

# Outcomes of a Telehealth Intervention for Homebound Older Adults With Heart or Chronic Respiratory Failure: A Randomized Controlled Trial

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**Purpose:** Telehealth care is emerging as a viable intervention model to treat complex chronic conditions, such as heart failure (HF) and chronic obstructive pulmonary disease (COPD), and to engage older adults in self-care disease management. **Design and Methods:** We report on a randomized controlled trial examining the impact of a multifaceted telehealth intervention on health, mental health, and service utilization outcomes among homebound medically ill older adults diagnosed with HF or COPD. Random effects regression modeling was used, and we hypothesized that older adults in the telehealth intervention ( $n = 51$ ) would receive significantly better quality of care resulting in improved scores in health-related quality of life, mental health, and satisfaction with care at 3 months follow-up as compared with controls ( $n = 51$ ) and service utilization outcomes at 12 months follow-up. **Results:** At follow-up, the telehealth intervention group reported greater increases in general health and social functioning, and improved in depression symptom scores as compared with usual care plus education group. The control group had significantly more visits to the emergency department than the telehealth group.

There was an observed trend toward fewer hospital days for telehealth participants, but it did not reach significance at 12 months. **Implications:** Telehealth may be an efficient and effective method of systematically delivering integrated care in the home health sector. The use of telehealth technology may benefit homebound older adults who have difficulty accessing care due to disability, transportation, or isolation.

**Key Words:** Telehealth, Heart disease, Home care, Homebound

Heart failure (HF) and chronic obstructive pulmonary disease (COPD) frequently coexist, share similar clinical presentations among older adults, and require multifaceted treatment procedures (Hawkins, Petrie, Jhund, Chalmers, Dunn, & McMurray, 2009; Mascarenhas, Azevedo, & Betencourt, 2010). Heart failure is a progressive and disabling medical condition estimated to affect 5.7 million Americans and consumes an estimated total of \$27 billion dollars in annual treatment expenditures (Rosamond et al., 2008). HF is a leading cause of cardiovascular-related morbidity

and mortality, and it is not uncommon to see the combination of HF with COPD in advanced illness among older adults (Rutten, Cramer, & Lammers, 2006). COPD is a progressive and irreversible condition in which the airways of the lungs are damaged and unable to process oxygen well. HF and COPD can influence each other, cause the same key symptom—shortness of breath, and are frequently treated simultaneously (Starling, 2009).

We report on a randomized controlled trial to test the impact of the Telehealth for Heart Education Activation Rehabilitation and Treatment (tele-HEART) intervention on health and mental health outcomes of homebound medically ill older adults diagnosed with HF or COPD receiving home health skilled nursing care. This study applied the concept of telehealth therapy technology to the medical care of these frail patients.

Home health care patients represent a diverse, isolated, medically frail, and high medical cost group of homebound older adults who frequently have financial stressors, numerous medical conditions, and limited access to care (U.S. Department of Health and Human Services, 2002). Generally, home health care is limited up to 90 days of care for an individual patient. In the home health care sector, one strategy to reduce costs for agencies and barriers in accessing health services for older patients (e.g., disabled, isolated, transportation) may be to utilize telehealth care technology. Telehealth is defined by the Health Research and Services Administration (2011) as “the use of electronic information and telecommunications technologies to support long distance clinical health care, patient and professional health-related education, public health and health administration.” Telehealth innovations have been instrumental in conducting patient assessment, health and psychological interventions, patient and provider education, and remote patient monitoring on a real-time basis with critical information feedback between patient and provider.

