

E-Health Based Heart Failure Intervention: Systematic Literature Review

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ABSTRACT

Patients with heart failure patients. This case in an increased incidence of mortality and rehospitalization. Monitoring and controlling are needed to improve the quality of life and self-care to improve health. The e-health telemonitoring intervention is a breakthrough to overcome this. Purpose: Review e-health telemonitoring interventions in heart failure patients and identify the context, components, and outcome of e-health telemonitoring interventions used in HF patients. Methods: The literature search in this study used a database based Pro-Quest, PubMed, and ScienceDirect. The search was carried out in October-November 2020. The paper keyword: “E-health” OR “Telemonitoring” OR “Remote health monitoring” AND “Intervention” NOT “Treatment” NOT “Therapy” AND “Heart failure” OR “Coronary failure” NOT “chronic obstructive pulmonary disease”. The type of study is Randomize control and trial. The protocols used were PRISMA and JBI to analyze and synthesize this study. Results and Discussion: 6 studies were obtained based on predefined inclusion criteria. The e-health telemonitoring interventions found were interactive telephone calls, websites, applications, electronic devices, and face-to-face calls. While the components of the intervention needed include technology, education, support, and direction. However, some studies show that the outcome is not affected by the intervention (null outcome). Conclusion: E-health telemonitoring is very helpful for improving QoL and self-care in heart failure patients with a combination of several e-health interventions and incorporating all existing intervention components to get maximum results. Some studies show that the outcome is not affected by the intervention (null outcome).

Keywords: E-health, telemonitoring, heart failure, interventions, systematic review

1. INTRODUCTION

Heart disease is the number one killer in the world. The prevalence of increasing heart failure globally currently reaches around 64.34 million cases or about 8.52% of the total population field [1]. The results of the AHA analysis show that the projection of the prevalence of heart failure will increase by 23.7% in 2030 [2]. Prevalence in Indonesia indicates that about 1.5% or around 29,550 people experience heart failure [3].

According to Szymanski, heart failure is a medical condition that results from disruption of the ventricles to fill or bleed. It can be caused by diseases of the myocardium, pericardium, endocardium, heart valves, blood vessels [4]. And some risk factors are not well controlled, including hypertension, diabetes, atherosclerotic disease, or obesity [5]. Heart failure has a significant impact on human physical abilities, affecting the quality of life for heart failure patients. Patients with heart failure experience the lowest quality of life in all areas whether physical, emotional, or social [6].

The closest healthcare provider is indispensable for monitoring, surveillance, and outpatient care programs for heart failure patients [9]. Lack of disease monitoring

and appropriate interventions can lead to increased mortality, resulting in heart failure patients being admitted to the hospital more frequently [10]. The increased mortality of patients with heart failure is increasing due to the need for repeated hospitalizations, and prolonged treatment so that it can burden patients physically and economically on the heart failure treatment system [1].

Health innovations are being carried out, namely by conducting maintenance and monitoring through e-health [11]. E-health is an optimization of the application of the internet and technology in the health sector to increase efficiency, access, and quality used by health services, nurses, doctors, and patients [12]. E-health has been transformed into a breakthrough to improve the quality of life for patients. E-Health is used as a general term that includes e-learning, remote monitoring (i.e. telemonitoring), structured telephone support, telerehabilitation, teleconsultation, and m-health apps [14].

Some of the advantages of e-health include: saving time; if the patient is in an emergency or critical situation, the family can directly communicate with medical personnel to resolve immediately [16]. Improve the

quality of health services by providing accurate, current, and complete information to minimize the number of errors during the diagnosis and intervention [16]. Increasing self-care for patients by sending intervention reminders regularly, is beneficial in providing real-time self-intervention system updates to patients [17]. It covers a broader area allows access to digital health resources and makes it easy to use, especially for remote areas [18].

Previous studies assessed the effects of e-health (telemonitoring) as part of a heart failure management program. Some have shown promising results, but others have demonstrated neutral results in patients with heart failure [17]. Results from previous studies were inconsistent with each other in terms of morbidity and mortality. This can be explained by differences in the e-health interventions used and the heterogeneous nature of the patient population included in the study [19].

