



The Usability and Feasibility Testing of *Tele-Heart Nursing Care/TNCA* Digital Application for Preventing 30 Days Re-Admission Among Heart Failure Patients

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Abstract

Background: An android-based application called '*Tele-Heart Nursing Care*'/TNC aims to assist remote monitoring for heart failure patients. By improving self-care through daily monitoring and efforts to increase adherence to therapy, it is expected to prevent 30-day readmission rates.

Purpose: To test the usability and feasibility of the application by users, the *System Usability Scale* (SUS) was used, a standardized questionnaire that has been declared valid and reliable with a *Cronbach Alpha* value of 0.778. This stage of testing is a continuation of the previous testing by expert cardiologists, cardiac specialist nurses and IT experts.

Methods: This study used quantitative methodology using SUS questionnaires to 10 heart failure patients at Dr M. Salamun Hospital Bandung in June 2024. Sampling with a cross-sectional approach with a minimum number to conduct testing. After patients accessed the TNC application then they filled out the SUS questionnaire. **Results:** From the ten questions in the SUS questionnaire, the average score of all respondents was 78.6 with a letter grade of B. The Tele-heart Nursing Care application can be used well by respondents, although there are still difficulties with the registration system, language use and other difficulties related to the use of applications related to the elderly.

Conclusions: It can be concluded that the use of the Tele-heart Nursing Care Application can be used properly by respondents. And in the future, the use of TNC applications can be widely used in heart failure patients.

Keywords: *30 Days Readmission, Heart Failure, Mobile Application, Usability Feasibility Testing*

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Introduction

Mortality and re-hospitalization rates for heart failure patients are increasing by more than 20% annually, prompting more comprehensive programs to manage it. The high rate of recurrence in heart failure patients

has triggered various programs to reduce the incidence (Akinosun et al., 2021). There have been many studies on the utilization of digital technology, including telemonitoring, to prevent recurrence, improve quality of life and affect mortality rates in heart failure patients. One of the most widely used forms of technology due to its easy access and use is the use of mobile or smartphone in health services for heart failure patients (Rebolledo Del Toro et al., 2023).

Previous studies have proven that the use of mobile monitoring is more effective than the use of other technologies (Giordan et al., 2022). There are not many similar apps with complete features for heart failure patients developed in Indonesia. Therefore, an android smartphone-based application was developed to answer the challenges of health technology development that focuses on heart failure patient care services. A prototype called "Tele-Heart Nursing Care"/TNC A prototype called 'Remote Cardiac Care'/TNC was developed with the aim of improving patient self-care and preventing 30-day readmission in heart failure patients (Amalia, Binti, et al., 2024).

The development of the TNC digital application involved cardiologists, cardiac specialist nurses and IT experts through a series of validity tests. Once successfully developed, the application needs to be tested for usability before being used in a wider scope. To measure whether a software can be accepted by users, *usability* testing is carried out (Usman & Gustalika, 2022). *Usability* testing usually uses the *System Usability Scale* (SUS), which is the most popular assessment in conducting *Usability* testing (Alves et al., 2021). SUS as a *Usability* testing questionnaire requires a questionnaire instrument that must be able to provide valid and reliable assessments. *System Usability Scale* or commonly called SUS itself is a test developed by Brooke as a 'Quick and Dirty' test where participants can quickly and easily access usability testing to assess a product or service SUS itself is one of the Usability testing options with 10 items question about whether it is difficult to use the application (Cheah et al., 2023).

The usability and feasibility are required for the developed application to be appropriate. Testing is also required to achieve the goal of this application, which is to improve patient self-care and prevent readmission among heart failure patients. The high rate of hospitalization in heart failure patients is related to patient self-care compliance (Nick et al., 2021). Information and education about the disease and its treatment are also important, and by using digital technology, the delivery will be more effective and proven to improve self-care and quality of life (Amalia, Said, et al., 2024). For this reason, the TNC app was developed comprehensively with various features such as vital signs, symptom monitoring, diet, exercise, and medication adherence. The

app tries to simplify patient monitoring without compromising on the objectives. So, it is imperative to evaluate this app first to determine if it is appropriate for use by heart failure patients.

Materials and Methods

Design

In this study, a research design with a cross-sectional quantitative approach was used. A cross-sectional study is a type of research design in which researcher collect data from many different individuals at a single point in time (Lav, 2023). The research was conducted by distributing the Tele-Heart Nursing Care (TNC) application link first to potential respondents. After successfully installing the application, the respondent fills in according to the instructions from the researcher. Then a questionnaire to measure usage and feasibility, namely the System Usability Scale (Scale), was distributed to respondents. SUS considered effective and efficient for testing mobile applications with 10 questions that are comprehensive and considered to represent all aspects of the mobile system assessment (Xiong et al., 2020). After obtaining the results of each respondent, the values obtained will be summed up and averaged. so that the final conclusion will be obtained regarding the score of SUS to assess whether the application is used or not.

