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Pilot Study

Telemonitoring of Heart Failure Patients and Their Caregivers: A Pilot Randomized Controlled Trial

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Heart failure (HF) is the leading cause of rehospitalization in older adults. The purpose of this pilot study was to examine whether telemonitoring by an advanced practice nurse reduced subsequent hospital readmissions, emergency department visits, costs, and risk of hospital readmission for patients with HF. One hundred two patient/caregiver dyads were randomized into 2 groups postdischarge; 84 dyads completed the study. Hospital readmissions, emergency department visits, costs, and days to readmission were abstracted from medical records. Participants were interviewed soon after discharge and 3 months later about effects of telemonitoring on depressive symptoms, quality of life, and caregiver mastery. There were no significant differences due to telemonitoring for any outcomes. Caregiver mastery, informal social support, and electronic home monitoring were not significant predictors for risk of hospital readmission. Further studies should address the interaction between the advanced practice nurse and follow-up intervention with telemonitoring of patients with HF to better target those who are most likely to benefit. Prog Cardiovasc Nurs. *2008;23:18–26.* ©*2008 Le Jacq*

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Heart failure (HF) is the leading cause of hospitalization for persons older than 65 years and often necessitates assistance from family caregivers.[1,2] Approximately 40% of older adults are readmitted within 3 months postdischarge, resulting in significant health care costs.[2,3] Indeed, more than one million hospitalizations attributed to HF cost the patient and United States health care system over $27 billion a year.[1] Hospitalizations related to HF are complicated by the aging process, comorbidities, and psychosocial concerns that affect successful management.[2]

In a study of patient outcomes post–hospital discharge, Naylor and colleagues[4] demonstrated that the use of advanced practice nurses (APNs) was effective in improving outcomes for patients with HF. The feasibility of adapting this approach is limited, however; costs for home visits by an APN are high, a shortage of APNs employed in home care exists, and funding for home care has decreased with the Medicare Prospective Payment System.[5]

An alternative strategy for promoting self-management of HF is the use of electronic home monitoring (EHM). EHM is a form of telemedicine in which medical/nursing management interventions are provided to individuals at a distance from the health care provider.[6] The primary objective of this pilot study was to examine the effectiveness of postdischarge telemonitoring by an APN on reducing subsequent hospital readmissions, emergency department (ED) visits, and costs and increasing the time between discharge and readmission among older adults with HF. Secondary objectives were to examine depressive symptomatology, quality of life, caregiver mastery, and social support for patients with HF.

BACKGROUND

Older adults with HF face a high risk of early hospital readmission within 3 to 6 months of discharge.[2,3] Upon hospital discharge, patients may encounter problems related to depressive symptoms, threatened quality of life, availability of informal and formal social support, and how they are monitored at home.[2] Family caregiving is affected by how one copes with problems and resources available.

Researchers found that patients with cardiovascular disorders including HF have a high prevalence of depressive symptoms or feelings of hopelessness, with rates reported from 24% to >40%.[7,8] Depressive symptoms were linked to increased hospital readmissions, number of comorbidities, impairment in activities of daily living, and the need for informal social support.[7–9]

HF has an enormous impact on the quality of life for patients because it is a chronic condition without a cure. According to the National Academy on an Aging Society,[10] persons with heart disease are less satisfied with their lives than the general population.

How patients adapt to a therapeutic regimen is strongly influenced by how they live within their disability.[11] In one of the few published studies that has examined quality of life in patients with HF that received post–hospital discharge case management, Pugh and colleagues[12] reported that quality of life scores were more favorable among those who received intensive postdischarge collaboration with their providers than those who received usual care. Furthermore, Goldberg and associates[13] found that patients with HF who had access to in-home telemonitoring had a slightly greater improvement in quality of life than those who received standard care.

Caregiver mastery may be viewed as a personal resource that directly and indirectly affects the relationship between patient stressors and outcomes. Caregiving mastery includes the expectation that one is capable of coping with problems.[14] In a rare study about caregiving skills, Scott[15] related that caregivers of patients with HF described both positive and negative components of receiving technologic care. While caregivers found satisfaction from caregiving, they feared the responsibilities of learning to use new technology. This learning may be associated with caregiver mastery.

