Original Article

Designing and Implementing a Telemedicine Program for Patients With Heart Failure at Rajaie Cardiovascular Medical and Research Institute: A Mixed Methods Study

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ABSTRACT

Background: The COVID-19 pandemic has rapidly expanded telemedicine in healthcare. We designed and implemented a telemedicine program at Rajaie Cardiovascular Medical and Research Institute.

Methods: This sequential mixed-methods study was conducted at Rajaie Cardiovascular Medical and Research Institute from April through December 2021 in 3 stages: 1) Findings obtained from a literature review were discussed in expert panel sessions, and a telemedicine program was designed. 2) based on a quasi-experimental method, patients were non-randomly assigned to the experimental and control groups, with the former receiving the telemedicine program for 3 months. 3) The groups were compared concerning the number of hospitalizations, the length of hospital stay, and emergency department visits 3 months after the implementation of the program. Data analysis was performed using SPSS, version 24. The χ^2 test was used for qualitative data analysis, and the *t* and paired samples *t* tests were employed for quantitative data analysis.

Results: The results showed no statistically significant differences between the experimental and control groups regarding the number of hospitalizations, the length of hospital stay, and the number of emergency visits after the implementation of the telemedicine program ($P > 0.05$).

Conclusions: The number of hospitalizations, the number of emergency visits, and the length of hospital stay did not significantly differ between the experimental and control groups after the telemedicine program. ***(Iranian Heart Journal 2024; 25(1): 74-81)***

KEYWORDS: Telemedicine, Heart failure, Hospitalization

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The COVID-19 pandemic has rapidly transformed the way physicians examine and treat patients. [1] The key point in reducing virus transmission is social distancing and reducing personal contact. [2] Since necessary measures to control COVID-19 include social distancing, quarantine, and isolation, healthcare providers face significant challenges in providing care. [3] Under such circumstances, remote work is recommended as much as possible. In the field of healthcare, these conditions have led to the use of telephone counseling and tools that enable virtual medicine. [4] The COVID-19 pandemic has led to a rapid expansion in the use of telemedicine in patient care and medical visits, significantly changing the outlook for telemedicine. [5] Telemedicine provides a new way to support and improve remote care, education, and healthcare from the initial response to the disease to recovery, with low cost and extensive coverage. [6] Telemedicine includes telephone counseling, short message services, and video conferences and is used worldwide, although its benefits and costs are still unknown. [7]

Remote care models, in which the patient is physically distant from the physician or other healthcare providers, are possible through communication technologies. [8] In addition to reducing the risk of infectious disease transmission, telemedicine has shown similar results to in-person visits in many studies. [9] Telemedicine also addresses the ongoing needs of patients with chronic diseases and reduces visits to outpatient clinics. [10]

Among various medical specialties in which telemedicine has been successful, cardiology is one of the most important ones. [11] Remote medical interventions have had benefits for patients with heart failure, reducing hospitalizations and improving the quality of life. [12] Designing such a program is time-consuming and requires resources, budget, and detailed guidelines. The COVID-19 pandemic provided a suitable opportunity for experts in various fields to implement their proposals in this operational area. [13] All countries were encouraged to participate in promoting remote and evidence-based medicine during the COVID-19 pandemic or future pandemics. The COVID-19 pandemic was an alarm for countries that do not have a remote medical system in their national healthcare system to accept the necessary frameworks to support the widespread acceptance of telemedicine. [14]

Therefore, the present study was conducted to design and implement a telemedicine program at Rajaie Cardiovascular Medical and Research Institute with a view to using it as a model for transforming the healthcare system.

METHODS

This study was a sequential mixed-methods study performed at Rajaie Cardiovascular Medical and Research Institute from April through December 2021. Both qualitative and quantitative approaches were utilized during the study. The study was done in 3 stages. The participants in the study were physicians, nurses, managers, academic staff, bioinformatics department staff, patients, and their caregivers.