Participants and Setting

A total of 10 respondents who met the inclusion criteria were involved in the study conducted at Dr M.Salamun Hospital in June 2024. The respondents who fulfilled the inclusion criteria were as follows: inpatients with a diagnosis of heart failure, have an android mobile phone and can operate it, with an age range of 40-65 years. In addition, researchers also made exclusion criteria, namely: patients who with unstable conditions, such as severe shortness of breath, chest pain, fatigue and uncooperative.

Ethical consideration

In testing this application, researchers are very concerned about research ethics. The first aspect is Respect for Autonomy, where the selection of research samples is carried out voluntarily without any coercion. What the researcher did was to conduct Informed Consent to the patient. In this activity, information is given about the benefits or risks that may arise when respondents participate in the study. The informed consent sheet was handed over to the respondent to sign if they agreed to take part in this study. This refers to the principle

that patients in research are chosen voluntarily, without any coercion or pressure from outside (Pietrzykowski & Smilowska, 2021)

Other ethical principles expected in this study include: Beneficence, Non-Maleficence, and Anonymity as basic principles that must be fulfilled by all researchers in conducting research involving humans (Nii Laryeafio & Ogbewe, 2023). In the principles of beneficence and non-maleficence, the researcher emphasized the benefits of using this app to support patient care. The intervention in this study is likely to be safe because there are no invasive measures, however, there are still risks from excessive use of mobile phones such as radiation hazards. The researcher guarantees the safety of using the application because the screen time required in filling out the TNC application is only around 10 minutes.

The researcher guarantees the confidentiality of all respondents who have been collected, and only reports certain types of data related to the results of the study. The examination results and data entered into the monitoring web, can only be accessed by researchers as the owner and the admin team (IT) who have signed an integrity pact of data confidentiality beforehand. Data is only stored for 6 months on the web for the purpose of processing research data.

Data collection

Data collection begins with the licensing process to the hospital. After the administrative process is complete, the researcher begins to determine the criteria for respondents and selects them using the one shoot method with a cross-sectional approach. Data collection was carried out one by one patient, namely by visiting the ward where the treatment was carried out, then the researcher gave informed consent to the patient or family. The TNC application was distributed to be installed on the patient's mobile phone if the patient agreed to take part in the study. During the process of filling and checking the application, the researcher guided the patient. The use of the TNC application consists of 4 main features, namely Daily monitoring where patients must check Vital Signs (BP, HR, RR, Sa O₂ and BMI), Diet and Fluids, Activity and Exercise and medication maintenance. The next feature is Information and Education which contains Videos and e-Booklets, patients are asked to access these features. The third section is the Counselling feature which contains discussion topics about heart failure problems. And the last feature is the conclusion of the Daily Monitoring that has been filled in by the patient, so that the patient knows his ability to do self-care.

After finishing using the application, the patient is asked to assess the use of the TNC application using the SUS questionnaire which consists of 10 questions. This questionnaire focuses on whether there are difficulties in using mobile phone-based applications, the likelihood of continued use and perceived ease of use. Then, the five responses that users can choose from range from 1 (strongly disagree) to 5 (strongly agree). The results obtained from all respondents were the percentil result show 0-19 (Worst), 2-14 (Poor), 15-59 (Ok), 35-64 (Good), 65-95 (Excellent), 96-100 (Best).

Data analysis

Data analysis was carried out after the questionnaire results were collected from 10 respondents. The researcher reviewed the scores and combined all scores and divided them by the total number of respondents. The average value of this SUS questionnaire is used as a research result by referring to the interpretation of the value according to the SUS guidance. There are 4 ways of interpreting the data in this questionnaire, namely by looking at the average number, letter grade conversion, adjective judgement and also percentiles. Where the average number obtained was 84,1-100 converted to the value A (Best Imaginable), 72,6-84,0 was converted to value B (Excellent), 62,7-72,5 was converted to value C (Good), 51,7-62,6 was converted to value D (Ok), 25,1-51,6 was converted to E (Poor) and 0-25 was converted to value E (Worst) (Cheah et al., 2023)