The tele-HEART program, a multidimensional telehealth treatment model in the home health care setting was developed to improve the quality of heart health care for frail homebound older adults. The tele-HEART model builds on lessons learned from prior studies to improve health care services for older adults diagnosed with heart failure via telehealthcare initiatives (Barlow, Singh, Bayer, & Curry, 2007; Clark, Inglis, McAlister, Cleland, & Stewart, 2007; Kobb, Chumbler, Brennan, & Rabinowitz, 2008). Prior reviews of the literature suggest targeting specific subpopulations of individuals with chronic

illness, incorporating meaningful comparison conditions, and examining the factors that enhance the quality of the care and its relationship with treatment outcome (Bensink, Halley, & Wootton, 2008; Ditewig, Blok, Havers, & van Veenendaal, 2010; Van der Kooy, van Hout, Marwijk, Marten, & Stehouwer, 2007). Researchers acknowledge the significance of patient self-care in their overall health care management (Polisena et al., 2010; Radhakrishnan & Jacelon, 2011). Building on the telehealth care delivery model, we designed the tele-HEART intervention to improve the provision of geriatric home health services and specifically increase the likelihood that older adults receive recommended chronic disease care management protocols and participate in their own care.

Unique features of the tele-HEART intervention compared with prior studies of home health care interventions include the following: (a) in-home assessment; (b) in-home setup and education on the telehealth monitoring device; (c) ongoing care management provided by a telehealth home care nurse specialist; (d) use of home care protocols for evaluation and management of HF and related COPD and comorbid depression; (e) utilization of an integrated electronic medical record; (f) use of a computerized care management tracking tool; and (g) our prior research on integrated mental health service delivery by home health care teams.

We hypothesized that compared with a usual care plus psychoeducation control, patients enrolled in the tele-HEART intervention would receive significantly better quality of care for HF/COPD using chronic disease management protocols resulting in improved health-related quality of life, mental health status, and satisfaction with care at 3 months follow-up and decreased emergency room use and hospital admissions at 12 months follow-up.

## **Design and Methods**

### *Setting*

The IRB approved randomized controlled study was conducted at the university-affiliated St. Peters Home Health Care, one of the largest hospital-based Medicare-certified home care programs in New York State. The agency is JCAHO-accredited and offers home-based health services to a diverse group of older adults including African American (13%), Latino (4%), Asian (1%), and Caucasian (82%) living in a large four-county region.

## Recruitment

Prospective participants, 65 years or older, were recruited from hospital discharge planners, local physicians, cardiologists, cardiothoracic surgeons, and administrators of community health centers who were notified of the study by the "university affiliated" marketing director and were instructed about the characteristics and benefits of the new telehealth care program.

Individuals who were admitted for services to the home health care agency were routinely screened and informed of the study by a nurse research coordinator trained by the first author. Eligible patients who expressed interest were provided further details about the project. Specifically, prospective participants were informed of a new home-based telehealth monitoring program for older patients with a diagnosis of HF or COPD. Patients were contacted and screened within 3–5 days after admission to home care or after receiving a referral from a discharge planner, physician, or case manager and were invited to participate in the tele-HEART treatment program. Patients were enrolled in the study if they met the following inclusion criteria: (a) 65 years or older and a medical chart diagnosis of Heart Failure or Chronic Obstructive Pulmonary Disease; (b) patient experienced frequent health care encounters (i.e., hospitalized twice in the last 6 months or seen at least twice in the Emergency Room in the past 2 months); (c) patient required three or more home visits per week; (d) patient consent to participate in the program with random assignment; and (e) patient was willing to learn how to use the telehealth monitoring system. Older patients that were excluded from the study were (a) unable to learn and use the HomMED telehealth device due to physical disability; (b) cognitively impaired based on medical chart diagnosis and had no caregiver; (c) exhibited behavioral problems (e.g., aggression, agitation, delirium, paranoia) that interfered with learning how to use the HomMED telehealth device and communicating with the telehealth nurse.

## Experimental Design

The project coordinator contacted interested participants who met inclusion criteria to obtain their informed consent. They were informed that participation would involve random assignment to telehealth intervention or usual care plus education services, the possible use of a telehealth monitoring unit in the home if assigned to the experimental

condition, periodic communication with a research assistant over a 12-month period, and completion of study questionnaires at baseline and approximately 3 months postbaseline. Once consent was obtained by the project coordinator, an appointment was made by a research assistant to conduct baseline assessment prior to assignment to condition.