External resources in this study included informal social support provided by family and friends and formal social support from home health care and EHM by an APN. Although families provide 80% to 90% of informal social support,[16] there is a dearth of studies about the relationship of informal social support and patient outcomes. Schwarz and Elman's[17] findings suggested that informal social support significantly reduced the risk of hospital readmission in patients with HF. Formal social support such as home care is a vital resource for patients with HF because of the patient's associated functional decline and need for education. Stewart and colleagues[18] reported that those patients receiving a structured home visit from a cardiac nurse 7 to 14 days after discharge had fewer unplanned hospital readmissions. Other researchers found that a comprehensive treatment program consisting of individualized home visits improved quality of life and decreased hospital readmissions and costs for patients with HF.[19]

An EHM system is typically monitored by an APN but does not replace direct home care visits. Rather, telemonitoring provides more frequent (eg, daily) surveillance of important clinical parameters that allows for more rapid intervention, which theoretically in turn would delay or prevent ED visits and hospital admissions.[20] Some researchers reported that the home telecare intervention had significantly reduced hospital readmissions, ED visits, and costs postdischarge.[20–22] In addition, Roglieri and colleagues'[23] findings indicated that a comprehensive program of patient education and telemonitoring by phone significantly reduced hospital admissions and readmissions. Using a daily EHM system, Goldberg and coworkers[13] found no significant differences in the overall time to death or first rehospitalization, however, and McManus[24] found no significant differences in hospital readmissions that were attributed to telemonitoring. Although most of the previous studies were randomized control trials,[13,20,21,24] they differed on patient age, technology used to monitor patients, means of data collection, and analyses of data.

Given the need to examine alternative methods to survey and monitor patients with HF in the home in a time of limited health care personnel, we examined the effectiveness of telemonitoring with an APN in a randomized clinical trial. The research hypotheses were as follows:

- Hypothesis 1: Hospital readmissions, ED visits, and costs of care will be significantly lower for HF patients with EHM as compared with usual care.
- Hypothesis 2: Rates of depressive symptoms will be lower, but days to readmission and measures of quality of life and caregiver mastery will be significantly higher in the EHM group compared with usual care.
- Hypothesis 3: Caregiver mastery, informal social support, and EHM will significantly reduce the risk of hospital readmission for patients with HF.

METHODS

Setting and Sample

This pilot study was conducted at a 537-bed tertiary teaching hospital in Northeastern Ohio. The study was reviewed and approved by the institutional review board at the participating hospital.

Potential participants for the study included patient/caregiver dyads who met the following criteria and routinely used the participating hospital. The patients, aged 65 years or older, had a diagnosis of New York Heart Association (NYHA) classification II, III, or IV HF[25] and were functionally impaired in at least 1 activity of daily living (ADL) or one instrumental activity of daily living (IADL), necessitating assistance of a family caregiver. They received home care from the participating home care agency if it was ordered by their physician, had Medicare eligibility and an operating telephone line, and were able to speak English. Classic symptoms of clinical HF are shortness of breath and fatigue, and abnormalities of systolic and diastolic dysfunction may coexist.[25] The principal investigator (PI) validated the diagnosis of systolic and/or diastolic HF with chart review of the cardiologist's impressions related to signs and symptoms of HF, ejection fraction and/or the echocardiography report after gaining oral consent from the patient before hospital discharge.

Exclusion criteria included planned discharge to a nursing home, inability to be interviewed because of physical illness, current use of a telemonitoring scale, inability to be contacted postdischarge, receiving regular infusions or dialysis, NYHA class I, independence in performing ADLs, no caregiver, use of hospice care, client of nonparticipating home health care