SYSTEM USABILITY SCALE

	Strongly Disagree			Strongly Agree	
1. I think that I would like to use this product frequently.	1	2	3	4	5
2. I found the product unnecessarily complex.	1	2	3	4	5
3. I thought the product was easy to use.	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this product.	1	2	3	4	5
5. I found the various functions in the product were well integrated.	1	2	3	4	5
6. I thought there was too much inconsistency in this product.	1	2	3	4	5
7. I imagine that most people would learn to use this product very quickly.	1	2	3	4	5
8. I found the product very awkward to use.	1	2	3	4	5
9. I felt very confident using the product.	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this product.	1	2	3	4	5

Figure 1. The System Usability Scale (SUS)

As for this research, the SUS questionnaire used was in Indonesian version with 10 questions (Tedyyana et al., 2022). Participants were asked to rate each of the ten statements based on their experience with the system. They should choose a number from 1 to 5, where 1 means 'strongly disagree' and 5 means 'strongly agree'. To calculate the SUS score, the following steps were used:

- For odd-numbered questions (1, 3, 5, 7, 9), subtract 1 from the user's score.
- For even numbered questions (2, 4, 6, 8, 10), subtract the user's score from 5.
- Multiply the sum by 2.5 to get the final SUS score.

SUS scores can range from 0 to 100, with higher scores indicating better usability. The average level of the *system usability scale* is 68. If the score is below 68, it indicates that there are problems affecting the *usability* level of the system (Hyzy et al., 2022)

SKALA PENGUKURAN PENGGUNAAN SISTEM APLIKASI

(System Usability Scale)

TELE-HEART NURSING CARE (TNC)

Nama Responden :

No. HP :

ID (diisi oleh peneliti) :

Petunjuk Pengisian :

System Usability Scale menggunakan skala Likert satu hingga lima yaitu 1 sangat tidak setuju, 2 tidak setuju, 3 netral, 4 setuju, dan 5 sangat setuju.

System Usability Scale		Sangat Tidak Setuju					Sangat Setuju				
1	Saya rasa saya akan sering menggunakan sistem ini.	1	2	3	4	5					
2	Menurut saya, sistem ini tidak terlalu rumit.										
3	Saya pikir sistem ini mudah digunakan.										
4	Saya rasa saya memerlukan dukungan dari orang teknis untuk dapat menggunakan sistem ini.										
5	Saya menemukan berbagai fungsi dalam sistem ini terintegrasi dengan baik.										
6	Saya pikir ada terlalu banyak ketidakkonsistenan dalam sistem ini.										
7	Saya membayangkan bahwa kebanyakan orang akan belajar menggunakan sistem ini dengan sangat cepat.										
8	Saya merasa sistem ini sangat rumit untuk digunakan.										
9	Saya merasa sangat percaya diri menggunakan sistem ini.										
10	Saya perlu belajar banyak hal sebelum saya bisa menggunakan sistem ini.										

Figure 2 The System Usability Scale (SUS) Indonesia Version

Results

SUS testing in this study was conducted on 10 heart failure patients undergoing treatment at RSAU dr. M. Salamun Bandung. From all respondents after agreeing to the Informed consent sheet, the Tele-heart Nursing Care (TNC) application was downloaded on android mobile-phone. Patients are given guidance from researchers regarding its use and then given an SUS questionnaire to test the use of the application. The following are the test results from 10 respondents:

Number Respondents	Figures SUS	Value Letter	Enter (Qualitative)
1	82.5	A	-
2	78.0	B	Log in use Phone Number, Email no needed
3	75	B	Separate English display only
4	80.5	A	-
5	76.5	B	Usage needs to be assisted
6	79.5	B	-
7	81	A	-
8	80.5	A	
9	80	A	Use of the app should be done regularly

Number Respondents	Figures SUS	Value Letter	Enter (Qualitative)
10	79.5	B	-
Average Grade: 78,6 (B)			

From these results, the average number of SUS scores from all respondents is 78.6 with the acquisition of a letter grade is B. And then it can be concluded that the use of the Tele-heart Nursing Care Application can be used properly by respondents. The SUS questionnaire consists of 10 statements with 5 response options. After getting the results of the questionnaire, calculations are performed to obtain the final SUS score. This value, which is a number on a scale of 0-100, will represent the level of usability of the system being tested. However, scale is not equivalent to a percentage, *usability* is a quality that describes how easy a system is to use (Xiong et al., 2020). SUS has been commonly used to test the usability of various technologies, from software to hardware. Although the value obtained is not an absolute value of the usability of a system, it is a value that measures the usability *perceived* by users. The results of SUS can be used to compare the usability of different designs (Nuswantari et al., 2020)

Item analysis conducted by researchers from 10 questions that the average respondent gave a score of 1-2 (Disagree) on questions number 4, 9 and 10, namely regarding confidence in using application. Almost all respondents expressed a lack of confidence in being able to operate it themselves and needed the help of others. This happens because it is related to the demographic factors of the respondent's age and education level. Almost all respondents in this use test are more than 50 years old with the latest educational background is junior high school. this will also affect the level of patient self-care ability, in line with research from (Locatelli et al., 2022) that age and gender factors of heart failure patients are closely related to the patient's self-care ability. Likewise, educational and occupational factors affect the level of self-care ability of patients (Amiri et al., 2023).