## Telehealth Monitoring Unit

This study used the Honeywell "HomMed" Health Monitoring System (HomMed, 2011), which consists of a small, tabletop in-home monitor and a Central Station located at the home health care agency. The data collection process took approximately 10 min in the home, required only a few key presses, and utilized voice and text commands in a variety of languages and volume levels. The monitor offered easy readability with a 20-character, two-line, vacuum fluorescent display and large font. The daily monitoring of weight, noninvasive blood pressure, pulse, oxygen saturation, and temperature had a preset scheduled time set for each patient based on patient preference. Audio prompts instructed patients through each step of the monitoring process and short text prompts remained on the monitor face to cue patients until the task was completed. A selection of modifiable questions was customized to the client's condition, requiring a Yes/No answer. The patient's response was captured with a single key press, and instructions were written for a sixth-grade level and were supported with graphics.

The telehealth monitoring system transmitted patient data via a telephone line from the home monitoring unit located in the patient's home to a central station located at the home care office. All transmitted data were encoded and stripped of patient-identifying information. The transmitted data were not associated with a patient until it was successfully received by the Central Station. Upon receipt, the central station checked the data to ensure it had retained integrity and then stored it in an encrypted format within a protected computer database. Patient data was displayed and triaged by color coding to allow immediate determination of nurse plans of care, tasks, and counseling. Patients having abnormal readings were contacted by the telehealth nurse for further evaluation. The clinician could quickly and easily email, print, or fax trend data to any member of the home care team. Additional reports that can be included as documentation in the electronic

medical record were patient note history; vitals compliance history (e.g., blood pressure, weight, pulse, temperature, etc.); patient demographics; and listing of physicians.

### *Random Assignment*

A simple randomization strategy (with a random numbers table) was used by the first author to assign participants to the usual care plus education control group or to the tele-HEART intervention group after informed consent was obtained.

### *Interventionist Training*

Two registered homecare nurses and a licensed practical nurse acted as telehealth therapy providers during the study. They were supervised by the homecare telehealth nurse manager who acted as project coordinator. The telehealth nurses received a week of training on the installation and use of the equipment by a Honeywell technical representative. Training materials included a user guide and patient teaching sheets and topics included use of monitors and peripheral devices, care and cleaning of the devices, and a patient log for tracking vital signs. The nurses were also trained in psychoeducation and problem-solving therapy strategies, based on our previous research (Gellis, 2010; Gellis & Bruce, 2010; Gellis & Nezu, 2011) using an empirically tested and established treatment manual (Gellis, McGinty, Horowitz, Bruce, & Misener, 2007) on integrated delivery of health and mental health services in home care settings to address the daily stressors older patients face while managing a chronic condition.

### *Telehealth Care Intervention*

During the initial in-home visit, the telehealth nurse set up the monitoring system and provided a detailed 1-hr tutorial session on its use. As part of the practice protocol, the nurse required a feedback demonstration of the equipment by the patient as evidence of knowledge and skill acquisition. Patients were informed of the normal clinical parameters and instructed as to when they should contact the telehealth nurse. The telehealth monitoring system was provided to home care patients to enhance the patients' self-management of their medical condition through a greater understanding of their disease processes. Patients obtained education on the disease process and counseling about the importance of daily monitoring of body weight, smoking cessation, behavioral activation, proper diet, medication

adherence, problem solving strategies on managing their daily medical condition, and monitoring of symptoms that may be indicative of worsening heart failure. Counseling was tailored to each patient's medical and psychological needs. The telehealth nurse was available to the patient daily, by telephone, and also for urgent home visits as needed.

On a daily basis, the telehealth nurse would review patient data, which included vital signs, heart rate, weight, blood pressure, pulse, oxygen saturation, and temperature, that were sent over the internet via the HomMED communication device. A preset scheduled time for collection of vital signs was arranged with each patient based on their preference. Audio prompts instructed patients through each step of the health data collection process. Short text prompts were also on the HomMED monitor display to cue patients until the requested task was completed. Sufficient time was given for patients to successfully perform each task. Telehealth nurses contacted patients based on abnormal findings from daily-transmitted clinical data. The most common reasons for contacting patients included (a) weight gain, (b) blood pressure, and (c) shortness of breath. An ongoing collaborative process was established between the telehealth nurse and the older patient. Another significant component of the telehealth intervention included a selection of modifiable (YES/NO) questions that was customized to the patient's condition. Patients had increased access and convenience to the telehealth nurse. Patients were informed that they could contact the telehealth nurse on a daily basis if needed. This process also offered older patients a daily structure and routine to learn more about and manage their medical conditions.

