

## Original Paper

# Impact of the Implementation of Telemanagement on a Disease Management Program in an Elderly Heart Failure Cohort

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Heart failure (HF) poses a significant burden to the health care system in the United States. The estimated incidence and prevalence of this condition is 5 million and 550,000, respectively. The number of hospital discharges attributed to HF in 2004 was 1,099,000, a 175% increase since 1979,<sup>1</sup> making it the largest expenditure by Medicare beneficiaries and the leading cause of hospital admissions in individuals aged 65 years and older.<sup>2,3</sup> Furthermore, the cost to treat HF was \$33.2 billion in 2007.<sup>1</sup> Clearly, cost-effective strategies that improve patient outcomes (ie, reduce hospitalization) are needed in the HF population.

Disease management programs have gained considerable attention in a number of patient populations including HF. An accepted definition of disease management is "a system of coordinated health care interventions and communications for populations with conditions in which patient self-care efforts are significant."<sup>4</sup> The goal of disease management programs is to improve compliance with interventions shown to positively impact outcome (decreased health care costs and hospitalizations and prolonged survival), typically on an outpatient basis. A number of studies have demonstrated that disease management programs reduce event rates in patients with HF.<sup>5-7</sup> Furthermore, disease management programs in HF appear to be cost-effective.<sup>8,9</sup> While the positive findings from disease management programs in HF continue to mount, there is still no uniform consensus on how they should be administered. Akosah

*The purpose of the present investigation is to examine the impact of a telemanagement component on an outpatient disease management program in patients with heart failure (HF). A total of 282 patients in whom HF was diagnosed and who were enrolled in an outpatient HF program were included in this analysis. One hundred fifty-eight patients additionally participated in a self-directed telemanagement component. The remaining 124 patients received care at an HF clinic but declined telemanagement. During the 7-month tracking period, 19 patients in the HF clinic plus telemanagement group and 53 patients in the HF clinic only group were hospitalized for cardiac reasons (log rank, 36.0; P < .001). The HF clinic only group had a significantly higher risk for hospitalization (hazard ratio, 4.0; 95% confidence interval, 2.4–6.7; P < .001). The results of the present study indicate that telemanagement is an important component of a disease management program in patients with HF. (Prog Cardiovasc Nurs. 2007;22:196–200) ©2007 Le Jacq*

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and colleagues<sup>6</sup> reported improved survival using a disease management program, which incorporated a multidisciplinary approach, with a combination of frequent one-on-one initial clinic visits and phone contact by a nurse practitioner. Fonarow and associates<sup>10</sup> likewise reported a significant reduction in hospital admissions using comprehensive group and individual education sessions before discharge for patients awaiting heart transplant, which was reinforced by outpatient clinic visits. Lastly, Kimmelstiel and colleagues<sup>11</sup> reported a significant reduction in hospitalizations with a program utilizing home visits by a

nurse case manager, reinforced by weekly or biweekly telephone contact. Based on this body of evidence, the American College of Cardiology/American Heart Association practice guidelines<sup>12</sup> for HF management has recommended the use of disease management systems in this population.

Ideally, a disease management program should be able to optimize the improvement in clinical outcome at the lowest cost and utilization of health care resources possible. The essential components of a disease management program are, however, yet to be defined. The present investigation explores the impact of adding a

low-cost telemanagement component to an outpatient disease management program in a group of elderly patients with HF.

## METHODS

This study was approved by the institutional review board at the community health care system. Two hundred eighty-two patients (New York Heart Association [NYHA] class III/IV) in whom HF was diagnosed were included in this analysis. A total of 75% of this cohort were diagnosed with systolic HF. The remaining 25% of patients were diagnosed with HF but presented with preserved systolic function. These patients had all been hospitalized at least 2 times in the previous 12 months with a primary or secondary diagnosis of HF and were subsequently referred to the HF treatment programs at the community health care system in Munster or Hobart, Indiana. Participants were seen in the HF clinic by a cardiologist, an advanced practice nurse, and a team of HF nurses every 1 to 2 weeks. Patients were assessed for symptom management, optimization of medications, and compliance monitoring. Measurements included heart rate, blood pressure, pulmonary auscultation, and laboratory work, including brain-type natriuretic peptide (BNP), glucose, blood urea nitrogen, creatinine, sodium, potassium, chloride  $\text{CO}_2$ , glomerular filtration rate, and anion gap. Progress reports were sent to the referring physician once per month. All patients were also offered the opportunity to participate in a telemanagement program (Healthcall LLC, Valparaiso, IN). One hundred fifty-eight patients accepted this offer and were enrolled in the telemanagement program, while the remaining 124 patients declined and continued to receive care in the HF clinic only.