Discussion

From the research results obtained, the average SUS score obtained is 78.6 (B) which means Excellent. Regarding the usefulness of the Tele-Heart Nursing Care (TNC) application, almost all respondents stated that they would use this application and feel the various functions that are well integrated. The benefits of the integration of functions in this application itself are felt to be useful because respondents can easily monitor

Vital Signs and signs of symptoms of disease. Likewise, monitoring diet, activity drugs and exercise are important elements in implementing self-care in heart failure patients so that it will also affect their quality of life (Koirala et al., 2020). With the existence of this application-based monitoring which tends to be easily accessible, it is very possible for patients in to get additional information about their disease so that will be affect the patient's overall health status. This is evident from research (Wang et al., 2024) that the importance of health information for patients with chronic diseases, especially the elderly. So that with the use of TNC, patients can improve their self-care abilities and will also have an impact on the rate of recurrence / rehospitalization of heart failure patients (Mahmoudi et al., 2023).

Although from the patient suggestions there are those who still say that the use of this application needs to be assisted. This is due to variations in the age, education and understanding levels of patients. It is certainly a challenge to develop a more user-friendly model. The use of language in the application also affects, where at the beginning of testing the TNC Digital App still displays 2 languages (Indonesian and English). The features in the application all work well, although when checking vital signs (blood pressure, respiration rate, heart rate and oxygen saturation) there are still problems related to the signal of each mobile phone when measurements are taken through the camera sensor. Screening for these vital signs can be an early detection of worsening in heart failure patients, so the risk of recurrence can be reduced (Fahimi et al.).

Reducing the risk of patient recurrence can also be done by improving patient self-care compliance. Self-care consists of the ability to recognize signs and symptoms, diet, exercise and medication (Johnson et al., 2022). Likewise, the TNC application is equipped with symptom monitoring, where patients can easily choose the answer options by clicking 'yes' or 'no' on the application. When users filled in the Diet, Exercise and Medication monitoring section of the TNC app, there were also no difficulties encountered. Adherence to medication and diet also affects readmission rates, with the less adherent the patient is, the higher the risk of recurrence (Baymot et al., 2022). The next test is on the information, education and counselling section of this TNC application. Where all of these features can be accessed properly by patients.

Adequate information is essential for heart failure patients, given the lifelong nature of the disease. Health literacy in heart failure patients determines the success of treatment program in patients (Bhattad & Pacifico, 2022). The TNC Digital App, which is based on android mobile phones, has also been equipped with educational features for patients. In accordance with previous research that to improve education and information systems with the aim of fostering a positive mindset regarding the importance of self-care, and

assisting patients in self-monitoring symptoms and signs, controlling and managing the disease without regard to time or location restrictions is important for the care of heart failure patients (Johnson et al., 2022).

Using technology to support medication adherence and reinforce healthy behaviors can be a successful program. One promising tool that can aid chronic disease self-management is the use of mobile health technology, which is described as the provision of preventive and medical care through the utilization of mobile devices such as tablets and smart phones (Athilingam et al., 2021). Therefore important to create cutting-edge technologies that support self-care and are easily integrated into clinical practice to increase knowledge, foster self-management capabilities, and improve health-related quality of life to decrease mortality, emergency hospitalizations, and readmissions among this population (de Sousa et al., 2022). By testing the TNC application that contains the features needed by heart failure patients, it is hoped that it can be used easily in the future. The use of the application in large numbers is also expected to increase patient compliance in carrying out Self-Care so that it has an impact on reducing the risk of patient readmissions and which will also have an impact on the mortality rate of heart failure patients.

Conclusions

Usability and Feasibility Testing on the Tele-Heart Nursing Care (TNC) Digital Application using the System Usability Scale (SUS) with an average result of 78.6 with the acquisition of a letter grade is B, it can be concluded that the use of the TNC application can be used properly by respondents. However, in-depth testing with qualitative methods can explore more input from users. Tests conducted on 10 people can also be improved in similar tests for other applications with a minimum number of 10% of the target population / research sample. Based on the results of input from test participants, further improvements will be made to the TNC application in accordance with the suggestions. By focusing on the initial log-in, the use of language and other conveniences that take into account the age aspect of the user.

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