### *Usual Care*

Participants assigned to the usual care plus education control group received standard home care services provided by registered nurses in the role of case managers. The nurses developed and managed the patient plan of care, which may have included one or more of the following services: physical therapy, social services, nutrition, and home aides based on patient needs and the plan of care. After the initial intake for registration, face-to-face home visits were conducted weekly to provide treatment based on patient goals and treatment progress over a 90-day period. Health education was provided to the patient on heart and/or chronic respiratory disease during home visits.

## Measures

Participants completed study assessments at baseline within 1 week prior to the assignment to condition and again at postintervention (3 months) by telephone interviews conducted by a research assistant who was blinded to the participant's randomization status. We collected the prior 12-month hospital service utilization data (emergency room use and hospitalization days) of enrolled patients and again at 12-month postbaseline.

**Depressive Symptoms.**—Depression was measured using two instruments: the Center for Epidemiologic Studies Depression (CES-D) Scale and the Patient Health Questionnaire (PHQ). The CES-D (Radloff, 1977), an 11-item self-report modified from the original scale was used to measure depressive affect, somatic symptoms, positive affect, and interpersonal relations. This version was originally used in the Established Populations for Epidemiologic Studies for the Elderly (EPESE) study (Kohout, 1992). The 11-item scale contained a three response format (0 = *hardly ever or never*; 1 = *some of the time*; 2 = *much or most of the time*) for each item with an established cut-point of 16 or greater indicating depression. This measure was used because it is administered at intake by the homecare nurse as part of the agency's routine care. However, it is only a screen for depression and thus requires further assessment if the screen is positive.

The PHQ-9 (Kroenke & Spitzer, 2002), a well-established depression module of the full PHQ (PRIME-MD) diagnostic instrument, was also used to assess depressive symptoms because it provides a provisional diagnosis and a severity score in order to select, guide, and monitor treatment. The PHQ-9 consists of nine questions about how often the respondent has been bothered by depressive symptoms during the past two weeks. Scores for each item range from 0 (*not at all*) to 3 (*nearly every day*). Total scores of 0–4 indicate no depression, 5–9 indicate mild depression, 10–14 indicate moderate depression, 15–19 indicate moderately severe depression, and 20–27 indicate severe depression. In this study, a score of 10 or greater was evidence of clinically significant depression requiring further evaluation.

**Medical Outcomes SF-36.**—We assessed health-related quality of life using three of the eight validated and well-established scales of the Medical Outcomes Study Short Form Health Survey (SF-36;

Ware, Kosinski, & Keller, 1994): (a) General Health, (b) Bodily Pain, and (c) Social Functioning.

**Patient Satisfaction Survey.**—A survey developed by the home care agency assessed satisfaction with services. Six questions included the patients' satisfaction with the telehealth experience, problems using the equipment, concerns about privacy when using the equipment, whether the telehealth intervention helped to improve their overall health, helped them stay healthier, and improved their understanding of their illness. Patients were asked to rate their care, using a Like scale from 1 to 10, with "10" being the highest satisfaction rating, and scores range from 6 to 60. The usual care patients completed the identical survey answering questions substituting the word "telehealth" with "usual homecare services."