In the first stage of the study, qualitative content analysis was employed to design the program. The aim of designing this program was to provide virtual visits for patients. To determine the steps of the program, the tasks of the participants, the selection of the virtual clinic program, and the implementation of the program, 2 expert panel sessions were held, each lasting 90 minutes, after the literature review. The participants in this stage included the educational deputy (n=1), cardiologists (n=3), heart failure fellows (n=2), colleagues from the bioinformatics department (n=2), and nurses (n=2). Sampling in this stage was done purposefully. Data collection in this step was initially done through a literature review by the research team. Then, 2 panel

sessions were held with the experts. The findings obtained from the literature review were discussed in expert panel sessions, and with the participation of the experts, an operational plan for telemedicine was designed. In the expert panel sessions, based on the suggestions made by the participants, the operational plan for remote medicine was designed by specifying tasks, activities, facilities, and resources.

The second stage of the study was conducted using a semi-experimental method. The participants in this phase included doctors, nurses, and patients. After designing the telemedicine program, the researcher attended the Heart Failure Clinic of the Rajaie Cardiovascular Medical and Research Institute and enrolled patients with heart failure based on convenience sampling and after obtaining written informed consent. The inclusion criteria included a diagnosis of heart failure, age 18 years or older, having suitable mental and physical conditions to participate in the study, having the necessary facilities to use the designed program, and having the ability to use it. The exclusion criterion was the unwillingness to continue participating in the study. The patients were non-randomly assigned to the experimental and control groups. If they had the necessary facilities and ability to use the designed program, they were placed in the experimental group; otherwise, they were placed in the control group. Afterward, the telemedicine program was implemented for the experimental group for 3 months, during which the patients did not visit the hospital, and their visits were conducted through virtual clinics. The visits for the control group patients were conducted routinely at the hospital.

In the third stage of the study, the telemedicine program was quantitatively evaluated by comparing the clinical outcomes of the experimental and control groups before and after the implementation of the program. The clinical outcomes examined in this study included the number of hospitalizations, the length of hospital stay, and visits to the emergency department. Data collection was performed in the first phase using expert panels and literature reviews. In the second phase, a data collection form was used to record patient information and actions taken during the implementation of the program. In the third phase, data were collected and recorded using a data collection form and clinical outcomes of the patients. Data analysis was performed using SPSS, version 24. The normality of the distribution of variables was assessed using the Kolmogorov-Smirnov test, and skewness and kurtosis indices were calculated. For qualitative data analysis, the χ^2 test was employed, and for quantitative data analysis, the *t* and paired samples *t* tests were used.

RESULTS

In the first stage of the study, based on a literature review and participant suggestions, a telemedicine operational plan was designed. The steps and details of the plan are listed in Table 1.

In the second and third stages of the study (implementation and evaluation of the telemedicine program), of 40 participating patients in the study, 20 (50%) were female, and 20 (50%) had underlying diseases. Six patients (15%) were illiterate and 9 (22.5%) had education below the diploma level. Additionally, 15% of the patients were single, 70% were married, and 15% were widowed. Unemployment was reported in 40% of the study population, and 27.5% were retired. Five percent of the patients lived alone, while 95% lived with their spouse or family. The experimental and control groups were homogeneous in terms of demographic characteristics, and no significant statistical differences were observed between the 2 groups (Table 2). Table 3 shows that 3

months before the implementation of the telemedicine program, the experimental and control groups did not significantly differ vis-à-vis the number of hospitalizations, the length of hospital stay, and the number of emergency visits. Further, after the implementation of the program, no significant statistical difference was observed between the 2 groups concerning the number of hospitalizations, the length of hospital stay, and the number of emergency visits.

Table 4 compares within-group data for the experimental group in terms of the number of hospitalizations, the length of hospital stay, and the number of emergency visits 3 months before and after the implementation of the telemedicine program. In the experimental group, the number of hospitalizations significantly decreased after the implementation of the telemedicine program (P = 0.005). The length of hospital stay also significantly decreased 3 months after the implementation of the program (P = 0.011). The number of emergency visits in the experimental group before and after the program did not have a significant difference (P = 0.545).

