an overview to developers to find out the level of user acceptance of the system/ application (Sufandi & Aprijani, 2022). Based on the results in the two tables above, it can be said that this prototype has a high level of usability and is worthy of development. This finding is almost the same as a prototype heart failure application called "TumTum" that reached high scores as of the superior category, reaching an overall percentage of 88.4% (De Sousa et al., 2022).

Question items 13 and 14 on the PSSUQ instrument are a limitation in this research. The prototype built does not provide interface services such as direct access to video calls or video meetings or direct online consultations. So question items 13 and 14 which assess user satisfaction regarding interface services mostly have negative values. The results also illustrate that the E-Nursing self-care application needs improvement to be able to provide interface services such as online consultations with face-to-face.

Even though there are still limitations, the prototype created is generally accepted by potential users, namely congestive heart failure patients with the characteristics that most of them are over 60 years old and no longer working. It should be emphasized that in this research, all participants who tried and assessed the prototype had their own smartphones. This indicates that elderly people in Indonesia can also use the E-Nursing application on their own smartphones.

Mobile technology is a growing strategy to increase access to health services in the community as a solution in delivering health promotion (Oliveira et al., 2024). E-nursing self-care has been made to assist HF patients in managing their own care and receiving health education. Developing this prototype into an application will have implications for improving self-care and quality of life. Furthermore, the prototype has a weight monitor for better control, as well as daily checking of signs and symptoms, involving the general perception of well-being and warning signs for consultation at a health service.

4. CONCLUSION

Based on the research results above, the usability of the E-Nursing Self-Care application prototype for heart failure patients, assessed using the SUQ and PSSUQ questionnaires, indicates that the application is generally well received by users in terms of application usability (Sysuse), information quality (Infoqual), interface quality (Interqual), and overall user satisfaction. It can be concluded that this prototype is classified as acceptable. Therefore, this prototype is worthy of further development into a real application in the future. Future research is needed to investigate the integration of the E-Nursing application with electronic medical records (EMRs) within existing hospital systems.

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