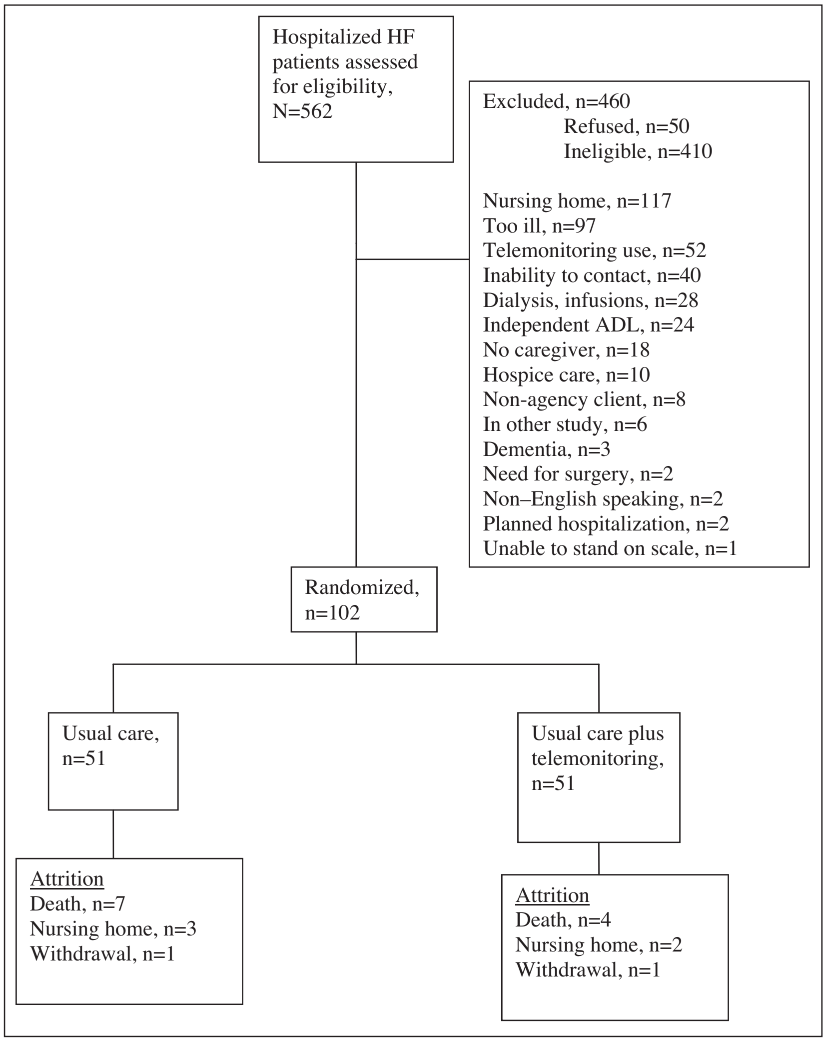

Figure. Algorithm of study participants who were screened for eligibility.

agency, participation in another study, dementia, planned surgery, inability to speak English, planned hospitalization, and inability to stand on a scale. Inclusion criteria for caregivers included being cognitively intact, having a familial relationship to the patient, and providing assistance with at least 1 ADL or 1 IADL. Overall, 562 patients were screened for eligibility (Figure). Of these, 152 (27%) were eligible; 102 (67%) agreed to participate.

Sample size determination was based on the reported difference (22%) in the proportion of patients readmitted in the control group vs the intervention group within 3 months of hospital discharge.[19] The targeted enrollment was 84 patient/caregiver dyads using a power of 80% and a one-tailed test of significance with α set at .05. Of the 102 dyads enrolled, 84 (82%) completed the study; 40 in the usual care group and 44 in the intervention group. Attrition was equivalent between groups.

Procedure

Institutional review board approval was obtained, and cardiologists and internal medicine physicians gave written permission for their patients to be identified and enrolled. Potential participants were identified by the HF care manager with the assistance of care managers in 4 hospital units. While making daily rounds, the HF care manager informed potential participants about the study and gained oral permission for the PI to contact them before hospital discharge. Prior to discharge, the PI briefly explained the study to the patient and/or caregiver, provided a letter of explanation, and received oral consent for a chart review to verify whether they met study criteria. Patients provided their phone numbers for contact upon discharge. Participants were randomized to usual post–hospital discharge care or to usual care with a telemonitoring scale by drawing from a preprepared, sealed envelope.

Participants were interviewed in their homes within 10 days of hospital discharge and 90 days later by trained registered nurses (RNs) who were not part of postdischarge care. To maintain inter-rater reliability, checks were conducted periodically throughout the study and maintained at >90% agreement. Written informed consent and Health Insurance Portability and Accountability Act (HIPAA) authorization were provided by patients and caregivers at the first interview. During data collection, patients received all standard treatments and services ordered by their primary physicians/cardiologists.