## Statistical Analysis

We compared baseline demographic characteristics using independent sample *t* tests and chi-square tests. We conducted an "intent to treat" (ITT) analysis with all randomized patients kept in the analysis. Multilevel modeling also known as hierarchical linear models, mixed effects models, random coefficient models, and multilevel models is an effective option for performing ITT analyses. Random effects regression models (RERMs) was the main analytic method used for assessing outcome measures and intervention robustness on the change between baseline and follow-up measurements. Outcome measures were analyzed at baseline and again at posttest by using RERMs in order to test for the effects of condition, time, and condition by time interaction. Since we hypothesized significant changes over time in participant outcomes, we deemed the condition by time interaction effects to be most relevant rather than time or main effects. RERMs offer several advantages over other repeated measures designs because they include missing case data (Hedeker & Gibbons, 2006). The final step included an assessment of participant self-reports of satisfaction with the treatment in both groups. A *t* test compared patient satisfaction questionnaire scores at posttreatment only in both groups.

## Results

### Sample Characteristics

During enrollment, a total of 214 patients were assessed for eligibility. Of those, 73 did not meet inclusion criteria and 26 declined to participate

(12% refusal rate). A total of 115 patients were enrolled and randomized: 57 patients were randomized to the treatment group and 58 were randomized to the control group (Figure 1). As reported in Table 1, comparative analyses at pretreatment of baseline demographics and health-related participant variables showed no significant differences among groups. More than 60% of the sample was female with a mean age of 79 years, whereas 22.5% were aged 85 or older. A majority were widowed and were also Medicare recipients (85%), and 25% had incomes less than \$14,000 per year. Approximately 44% of participants lived alone. A majority (60%) had a prognosis of poor to fair, and all patients were home health care recipients with a main diagnosis of either HF (81%) or COPD (19%). Patients had a mean of 3.95 other concurrent diagnoses and 18% had a history of substance abuse. More than a third had some type of hearing impairment. The majority of intervention and control group participants were independent in basic activities of daily living (ADLs; 66% vs. 70%;  $p = .38$ ). Overall, patients had a mean of 3.3 ADL impairments, with the most frequent being dressing, bathing, and ambulating. About 53% of patients resided with a family caregiver.

### Process of Care Outcomes and Implementation of the Model

Table 2 delineates the procedures of nursing care and the execution of the main components of the tele-HEART intervention for the older adults assigned to the experimental group who had a preliminary clinical home care assessment. Data on the model shows the homecare site involving the referral source and the tele-HEART team in homecare admission, thus succeeding with a high compliance in the following: (a) targeting care to high-risk patients, (b) timely initial clinical assessment, (c) assignment of a homecare manager, (d) initial home visit completed within 5 days of referral, including patient education on use of the telemonitoring device, and (e) initiation of a majority of tele-HEART chronic disease care protocols.

Eighty-nine percent of patients (51/57) randomized to the tele-HEART group used the home-based teletherapy services during the study period. The number of patients is lower in follow-up due to the following: (a) received fewer than three home care visits and were discharged to a nursing home ( $n = 4$ ), (b) discharged to hospice ( $n = 2$ ), and (c) unable to contact ( $n = 3$ ). Intervention patients received a