Based on this background, the authors would like to discuss the E-Health Based Heart Failure Intervention which aims to explain and analyze e-health telemonitoring interventions used by heart failure patients, explain the results of telemonitoring to heart failure patients, and identify the weaknesses it causes.

2. METHODS

2.1. Research Methods

The research method used in this study is a systematic literature review. Done by identifying, selecting, assessing, and synthesizing relevant empirical evidence to reach conclusive answers to research questions with guidance [21]. This study uses JBI Guideline to reference summary assessments of the field [22]. An evaluation uses PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [23].

2.2. Resources

The search for data in a systematic literature review was carried out in October-November 2020. This systematic literature review uses secondary data as a data source, namely data obtained from previous research [21]. A Literature search using a database, namely the Pro-Quest database, PubMed, and ScienceDirect. The keywords used in this systematic literature review use Mesh (Medical Subject Heading) and Boolean operators (or connectors) OR, AND, and NOT. The keyword: "E-health" OR "Telemonitoring" OR "Remote health monitoring" AND "Intervention" NOT "Treatment" NOT "Therapy" AND "Heart failure" OR "Coronary failure" NOT "chronic obstructive pulmonary disease."

2.3. Inclusion and Exclusion Criteria

The inclusion and exclusion criteria were based on the field PICOS elements [24]. Inclusion criteria study is: The study focused on heart failure patients aged 55-75 years who received the E-Health; A study that examines the provision of e-health interventions, namely telemonitoring given to patients with heart failure; The comparison groups were those who were given other interventions or were not given interventions that were only observed; A study that describes e-health telemonitoring interventions affecting heart failure patients; Randomize control and trial study design; English language paper; 2015-2020 public years.

2.4. Study Selection

Literature search results on the Pro-Quest database, PubMed, and ScienceDirect are done manually by entering keywords according to MeSH and Boolean operators, then for each database filter inclusion and exclusion criteria that have been determined are used. Researchers got 213 articles that matched the specified keywords and filters. Subsequent reports were sent to external citation management software that is Mendeley Desktop Software (v1.19.6) [25] with the NBIB file extension format.

Mendeley's software detected duplication of articles, there were 11 duplications of articles, leaving 202 articles. The next step is to screen titles based on the PICOS framework on the theme of systematic literature review, as many as 58 articles were issued leaving 144 articles.

Then an abstract screening was carried out for 71 excluded articles and the remaining 73 articles. Assessment based on full text and overall eligibility criteria obtained six articles that can be used for systematic literature review. This will be explained in the flow chart diagram (figure 1).

2.5. Risk of Bias

This study uses the analytical appraisal of two reviewers to complete the study. There are 13 questions in The Joanna Briggs Institute Critical Appraisal for study randomized control and trial, in which there is a choice of criteria assessment "Yes", "No", "Unclear" or "Not Applicable". Each criterion that is rated "Yes" will get one point while the others will get zero points. Appraisal critical is used as an assessment score of 50% with value cut-off that has been agreed by the researchers included in the inclusion criteria for data synthesis [22].