Participants randomized to the intervention group received the Cardiocom EHM system (Cardiocom, LLC, Chanhassen, MN) at the first interview, and the nurse removed the equipment 90 days later, at the second interview. The HF care manager trained the PI about use of the EHM system and ensured its availability. The RN data collector was further trained by the PI about the equipment and taught the patient/caregiver dyad how to use the EHM system. The PI met with the HF care manager weekly to discuss technical issues with the equipment. On occasion, the PI called patients soon after placement of the scales to inquire whether they had any difficulty understanding instructions for its use.

EHM System

The Cardiocom EHM system was leased to the research team during the study period, and patients were not responsible for charges. The RN data collector placed a weight scale in the participants' homes and connected via the telephone line to a computer system in the collaborating hospital. The data-receiving computer was positioned in an office on the telemetry unit of the study hospital. The EHM system was programmed to measure weight on a daily basis. The display on the device asked the participants to answer "yes" or "no" to questions about shortness of breath, cough, fatigue, swelling, chest discomfort, urination, exercise, dizziness, medication use, and sodium intake. The computer stored each patient's electronic health file and automatically displayed clinical variances when prescribed parameters exceeded predetermined ranges. Variances included failure to call daily, changes in symptoms, and weight outside prescribed parameters. The Cardiocom Telescale (Cardiocom, LLC, Chanhassen, MN) is accurate to ±0.1 lb and detects as little as 45 mL of fluid gain (D. Consentino, oral communication, February 8, 2002). The HF care manager, an APN, was responsible for daily monitoring of parameters received electronically. When participants had measurements outside of prescribed parameters, the monitoring nurse called the caregiver in the dyad to further assess the situation, provide education, and update the medication regimen. In addition, the APN notified the primary physician or cardiologist about the patient's status as needed.

Variables and Measures

Demographics such as age, sex, education, race, socioeconomic status, and perceived health of the patient and caregiver were measured by self-report at baseline. Hospital readmissions, defined as unplanned hospital readmissions for HF symptoms within 3 months post–hospital discharge, were collected by medical record review after 90 days postdischarge. Emergency department visits for HF were ascertained through medical record review after 90 days' postdischarge. Days to readmission were used as a measure of risk for hospital readmission. Days to readmission, defined as the number of days between the date of initial hospital discharge and the first readmission to the hospital, was assessed through medical record review after 90 days' postdischarge.

Physiologic health indicators, blood pressure, apical pulse, weight, and oxygen saturation were assessed by the PI or research RN at baseline and 3 months later. Comorbidities and prescribed medications were abstracted from the medical record before hospital discharge and were confirmed at baseline. Use of home health care was documented with a computerized chart review after 90 days' postdischarge. Severity of HF was assessed subjectively by the PI or research RN using the NYHA functional class[25,26] at baseline and at 90 days' postdischarge.

Functional status was measured as the ability to perform ADLs and IADLs at baseline and 90 days' postdischarge. The ADL tool[27] consists of 6 items (eating, dressing, bathing, transfers, incontinence, and toileting) and is scored from 0 (totally independent) to 2 (totally dependent). The ADL Index has a Cronbach's α of 0.82 for hospitalized older adults.[28] Seven items from the IADL scale[29] (eg, cooking, housekeeping) were scored similarly. The IADL scale has a high reproducibility coefficient of 0.96 and inter-rater reliability of 0.87.[29] The ADL and IADL sum score range is 0 to 26. Spector and Fleishman[30] demonstrated the feasibility and validity of combining the 2 scales with a sample of functionally disabled older adults and reported that the correlation between the IADL scores and ADL scores was 0.70. For this sample, Cronbach's α was 0.85 for the combined scale.

Depressive symptomatology was measured using the Center for Epidemiological Studies Depression Scale (CES-D)[31] at baseline and 90 days' postdischarge. Participants rated 20 items on a 4-point Likert scale from 0 ("rarely") to 3 ("most or all of the time") with a possible range of 0 to 60. Higher scores indicate more depressive symptoms. The CES-D demonstrated excellent psychometric properties in community samples.[31,32] In this sample, Cronbach's α at time 1 and time 2 were 0.89.