### Telemanagement Component of the Disease Management Program

Each patient received a welcome packet with the toll-free number and instructions. Patients were given a bathroom

**Table I. Questions in the Disease Management Program Answered by Telephone<sup>a</sup>**

Please enter your weight.
Are you more short of breath?
Are you having any chest discomfort?
Have you been coughing more?
Do you feel dizzy or lightheaded?
Do you have any swelling in your hands or feet?
Are you urinating more or less than usual?
Are you more tired than usual?
Have you taken your medications today?
<sup>a</sup> Weight was entered in pounds; all other questions: 1 for yes; 2 for no.

scale with a digital display. Prior to calling in, the patient was weighed. The patient then called in daily and answered a short health assessment listed in Table I. This information was immediately stored and analyzed by automated decision support tools. Alerts were set for absolute and relative changes in signs, reporting of symptoms, and noncompliance to medication. A weight change of 3 lb in 3 days was considered an alert. Participants with abnormal scores were identified for immediate intervention and the HF nurse was notified. HF nurses accessed the system via a secured, encrypted connection to the Internet. Based on the accessed information, the HF nurse would adjust the treatment plan appropriately.

### Event Tracking

All patients were tracked for cardiac-related hospital admissions for 7 months following initiation of usual care or the disease management program. All hospital admissions with a cardiac related discharge diagnosis were considered an event. Noncardiac hospital admissions were not considered an event. Physicians responsible for the decision to admit a patient were not involved with this study. The number of hospital admissions for 12 months before initiation of the HF disease management program was also recorded.

### Statistical Analyses

Unpaired *t* testing compared differences in continuous variables between the HF clinic plus telemanagement

and HF clinic only groups. Chi-square analysis compared differences in categorical baseline variables as well as the difference in the percent change in the number of patients hospitalized before and following the disease management program and the percentage of patients with multiple hospitalizations during the tracking period between the HF clinic plus telemanagement and HF clinic only groups. Kaplan-Meier and univariate Cox regression analysis assessed differences in hospitalization rates between groups. All statistical tests with a *P* value <.05 were considered significant.

## RESULTS

A comparison of baseline characteristics between the HF clinic plus telemanagement and HF clinic only groups is presented in Table II. With the exception of angiotensin-converting enzyme inhibitor use, the 2 groups were comparable with respect to age, sex, HF etiology, left ventricular ejection fraction, and BNP. The average number of calls and percent reporting compliance with medications during the 7-month period for patients in the HF clinic plus telemanagement group was  $159.6 \pm 84.5$  and  $92.3\% \pm 16.5\%$ , respectively. Approximately 15% of the patient-initiated calls required a return call from a nurse. Fifty percent of those calls required an intervention by a nurse practitioner. The most common intervention was an increase in diuretic dose. Twenty-five percent of the calls included education and clarification without any adjustment

**Table II. Comparison of Baseline Variables Between the Disease Management and Usual Care Group**

	HEART FAILURE CLINIC AND TELEMANAGEMENT (N=158)	HEART FAILURE CLINIC ONLY (N=124)	P VALUE
Age, y	75.0±12.8	74.1±13.2	.57
Sex, male/female, %	54.8/45.2	57.7/42.3	.51
HF etiology, ischemic/nonischemic, %	43.0/57.0	49.2/50.8	.17
Left ventricular ejection fraction, %	41.2±15.7	37.8±17.0	.20
BNP, pg/mL	943.8±1086.8	1139.4±955.8	.22
ACE inhibitor, % prescribed	52.5	64.5	.008 <sup>a</sup>
β-Blocker, % prescribed	64.2	73.4	.06
Diuretic, % prescribed	79.1	82.3	.39

<sup>a</sup>Statistically significant. Abbreviations: ACE, angiotensin-converting enzyme; BNP, brain natriuretic peptide; HF, heart failure.