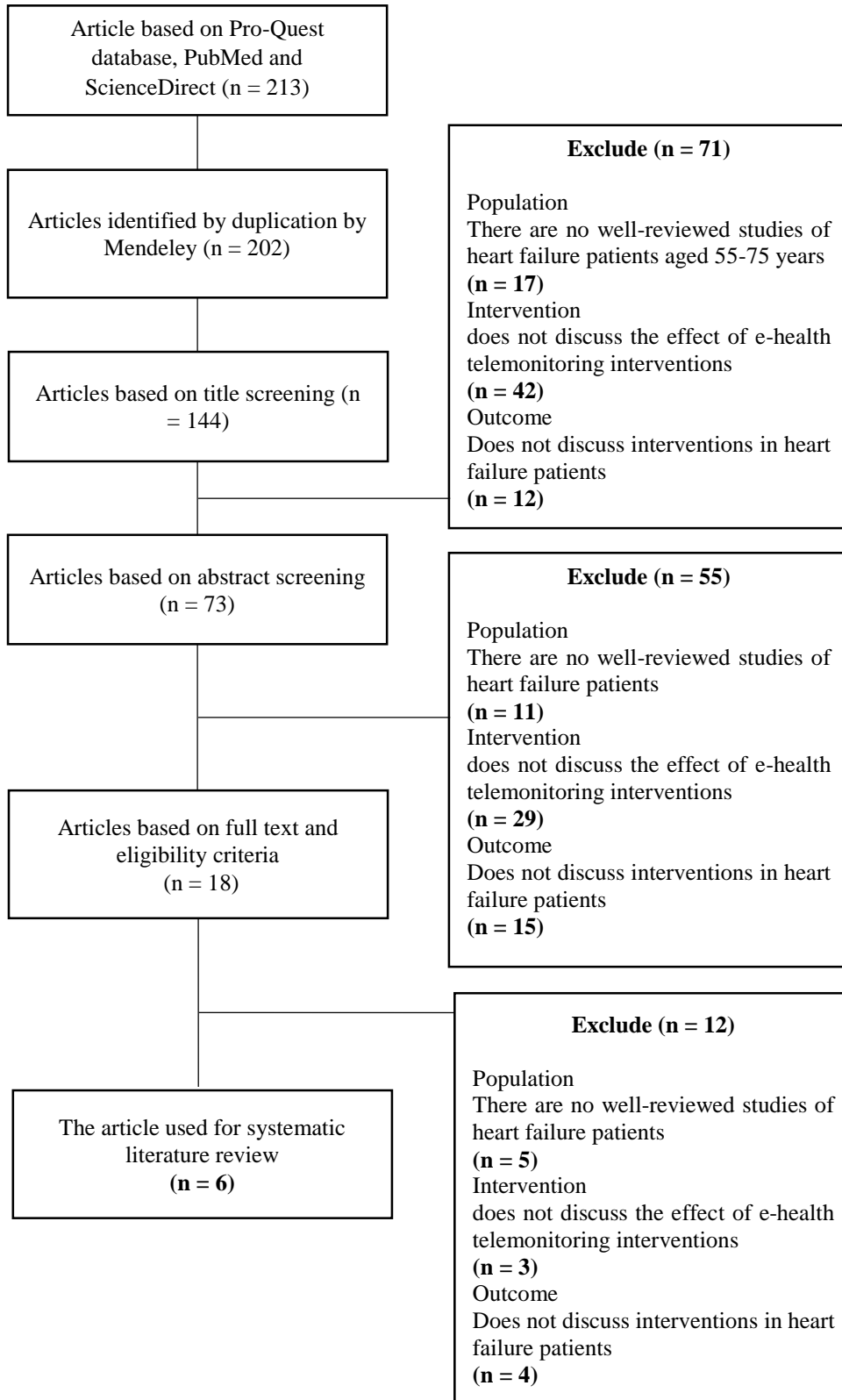


Figure 1. Flowchart of PRISMA literature search and selection

Table 1. Baseline characteristics of patients in the study for systematic literature review

Citations	Journal 1 [19]	Journal 2 [13]	Journal 3 [48]	Journal 4 [49]	Journal 5 [50]	Journal 6 [51]	Total (n = 2335)	%
Gender								
Man	141	334	139	30	316	19	979	41.9%
Women	43	116	44	10	664	22	1356	58.1%
Age								
55-70	184	450	-	40	1437	41	2152	92.1%
71-74	-	-	183	-	-	-	183	0.9%
Habit								
Smoking history	165	432	-	-	-	-	597	25.5%
NYHA								
I	-	183	-	1	-	28	212	9%
II	184	154	83	19	-	9	449	19.2%
III	-	58	100	20	440	2	620	26.5%
IV	-	33	-	-	440	2	475	20.3%
LVEF (%)								
LVEF%	28.25	35.6	35	25	57.8	29.2	-	-
LVEF ≤ 40%	-	70.4	-	-	-	-	-	-
Chronic conditions								
Diabetes	68	110	115	-	663	-	956	41%
Hypertension	144	197	109	40	1161	41	1692	72.5%
Kidney failure	30	69	42	40	586	-	767	32.8%
Hypercholesterolemia	-	146	106	-	-	-	252	10.7%
Pharmacological Therapy								
Aldosterone receptor antagonist	106	186	73	-	277	-	642	27.4%
Diuretic	144	336	162	40	1135	38	1885	80.7%
ACEI	142	352	73	-	798	-	1365	58.4%
Digoxin	29	212	51	-	244	-	536	22.9%
Beta-Blockers	161	327	102	-	1072	-	1662	71%