Quality of life, defined as patient's perceptions of the effects of HF on one's life, was measured with 18 items from the Minnesota Living with HF questionnaire (MLWHF)[11,33] at baseline and 90 days' postdischarge. The MLWHF measures individuals' perceptions of the ways in which symptoms of HF have impacted their lives in the past month. Since the majority of patients were older and not employed and depression was assessed with the CES-D, questions about working, sexual activities, and depression were eliminated from the original scale. Eighteen items were rated on a 6-point Likert scale from 0 ("no") to 5 ("very much"), with a possible range of 0 to 90. A higher score indicated more symptomatic impact on one's life. For this sample, Cronbach's α coefficients at time 1 and time 2 were 0.91. Rector and Cohn[33] reported that the MLWHF was a valid patient self-assessment of the therapeutic benefit of medical therapy.

Caregiver mastery, defined as a positive view of one's ability to provide care, was measured with the mastery subscale from the Philadelphia Geriatric Center Caregiving Appraisal Scale (PGCCAS)[34] at baseline and 90 days' postdischarge. Six items assess the likelihood of caregiver uncertainty about how to provide care, reassurance that the patient is receiving proper care, feeling on whether they should be doing more for the patient, feeling that they are doing a good job of providing care, perceptions about capability of dealing with problems as they arise, and identifying the patient's needs. Caregivers rated 6 items on a 5-point Likert scale from 1 ("never") to 5 ("nearly always"), with a possible range of 6 to 30. Higher scores indicated greater mastery. Studies demonstrated moderate Cronbach's α coefficients ranging from 0.61 to 0.73.[34,35] For this sample, Cronbach's α was 0.65 at time 1 and 0.70 at time 2.

Table I. Participant and Caregiver Characteristics at the Index Hospital Visit by Study Group (N=102)

PATIENT	INTERVENTION GROUP (N=51)	USUAL CARE GROUP (N=51)	*P* VALUE
Age, y	77.1±7.3	79.1±6.9	.17
Female[a]	22 (43)	31 (61)	.07
White[a]	41 (80)	42 (82)	.56
Married[a]	36 (71)	28 (55)	.25
High school graduate or higher[a]	42 (82)	25 (49)	.01
ADL[b]/IADL[c]	6.5±4.9	8.1±4.1	.08
NYHA class II[a]	12 (24)	9 (18)	.74
NYHA class III[a]	23 (45)	26 (51)	
NYHA class IV[a]	16 (31)	16 (31)	
Comorbidities	4.2±2.4	4.9±2.1	.14
Current medications	10.2±4.5	9.9±3.7	.79
Heart medications	5.6±1.9	5.4±2.0	.51
Cardiologist[a]	46 (90)	41 (80)	.16
CAREGIVER			
Age, y	63.9±15.4	63.0±16.7	.76
Relationship			.12
Spouse[a]	32 (64)	22 (43)	
Child[a]	13 (26)	16 (31)	
Other[a]	5 (10)	13 (26)	

Values are expressed as mean ± SD unless otherwise indicated. [a]Value is No. (%). [b]Functionally impaired in >1 activity. [c]Functionally impaired in 1 activity. Abbreviations: ADL, activities of daily living; IADL, instrumental activities of daily living; NYHA, New York Heart Association.

Informal social support, described as instrumental activities performed by families and friends, was measured with the tangible subscale from the Modified Inventory of Socially Supportive Behaviors Scale (MISSB)[36] at baseline. The tangible subscale reflects activities such as receiving a monetary loan. Caregivers rated 9 items on a 4-point Likert scale from 1 ("never") to 4 ("very often"), with a possible sum score of 9 to 36. Higher scores indicated more informal social support. Cronbach's α coefficients ranged from 0.71 to 0.92 in studies of caregivers of patients who were recently hospitalized.[17,32] For this sample, the Cronbach's α coefficient was 0.90.

Cost of care was calculated for the 90-day period post–initial hospitalization. Charges posthospitalization were calculated by tracking billing charges for rehospitalization, emergency department visits, and charges for usual home care from the provider of home health care. Costs of care for the EHM group included the former charges plus the additional monthly charge of renting the monitoring system. Charges for usual home care were calculated by multiplying the standard charge data times the number of visits by the RN (at $155 per visit), home health aide (at $85 per visit), social worker (at $165 per visit), and physical therapist, occupational therapist, dietitian, or speech therapist (at $140 per visit). Supply costs averaged $38.50 per episode of care. Charges for EHM were calculated for direct costs of placement of the Cardiocom unit ($165). Data for reimbursement for the telemonitoring specialist were not available and, therefore, not included. In addition, out-of-pocket expenses for services posthospitalization were determined by calculating the number of physician office visits and instances of laboratory work and assigning a co-pay of $12.