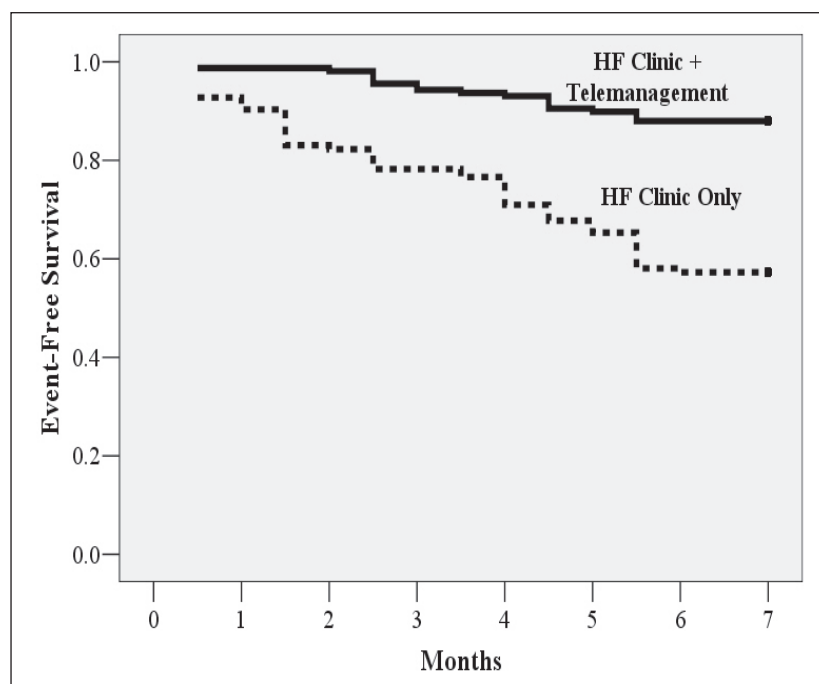


Figure. Kaplan-Meier analysis for 7-month cardiac-related events. Of the patients in the heart failure (HF) clinic plus telemanagement group, 158 met criteria, 19 experienced events, and 88% were event-free. Of the HF clinic only patients, 124 met criteria, 53 experienced events, and 57.3% were event-free. Log rank, 36.0;  $P < .0001$ .

in medications (reduce sodium intake, remember to take your medications, reduce our activity today). The remaining 25% of the return calls to the patients were deemed “false-positive” after further questioning.

For the 12 months before initiation of the programs, all patients included in this analysis were hospitalized at least 2 times for cardiac reasons. The average number of hospital admissions in the HF clinic only and HF clinic plus

telemanagement groups were  $2.6 \pm 0.75$  and  $2.5 \pm 0.80$ , respectively ( $P = .34$ ). During the 7-month tracking period following initiation of the programs, 19 (12.0%) patients in the HF clinic plus telemanagement group and 53 (42.7%) patients in the HF clinic only group were hospitalized at least 1 time for cardiac reasons. The discharge diagnosis for first-time hospitalization was decompensated HF for all 19 patients in the HF clinic plus telemanagement

group. In the HF clinic only group, the reason for first-time hospitalization was angina, acute coronary syndrome, and decompensated HF in 3, 2, and 48 patients, respectively. Five patients in the HF clinic plus telemanagement group (3.2%) and 17 patients in the HF clinic only group (13.7%) required multiple hospital admissions ( $P < .001$ ). The 5 patients in the HF clinic plus telemanagement group requiring multiple hospital admissions were each hospitalized 1 additional time (decompensated HF = 5). For the 17 patients in the HF clinic only group, 5 were hospitalized 2 additional times, and 1 was hospitalized 3 additional times for a total of 23 additional hospital admissions after the first event (acute coronary syndrome = 2, decompensated HF = 21). The percentage of patients hospitalized in the HF clinic only group (43%) and HF clinic plus telemanagement group (12%) was significantly lower ( $P < .001$ ) compared with preprogram admission rates (100% for both groups). Kaplan-Meier analysis for differences in first-time hospitalization between groups is illustrated in the Figure. The percent of patients who remained event-free during the 7-month tracking period was significantly higher in the HF clinic plus telemanagement group.

Univariate Cox regression analysis revealed that patients in the HF clinic only group were at significantly higher risk for adverse events (hazard ratio, 4.3; 95% confidence interval, 2.5–7.2;  $P < .001$ ).

The cost to administer the telemanagement program was \$30 per patient per month, equating to a total expenditure of \$33,180 for the 158 patients over a 7-month period. The average cost for a hospital admission was \$6744. Patients in the disease management group were hospitalized a total of 24 times (19 initial and 5 repeat), equating to an estimated hospitalization cost of \$161,856 (\$1,024.41 per patient). Patients in the HF clinic only group were hospitalized a total of 76 times (53 initial and 23 repeat), equating to an estimated hospitalization cost of \$512,544 (\$4,133.42 per patient). The total estimated expenditure in the disease management group was therefore \$317,508 less than the group receiving care in the HF clinic only when factoring in cost to administer the telemanagement program.

## DISCUSSION

The results of the present study indicate that an outpatient HF treatment program is in itself effective in reducing the number of hospital admissions. This is in agreement with other investigations examining this area.<sup>6</sup> Furthermore, participation in a telemanagement component in conjunction with an outpatient HF treatment program further decreases hospitalization rates in elderly patients with HF in a cost-effective manner.