2.6. Data Extraction

Extraction of data from systematic literature review independently conducted and verified by 2 reviewers. By using a data extraction form based on the PICO component [21].

2.7. Method of Analysis

The method of analysis in this study used descriptive analysis. Descriptive analysis is an analysis that describes and explains the results of research with relevant narratives with relevant questions [26].

2.8. Ethical Considerations

Ethical issues including plagiarism, consent, violation, forgery, multiple publications in this study were fully

observed by the authors. The researcher intends to update the public registry with this review at all phases of its implementation, report any important guidance amendments, and publish the results in a widely accessible journal [27].

3. RESULT

3.1. Study Quality and Risk of Bias

All studies demonstrated significant data analysis and testing results based on quality points totaling 11 to 13 out of 13 points, as a condition for avoiding the risk of bias in the systematic literature review [28].

Table 2. Summary of study interventions

Country	Research design, population	Intervention	Physical Context
Journal 1 Australia	RCT, N = 184 Control group: 93 Intervention: 91	instruction time to perform HF treatment; Logbook Chronic Heart Failure; Every day weighing with electronic scales for 6 months; Computer tab connected Applications Global MedTech; daily interactive telephone calls to patients within 6 months; Collaborative care	Hospital, Research center
Journal 2, Netherlands	RCT, N = 450 Control group: 150 Interventions: 300	Within a year the participants get private doctors and nurses for consultation; within 1 time an explanation and how to use regarding the website and platform; brochure for more complete information; every 3 months in 1 year are reminded to use the web; Every day record body weight, blood pressure and heart pressure; If the condition worsens the patient receives a warning on the platform and the web; interactive telephone; collaborative care	Outpatient Clinic
Journal 3, Italy	RCT, N = 183 Control group: 94 Intervention: 89	Operation of HF patients with CRT-D; The patient's small portable device was connected by a cell phone line to the hospital's Monitoring Service Center for 12 months; within 48 hours of a standard telephone interview by the health center about selfcare; Follow-up visits.	Academic medical center, Hospital
Journal 4, USA	RCT, N = 40 Control group: 20 Intervention: 20	Participants are given the Glow Cap® system within 30 days in a bottle form; the loop diuretic is administered; wireless protocol for; interactive calls for 30 days;	Hospital
Journal 5, California	RCT, N = 1437 Control group: 722 Interventions: 715	Education and training on HF prior to discharge from the hospital; Received 9 training calls by telephone over a 6-month period; weight telemonitoring; blood pressure, heart rate, and symptoms from home with the synchronized device for a period of 6 months;	Hospital, Academic medical center,
Journal 6, USA	RCT, N = 41 Control group: 20 Intervention: 21	Face to face and explanation of the devices used; scheduling home care visits; tri-axial accelerometer wireless watch-based monitoring device for 6 months; measure blood pressure, weight, heart rate every day for 6 months; measurement by TEQ for 6 months;	Hospital, Research center

3.2. Characteristics of Respondents from the Study

Respondents of this study (see Table 1) are inpatients and outpatients suffering from heart failure in hospitals from various countries [2]. The total number of respondents in the study was 2335 respondents. The respondent's age ranges from more than 55 years to 75 years to join the research that has been determined, this is because at that age the immune system starts to decrease and the body's system to repair damaged cells also decreases which results in the emergence of disease [29].