Data Analyses

Descriptive and comparative analyses were performed using SPSS for windows, version 13 (SPSS, Inc, Chicago, IL). Descriptive statistics, frequencies, and measures of central tendency and dispersion were used to describe the sample. Associations between variables were analyzed with Pearson correlation coefficients for interval variables and the Spearman correlation coefficient for ordinal variables. Means were substituted for the relatively few areas of missing data. The effectiveness of the intervention was examined by using an intention-to-treat analysis; α was set at ≥.05. Outcomes were examined between the 2 groups using chi-squared likelihood ratio tests for categorical variables, *t* tests for approximately normally distributed variables, and Wilcoxon rank sum tests for skewed variables. Subgroup analyses were conducted, comparing the intervention and usual care groups by risk status.

Survival analysis with Cox proportional hazard modeling[37] was used to assess risk for hospital readmission by the number of days between discharge and first readmission. Cox proportional hazard modeling accommodates for the

Table II. Subsequent Hospital Readmission, ED Visits, and Cost of Care by Group (N=84)

Variable	Intervention Group (n=44)	Usual Care Group (n=40)	*P* Value
Hospital readmission	0.32±0.6	0.33±0.6	.90
ED visits	0.34±0.6	0.38±0.5	.73
Costs of care, US $	12,017.99±29,405.65	6,673.29±10,258.28	.28

Values are expressed as mean ± SD. Abbreviation: ED, emergency department.

censoring of information and accounts for the competing risk.[17,37] The pool of potential predictors of risk for hospital readmission specific to the dyad included caregiver mastery, informal social support, and EHM. The multivariable model was derived using multiple model building techniques: backward elimination with α=.05 stay criteria, stepwise with α=.25 enter criteria, and α=.05 stay criteria to identify independent predictors of days to readmission.

RESULTS

Participant Profile

One hundred two patients were originally enrolled in the study; 51 in the EHM group and 51 in the usual care group. The mean age of the entire sample was 78.1 years with a range of 65 to 94 years. Fifty-two percent (n=53) were women. Participant characteristics at the time of the baseline visit in the hospital are shown in Table I. Education level was significantly higher for patients in the intervention group (χ^2=18.5; *P*=.01). At baseline and 3 months later, there were no significant differences between groups for prescribed use of angiotensin-converting enzyme inhibitors, β-blockers, digoxin, or diuretics.

Twenty percent of the participants (n=20) had implanted defibrillators. Significant differences existed for use of defibrillators between the intervention (n=14) and usual care (n=6) groups at baseline (χ^2=3.98; *P*=.05). At 90 days' postdischarge, differences for defibrillators were similar between the intervention (n=13) and usual care (n=6) groups (χ^2=2.53; *P*=.11). Twenty percent of patients without defibrillators did not finish the study. The number of hospital readmissions was similar between those with and without defibrillators (*t*=–1.3; *P*=.19). Use of home care, total number of home care services, and informal social support were similar between intervention and usual care groups (*P*=.32, .66, and .74, respectively).

The total sample reported having multiple comorbidities: hypertension (51%), diabetes (50%), atrial fibrillation (30%), myocardial infarction (29%), stroke (13%), bypass surgery (28%), chronic obstructive pulmonary disease (29%), and cancer (6%), and groups had similar comorbidities (χ^2=12.13; *P*=.28). Systolic blood pressure at baseline ranged from 84 to 180 mm Hg with a mean of 127.56±19.21 mm Hg, and diastolic blood pressure ranged from 50 to 100 mm Hg with a mean of 69.3±9.74 mm Hg. Heart rate ranged from 40 to 110 beats per minute (bpm) with a mean of 71.39±11.4 bpm. Oxygen saturation ranged from 86% to 98% with a mean of 94.9±2.36%. Weight ranged from 85.6 \ to 372.5 lb with a mean of 179.14±49.53 lb. Caregivers reported providing assistance from 1 month to 27 years with a mean of 4.5±5.5 years.

Patient/caregiver dyads that completed the study (n=84) did not differ from those who did not (n=18) on demographic characteristics, physiologic health indicators, severity of illness, depressive symptomatology, quality of life, informal social support, caregiver mastery, or cognition. Patients not completing the study were more dependent in ADLs and IADLs than those who completed it (10.8±4.1 vs 6.6±4.3; *t*=–3.67; *P*<.001).