To date, the disease management programs implemented in clinical practice or studied scientifically have been rather heterogeneous, indicating that multiple approaches can produce the desired effect (eg, reduce events and health care utilization, improve quality of life). Self-directed care should, however, be a central component of all disease-management programs.<sup>4</sup> The telemanagement component of the disease management program investigated in the present study embraced the concept of the patient taking an active role in his/her care. This approach allowed for minimized utilization of further health care resources. The clinician receiving the information had to act only if

incoming data indicated deterioration in clinical status.

The timing between the reporting of symptoms and action taken by the nurse may be one of the primary reasons admission rates were significantly lower when the telemanagement component was implemented as compared with disease management implemented only in the outpatient HF treatment program. Many patients fail to report symptoms to their physician, such as shortness of breath, fatigue, and edema. Patients in the telemanagement group who gained weight and/or experienced other symptoms suggestive of decompensation were prompted to immediately relay this information to nurses of the HF treatment program. In turn, the nurse was able to immediately alter the treatment plan with the intent of preventing further deterioration of clinical status and subsequent hospitalization. Actions taken by the nurse included notifying the primary physician, arranging home health, advising use of medications/treatments, and scheduling office visits. While the outpatient HF treatment program in itself reduced hospitalizations compared with the 12-month preprogram initiation, there is still the possibility for a longer period between a patient gaining weight and/or experiencing symptoms and reporting these symptoms to the nurse at the outpatient visit. This delay may allow for the deterioration in clinical status to the point where hospitalization is necessary. Another possibility for the disparity in hospitalization between the 2 groups is compliance with the treatment program. Patients who utilized the telephone-based component of the program were prompted to answer if they had taken their medications. Mean patient-reported compliance with medications was >90% in the group receiving telemanagement. The fact that patients were asked to respond to this question daily may have served as a reminder, thereby improving medication compliance. Compliance was not tracked in the

HF clinic only group, and therefore this hypothesis requires verification by future investigations.

The fact that patients were not randomized to 1 of the 2 groups is an inherent limitation of this study. Patients in both groups were, however, of similar age, disease severity (NYHA class III/IV, BNP levels, left ventricular ejection fraction), and generally had similar pharmacologic regimens. Furthermore, the number of hospitalizations in the HF clinic plus telemanagement and HF clinic only groups were not significantly different before initiation of treatment. These findings support the hypothesis that the intervention, and not differences in group characteristics, resulted in the significant disparity in adverse events.

A number of previous investigations in this area of research compare patients in a disease management program with patients receiving usual care by a general practitioner.<sup>5,6,9,13</sup> The present study is unique in that both groups received the same outpatient disease management experience, while only 1 of the groups had an additional telemanagement component added. Both groups experienced a significant reduction in events compared with the 12 months before enrollment, and the percent of patients prescribed medications known to benefit patients with HF was higher than what has been previously reported.<sup>14</sup> The group receiving the additional telemanagement component of the program demonstrated a significantly greater reduction in adverse events compared with the group receiving care in the HF clinic only. This finding indicates that certain components of a disease management program may be more valuable than others in improving outcome. Future research should be directed toward exploring the clinical impact of specific components of the disease management model to determine which provide the greatest benefit. These types of investigations will greatly facilitate standardization of these programs and facilitate implementation into clinical practice.

Most of the previous research investigating the impact of disease management in HF has done so in patients with systolic dysfunction. While the majority of patients in the present investigation were diagnosed with HF secondary to systolic dysfunction, a number of individuals did possess preserved systolic function. The relatively small sample in the present study limits the ability to perform a meaningful subgroup analysis. The information gathered by the telemanagement program used in this study was not specific to patients with systolic HF, thereby supporting its use in patients with preserved systolic function. Future research should be directed toward comparing the impact of disease

management programs between HF patients with systolic dysfunction and those with preserved systolic function.

The patients included in the present study had NYHA class III/IV and therefore were at high risk for readmission. The level of disease severity was a key factor in deciding to conduct clinic visits every 1 to 2 weeks in the entire cohort. Determining whether altering the interval between clinic visits impacts readmission rates should be addressed by future research. For example, with respect to the present study, assessing whether the telemanagement group would still have demonstrated a significantly lower readmission rate if the time interval

between visits was extended to 3 to 4 weeks is an important question that should be investigated.

## CONCLUSIONS

Numerous studies have demonstrated that disease management programs are beneficial in the HF population. The present study adds to this body of research and is one of the first to demonstrate that certain components of a disease management program, such as self-directed telemanagement, may be of higher value. Given the cost-effective nature by which this type of telemanagement program can be implemented, widespread clinical application may be warranted.

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