Table 5 compares the control group with respect to the number of hospitalizations, the length of hospital stay, and the number of emergency visits 3 months before and after the implementation of the remote medical program. In the control group, no statistically significant differences existed in the number of hospitalizations, the length of hospital stay, and the number of emergency visits 3 months before and after the implementation of the telemedicine program.

Table 1: Telemedicine Program for Patients With Heart Failure: Steps and Detailed Activities

Steps of the Telemedicine Program	Detailed Activities
Designing the telemedicine program	Carrying out a literature review
	Holding 2 expert panel meetings to assess the needs and determine the expected uses of the program
	Designing the program and preparing the steps of the telemedicine program
Preparation of infrastructure for the telemedicine program	Coordination with the Iranian Ministry of Health and Medical Education to use the telemedicine application
	Examining the possibilities of the virtual program and its compatibility with the expected applications raised in the expert panel meetings
	Considering a nurse to select patients and coordinate visits in the virtual clinic
	Training course on using the virtual visit program by the relevant company
	Testing the implementation of the telemedicine program by the nurse and a patient
	Providing feedback on the telemedicine program through the virtual program and determining existing defects
Implementation of the telemedicine program	Selecting patients to participate in the study based on the inclusion criteria by the researcher (coordinating nurse) in the heart failure clinic.
	Holding a training class to teach the use of the telemedicine program to patients in the clinic
	Providing patients with the contact number of the researcher to call if they had any questions
	Registering patient information in the electronic file
	Appointing patients' virtual visits according to their conditions and doctors' diagnosis and recording the information in the electronic file
	Notifying patients by the researcher (coordinating nurse) about the time of the virtual visit by phone
	Connecting patients and doctors to the remote visit program via the Internet Registering a visit and recording patients' history, signs, and symptoms, as well as doctors' recommendations
	Writing an electronic prescription if needed
	Considering a telephone visit as an alternative in case of communication

	interruption
	Determining the next appointment and recording it in the patient's electronic file
	In the event of requests for visits outside the scheduled time, entering the patient into the program

Table 2: Demographic Characteristics of the Studied Patients (N = 40)

Demographic Changes \ Group		Experiment (n=20) n (%)	Control (n=20) n (%)	*P* value*
Sex	Female	10 (50%)	10 (50%)	1.000
	Male	10 (50%)	10 (50%)	
Underlying illness	Yes	9 (45%)	11 (55%)	0.527
	No	11 (55%)	9 (45%)	
Education	Illiterate	2 (10%)	4 (20%)	0.192
	Below diploma	3 (15%)	6 (30%)	
	Diploma	9 (45%)	3 (15%)	
	Bachelor's degree or higher	6 (30%)	7 (35%)	
Marital status	Single	2 (10%)	4 (20%)	0.558
	Married	14 (70%)	14 (70%)	
	Widowed/divorced	4 (20%)	2 (10%)	
Occupation	Unemployed	7 (35%)	9 (45%)	0.903
	Clerk	5 (25%)	3 (15%)	
	Self-employed	2 (10%)	2 (10%)	
	Retired	6 (30%)	5 (25%)	
	Disabled	0	1 (5%)	
Living condition	Alone	2 (10%)	0	0.570
	With spouse	3 (15%)	2 (10%)	
	With son/daughter	2 (10%)	2 (10%)	
	With Family	13 (65%)	16 (80%)	

*χ^2 test

Table 3: Comparisons of the Number of Hospitalizations, the Length of Hospital Stay, and the Number of Emergency Visits of the Studied Patients With Heart Failure Before and After the Implementation of Telemedicine Between the Experimental and Control Groups

Changes \ Group	Experiment (n=20)		Control (n=20)		*P* value**
	Mean	Std. Deviation	Mean	Std. Deviation	
Number of hospitalizations 3 months before the intervention	0.40	0.598	0.30	0.732	0.639
Number of hospitalizations 3 months after the intervention	0.05	0.223	0.40	1.353	0.261
Length of hospital stay (d) 3 months before the intervention	2.90	5.514	1.95	5.725	0.596
Length of hospital stay (d) 3 months after the intervention	0.75	3.354	1.25	3.416	0.643
Number of emergency visits 3 months before the intervention	0.55	0.998	0.40	0.598	0.568
Number of emergency visits 3 months after the intervention	0.40	0.753	0.55	0.998	0.595