Smoking habits in all minority studies were due to regulations from developed country governments and health awareness [30]. The classification of heart failure severity refers to the NYHA classification, respondents in the study showed the level of NYHA III and IV, which means limited activity with light to reduce the elasticity of the heart arteries, causing damage to the heart [31]. The patient received treatment with diuretics is

dominated for HF and showed improvement of symptoms and cardiac function [32].

3.3. Intervention Component e-health

The components of the 6 study interventions are summarized into 4 groups which include: a) technology; b) Education; c) support, and d) instructions/directions. (See table 2)

The number of components for individual interventions varies widely, namely about 3 to 6 components in one intervention, and is carried out every day for monitoring.

3.4. Intervention Context e-health

Interventions conducted by the study took place in several countries (see Table 2) includes the Netherlands, Italy, the United States of America, and California. Most of the directions on the use of the intervention component were delivered in various places, including hospitals,

outpatient clinics, a research center, academic medical center. All follow-up interventions are carried out in the patient's home. 6 interventions were combined into three delivery contexts, namely through interactive telephone calls, Web or application, several technological enhancements, and face to face.

3.5. Outcome

E-health outcomes telemonitoring in HF patients (see table 3) presents five points: terms of habit, adherence, cognitive, mortality, and economy. As well as produce positive outcomes (outcome main and outcome secondary) and null outcomes (the intervention did not affect the patient / no result).

Outcome the main thing is the increase in self-care which has a significant effect on the QoL of HF patients. It is mentioned that e-health telemonitoring can improve self-care so that QoL in patients HF increases [33]. Outcome secondary like medication adherence, use of electronic devices, patient knowledge, medical personnel have a significant influence. But 2 studies reported that outcome secondary (death, rehospitalization) found that the intervention did not affect the patient / no outcome (Null Outcome).

4. DISCUSSION

4.1. Intervention context

Various kinds of interventions e-health for HF patients who focus on telemonitoring much as time progresses field [34] namely by using telephone HF patients.

But it cannot work with just one intervention. It must combine several interventions to get maximum results [35].

One of the telemonitoring, website, application, electronic system devices, and face-to-face media better impacts interventions that combine electronic devices, collaborative care, and interactive phone calls are conducted by the Research Center e-health in Australia in chronic heart failure patients [19]. This intervention gets outcome the form of HF patients can do self-care, such as daily bodyweight monitoring to assess fluid balance and indicate decompensation. This has been summarized in evidence-based clinical guidelines for HF [36]. Telemonitoring in the context of this study focused exclusively on recording daily body weight. These findings imply the need to expand telemonitoring interventions for comorbid and non-HF critical health conditions related to the health problems faced by HF patients in a more comprehensive manner [37].

Similar research has shown that interventions that rely solely on interactive phone calls can improve quality of life, habits, and knowledge like the findings of this study [38]. However, the rehospitalization and mortality

rates persist given that the NYHA and LEVF factors of heart failure have increased [39]. The telemonitoring intervention carried out is effective and has a positive impact on QoL levels in patients, and is not effective in reducing the rate of rehospitalization.

Website, platform, and application-based telemonitoring interventions combined with other intervention components have been widely used [40]. One of them is integrating websites, applications, phone calls, and face-to-face at the same time [17]. Efficient merging of e-health combined with existing care by replacing routine consultations can reduce the HF nurse's time investment per patient, thus creating more patient care. This incorporation can provide deep patient access to self-care and reduce hospital visits [41]. Intervention systems like this have a positive impact on increasing QoL and adherence to self-monitoring (weighing routinely, measuring oxygenation, daily heart rate) and patient cognitive and nurse and doctor cognitive.

The most recent intervention is the incorporation of system tools with routine consultations, this tool has been used in several developed countries, as a medication adherence reminder system by using an alarm as a reminder. Furthermore, regular consultations are held as medical check-ups and evaluations with a scheduled plan. This system instructs patients with medication adherence to reduce rehospitalization rates [39].

Based on the above summary, the selection of appropriate interventions that provide impactful benefits for E-health is the incorporation of websites, applications, telephone calls, and face-to-face meetings for 6 months. This is because the combination is capable and effective in increasing QoL, self-care, and reducing hospital visits.