Electronic Home Monitoring

The majority of participants in the intervention group (91%) reported using the EHM system on a daily basis during the 90-day post–hospital discharge monitoring period. According to the APN's report, however, the majority of patients (93%) did not use the EHM system on at least 1 day. The mean number of days that EHM system was not used was 16.1±17.9 days for the investigation group with a range of 0 to 66 days. The APN called the majority of patients (95%) about symptoms that exceeded the parameters on at least 1 day during the 90-day monitoring period. The average number of days that the APN called patients in the intervention group who reported symptoms that exceeded the prescribed parameters was 26.7±21.14 with a range of 0 to 77 days.

Hospital Readmissions, Emergency Department Visits, and Costs of Care Between Groups

Table II displays subsequent hospital readmissions, emergency department visits, and costs 90 days' postdischarge. There was no difference in hospital readmission between the intervention (n=12) and usual care (n=13) groups (χ^2=0.27; *P*=.60). Hospital charges alone did not differ significantly between intervention and usual care groups ($10,996.86±$29,230.05; $5,462.58±$9,825.00, respectively; *P*=.26). In addition, out-of-pocket costs for medications, physician office visits, and laboratory testing were similar between groups.

Depressive Symptoms, Days to Readmission, Quality of Life, and Caregiver Mastery Between Groups

Table III displays depressive symptoms, days to readmission, quality of life, and caregiver mastery among the intervention and usual care groups at 90 days' postdischarge. While differences existed between groups

Table III. Depressive Symptoms, Days to Readmission, Quality of Life, and Caregiver Mastery at 90 Days by Study Group

Variable	Intervention Group (n=44)	Usual Care Group (n=40)	*P* Value
Depressive symptoms			
At baseline	8.7±8.9	6.8±8.9	.32
At 90 days	8.2±11.2	6.6±6.7	.44
Days to readmission			
At baseline			
At 90 days	40.6±31.3	41.2±24.0	.96
Quality of life			
At baseline	39.5±23.3	35.8±21.5	.46
At 90 days	27.4±21.7	27.3±21.6	.98
Caregiver mastery			
At baseline	24.7±3.3	26.3±3.7	.05
At 90 days	25.2±3.8	25.8±3.0	.38

Values are expressed as mean ± SD.

at baseline with regard to caregiver mastery, there were no differences between groups for any outcome at the 90-day follow-up visit. For those readmitted to the hospital, days to readmission were similar between the intervention and usual care group (40.6±31.3; 41.2±24.0, respectively; P=.96). For the entire sample, quality of life improved significantly from baseline to the 90-day follow-up visit (t=3.9; P<.0001).

Caregiver Mastery, Informal Social Support, and Telemonitoring as Predictors of Reduced Hospital Readmission

Cox proportional hazards regression modeling was used to identify independent predictors of risk for hospital readmission in days. Independent variables included caregiver mastery, informal social support, and telemonitoring (yes/no). None of these predicted risk of hospital readmission.

DISCUSSION

Aging of the US population and concomitant increase in the prevalence of HF dictate the need for strategies to improve self-care management and minimize costly health service utilization. This pilot study examined whether the addition of an EHM system and APN responder to usual postdischarge home care would reduce number of hospital readmissions, emergency department visits, health service charges, and risk of readmission among older patients with HF. In addition, we examined whether more frequent surveillance and contact with patients and their caregivers would decrease depressive symptoms, increase days to readmission, improve quality of life, and increase caregivers' sense of mastery in the management of HF. We found no significant health care consumption or psychological benefit to patients by adding telemonitoring in the health service.

The overall lack of effect of our intervention might be related to several issues, including the experience of the current cohort of older adults and the nature of their illness. Baby boomers are more experienced with technology and they may desire more sophisticated means of monitoring their health as they age. A higher proportion of our patients (79%) were classified as NYHA class III or IV as compared with an earlier study by Schwarz and Elman.[17] Newer therapies added to traditional medical therapy have led to improvements in function, exercise capacity, and quality of life in many studies of patients with mild to moderate HF.[25] In this study, equivalency in hospital readmission and emergency department visits among groups may reflect the natural history of HF for patients with a clinically advanced state.[13] Management of HF is further compounded by many psychosocial and economic factors that cannot always be measured.[2] Furthermore, since the APN was not always available on weekends, monitoring by phone may have varied within the intervention group.