** *t* test

Table 4: Comparisons of the Number of Hospitalizations, the Length of Hospital Stay, and the Number of Emergency Visits of the Studied Patients With Heart Failure Before and After the Implementation of Telemedicine in the Experimental Group

Variable	Measuring Status	Mean	Std. Deviation	*P* value***
Number of hospitalizations 3 months before and after the intervention	Before the intervention	0.40	0.598	0.005
	After the Intervention	0.05	0.223	
Length of hospital stay 3 months before and after the intervention	Before the intervention	2.90	5.514	0.011
	After the Intervention	0.75	3.354	
Number of emergency visits 3 months before and after the intervention	Before the intervention	0.55	0.998	0.545
	After the Intervention	0.40	0.753	

***Paired samples *t* test

Table 5: Comparisons of the Number of Hospitalizations, the Length of Hospital Stay, and the Number of Emergency Visits of the Studied Patients With Heart Failure Before and After the Implementation of Telemedicine in the Control Group

Variable	Measuring Status	Mean	Std. Deviation	*P* value***
Number of hospitalizations 3 months before and after the intervention	Before intervention	0.30	0.732	0.541
	After Intervention	0.40	1.353	
Length of hospital stay 3 months before and after the intervention	Before intervention	1.95	5.725	0.320
	After Intervention	1.25	3.416	
Number of emergency visits 3 months before and after the intervention	Before intervention	0.40	0.598	0.453
	After Intervention	0.55	0.998	

***Paired samples *t* test

DISCUSSION

The present study was performed to design and implement a telemedicine program at Rajaie Cardiovascular Medical and Research Institute. The telemedicine program was designed, implemented, and evaluated. The results showed that after the implementation of the program, there was no statistically significant difference between the 2 groups in terms of the number of hospitalizations, the length of hospital stay, and the number of emergency visits. Therefore, virtual visits and telemedicine did not differ in the clinical outcomes of patients. Evaluating the results of remote medical programs during the COVID-19 period indicates that a cost-effective and accessible system does not need to improve clinical outcomes, but it is sufficient not to worsen the care provided by traditional methods. [15] Telemedicine is a low-cost, accessible, and acceptable method for patients and healthcare providers. The COVID-19 emergency conditions not only facilitated the use of this technology in crises but also increased its accessibility, safety, and effectiveness in the primary and specialized care system. [16] With improved monitoring, management, and treatment of patients, telemedicine will be considered an advancement in the strategy of caring for patients with heart failure. The implementation of telemedicine has been accelerated during the COVID-19 period and will improve in the future. [17] A systematic review study in 2015 compared the impact of telehealth, including video conferencing and remote monitoring, with the results of in-person and telephone visits for diabetic and patients with heart failure, and similar clinical outcomes were observed, [18] which is consistent with the present study. In the electronic health system, access to necessary bandwidth is essential, which poses challenges for marginalized individuals, those without internet access, and vulnerable groups who

cannot afford the cost. [6] In the present study, these services were not available to all patients. Those who had access to the Internet and smartphones and were capable of using them were included in the intervention group. Individuals slower to adopt innovation are older people with less education and lower economic and social status. Reaching these people through telemedicine requires significant effort. [19] Telemedicine should not be deemed a possible or additional option for responding to emergencies but rather a preventive approach to ensure the continuity of care for patients with chronic diseases. [20]

CONCLUSIONS

This study showed that after the implementation of a telemedicine program, no significant statistical difference was observed between the experimental and control groups vis-à-vis the number of hospitalizations, the length of hospital stay, and the number of emergency visits. Therefore, considering that the outcomes of patients with heart failure participating in the telemedicine program did not differ significantly from those who visited the clinic in person, telemedicine can be used to save time and visit patients with heart failure during pandemics.

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