Several studies have shown that interventions that have no impact on E-health are system tools with regular consultations for 3 months. This is because it does not show significant results. After all, only routine consultations with the system do not combine other devices, which causes low QoL levels and does not occur in patient self-care.

4.2. Intervention Component

Based on the summarized study, it was found that the key to intervention e-health requires components in the form of technology, education, support, and instructions/directions to produce outcomes effectively [42].

Most interventions can be labeled as complex interventions, larger sample sizes, and mixed methods (technology, education, support, and guidance), which should be considered for outcome evaluation, to obtain

Table 3. Summary of Outcome categories

	Positive Outcome	Null Outcome	Mixed Outcome
Habit	Improved patient self-care at 30 days, 3 months and 6 months nurse / doctor visits	-	Self-care patients; Nurse / doctor support
Obedience	Patient adherence to treatment at 6 months. Using monitoring tools within 30 day, 3 months, and 6 months	Patient non-compliance with the 30-day protocol, 3 months	Medication adherence and monitoring tools
Cognitive	The patient knows HF. Interactive learning for nurses and. 3-month QoL improvement, and 6 months QoL improvement	-	QoL in patients; Patient and nurse knowledge.
Dead	Death within 6 months	Dead cause	Death in patient
Economy	Rehospitalization in 3 months, and 6 months	Rehospitalization in 30 days	Rehospitalization of patients

information on how much a particular component will produce Outcome better

4.3. Outcome

The results obtained in all studies showed positive results that were not influenced by the intervention (null outcome), the positive result was an increase in the patient's QoL as well as an increased self-care that supports heart failure patients in their treatment and monitoring [39]. And also the cognitive enhancement of patients and health workers involved to support further advances in the health sector [42].

Outcome Furthermore, there is still a mortality rate and a rehospitalization rate that still occurs in HF patients. These deaths and rehospitalizations were attributed to higher levels of NYHA and LVEF in HF patients [43]. And the low level of adherence to treatment and intervention in HF patients is a complex problem because non-adherence to treatment is one of the contributions to hospitalized patients recently discharged from the hospital with HF [44].

Joint innovative intervention design and model improvement e-health Experience-based and an approach that focuses on the experience of patients, family members, and health workers are needed for further interventions as a further design model to overcome some shortcomings and the involvement of various parties for intervention design that needs to be redesigned for the future [45].

Applications e-health in Indonesia is very possible due to the development of increasingly advanced technology [46]. HF patients in Indonesia have a low level of education and economic power as well as a desire to obtain adequate health facilities [47] so that e-health Telemonitoring following the circumstances is the incorporation of websites/applications, interactive media for telephone calls, and support for health devices wireless (Bluetooth based weight scale) which is directly

connected to the health center. This refers to the development of smartphones that almost all HF patients have, and health monitoring tools that are readily available so that they can improve self-care and QoL in HF patients in Indonesia [47].

4.4. Limitations

Databased in article searches using filters free access, so it is possible to miss articles in reference searches. Since searches are limited to articles that focus on advanced technology, it is also possible that articles from developing countries are less searchable.

5. CONCLUSION

Intervention e-health especially telemonitoring is necessary for HF patients to undergo the treatment period and monitor their health. Multiple interventions e-health provided is through telephone calls, websites, platforms/applications, and face-to-face or consultations with collaborative care. The components that must be present in the intervention are technology, education, support, and instructions/directions to form outcomes maximally in HF patients. Telemonitoring interventions have a positive outcome that is they can improve QoL, self-care in patients with HF and has a positive impact, namely cognitive enhancement of HF and intervention media for nurses and doctors. But it does not affect the mortality and rehospitalization of HF patients.

The results of this review can be used as data-based for further research and future researchers are expected to review Asian telemonitoring interventions comprehensively. For further research, use a database-based search for articles with paid access to add references to articles.

AUTHORS' CONTRIBUTIONS

This study was developed by LN and DH. The draft script was written by LN and then developed by DH. All

authors contributed to the clinical study design and/or critical revision of the manuscript.

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