Although Jerant and associates[20] and Benatar and colleagues[21] found that telemonitoring reduced hospital readmissions and emergency department visits, our findings are consistent with the lack of effect of telemonitoring found by Goldberg and colleagues[13] and McManus.[24] Compared with the reports of Jerant and coworkers[20] and Bentar and colleagues,[21] our patients were older and may have had less chance to respond optimally in the short follow-up time. Jerant and associates[20] followed patients for 180 days; thus, a 90-day follow-up may not have been adequate to educate patients and their caregivers about self-care and adherence to the plan of care.

Similar to Pugh and colleagues'[12] findings but contrary to others,[20–22] costs post–hospital discharge did not differ significantly between groups. For the present study, a member of the research team was able to access hospitalization costs for readmissions. Costs were not categorized by physician visits, supplies, tests, etc. Although telemonitoring did not save on costs for health services, costs related to saving time should also be considered. Future research is needed to learn more about EHM as a convenience to patients, especially those who are homebound, travel frequently, are socially isolated, have transportation costs associated with office visits, or work outside the home during typical physician office hours. Telemonitoring offers health care providers and patients interaction at a distance, when away from home, and at the convenience of both parties.

Depressive symptoms and caregiver mastery have rarely been studied in patients receiving a home monitoring intervention. Depressive symptoms were low and caregiver mastery was high in both groups and did not differ significantly due to EHM. These findings concur with those of Friedman and Griffin[38] who found that patients were not generally depressed. Contrary to the findings of Benatar and colleagues[21] and Bondmass and coworkers,[22] quality of life scores did not differ significantly between groups. Reasons for these findings may be related to the length of time that family members had been providing care and the type of care provided. Most patients in this sample had been living with HF or required assistance from a caregiver for an average of 4 years. Caregivers remarked that they had adjusted to the problems that accompany limited activity, many had very good insurance benefits from their past employers, and they expected the changes that come with aging.

Informal social support was high in this sample and was not a significant predictor of risk of readmission. Although Schwarz[32] found that tangible social support predicted less early hospital readmission, the sample included patients with multiple comorbidities in addition to HF and who were more functionally impaired.

Limitations

Our study has several limitations. Our findings are limited to patients classified in NYHA classes II, III, and IV. Since 31% of patients in this study were NYHA class IV, a replication study using less severely ill patients may lead to greater differences between groups, even with a short follow-up period. Although the majority of intervention patients reported that they used the EHM system on a regular basis, the PI did not have information about whether teaching before hospital discharge was consistent between groups.

Functional status, number of comorbidities, and medication use did not differ significantly between groups at baseline or 90 days' postdischarge. Patients subjectively reported their functional abilities, however, and severity of comorbidities was not studied. In past studies of patients with HF, researchers reported variations in how medications were prescribed and issues with compliance.[39,40] Although patients reported taking medications as prescribed, a formalized monitoring system was not used. Information about dosages or changes in medications was not collected, and these variables could have differed between groups and affected results.

Specific number of visits to the patients' cardiologist/primary physician and how physicians responded to nursing assessments were also not obtained as part of the study. Several of the cardiologists voiced concerns about the amount of paperwork involved when monitoring via an EHM system. Lack of attention to paperwork could have minimized information used in decision making and therefore limited actions that could have prevented hospitalization or early readmission.

Limitations of the study may be due to absence of control over usual care provided by the home care agency. Contrary to this study, others used a study nurse to provide care, and together the PI and nurse reviewed assessments of patients.[20] Finally, there was no group that received EHM and not home care in our study. Thus, we do not know whether EHM would benefit patients who have a similar status as a solo resource/service.

CONCLUSIONS

Telemonitoring by EHM did not reduce rates of hospitalization, emergency department visits, cost of care, or depression, and it did not increase caregiver mastery, quality of life, or days to readmission; however, EHM did not cause harm, as there were no negative differences between groups in primary outcomes. Further EHM technological developments may enhance self-management of HF and eventually lead to improved clinical outcomes. Research is needed to better target those most likely to benefit from this intervention. Future research should address the interaction between the APN and follow-up intervention with telemonitoring.

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