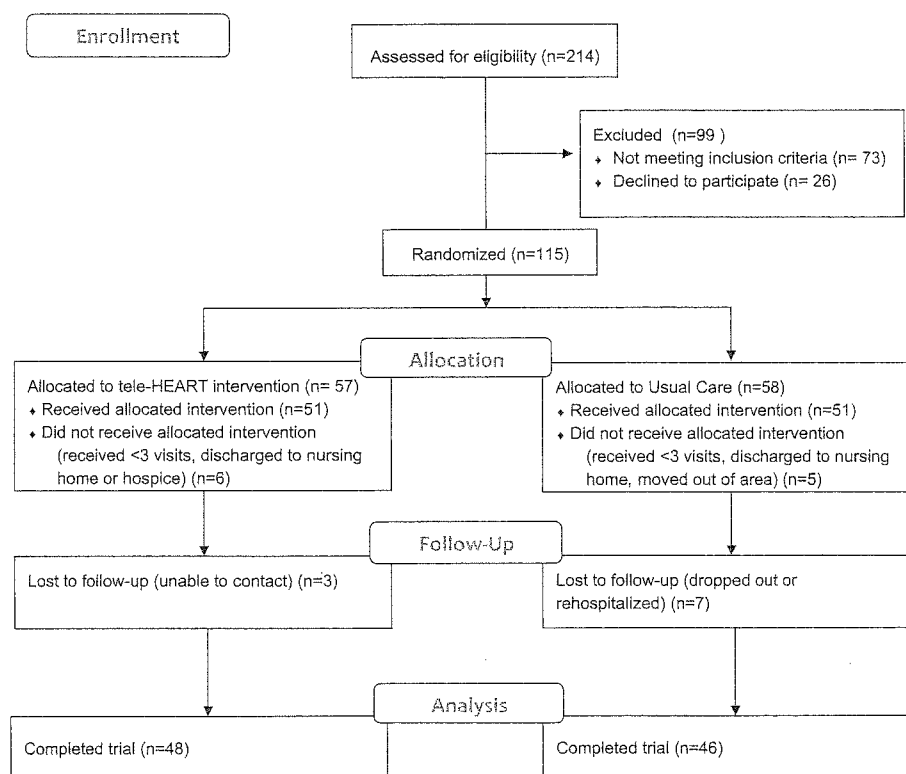


Figure 1. Flow diagram of study.

Table 1. Baseline Characteristics of Homebound Patients by Study Group<sup>a</sup>

| Characteristic   | Tele-HEART<br>( <i>n</i> = 57) | Control group<br>( <i>n</i> = 58) |
|--|--------------------------------|-----------------------------------|
| Age, <i>M</i> ( <i>SD</i> ) years  | 80.1 (7.8)                     | 78.3 (6.9)                        |
| Marital status, % married  | 37.3                           | 31.4                              |
| Education, % <12 years   | 51.2                           | 53.1                              |
| Female, %  | 62.7                           | 68.6                              |
| Income, < \$14,000, %  | 29.6                           | 30.1                              |
| Lives with caregiver, %  | 55.3                           | 60.8                              |
| Medicaid recipient, %  | 17.6                           | 21.6                              |
| Vision impairment, %   | 12.9                           | 11.8                              |
| Hearing impairment, %  | 37.3                           | 38.2                              |
| Disease group, %   |                                |                                   |
| HF   | 80.7                           | 74.1                              |
| COPD   | 19.2                           | 25.8                              |
| Comorbid medical conditions, %   |                                |                                   |
| Hypertension   | 46.1                           | 47.3                              |
| Diabetes mellitus  | 24.3                           | 23.9                              |
| Osteoarthritis   | 21.7                           | 22.4                              |
| Cancer   | 3.5                            | 4.1                               |
| MMSE, <i>M</i> ( <i>SD</i> ) score   | 25.1 (1.7)                     | 25.8 (0.6)                        |
| ADLs, <i>M</i> ( <i>SD</i> )   | 3.5 (1.6)                      | 3.3 (1.8)                         |
| Health services utilization  |                                |                                   |
| ER visits in past twelve months, <i>M</i> ( <i>SD</i> )                            | 0.8 (0.8)                      | 0.7 (9.3)                         |
| Hospital days in past 12 months, <i>M</i> ( <i>SD</i> )                            | 13.9 (9.9)                     | 14.3 (9.7)                        |
| Patient episodes of homecare service in past twelve months, <i>M</i> ( <i>SD</i> ) | 1.9 (1.2)                      | 2.0 (1.2)                         |

Notes: ADL = activities of daily living; COPD = chronic obstructive pulmonary disease; ER = emergency room; HF = heart failure; MMSE = Mini Mental Status Examination; Tele-HEART = Telehealth for Heart Education Activation Rehabilitation and Treatment.

<sup>a</sup>There were no statistically significant baseline differences between groups.

mean of 18 contacts during the 3-month intervention period, with a mean of two visits being face-to-face in the patients' home for installation and pickup of telehealth equipment at discharge and the remainder by telephone communication.

Eighty-eight percent of patients (51/58) were randomized to the control group and received usual care home visits plus education provided by home care nurses. Usual care treatment plans were developed and implemented for patients with a mean of 18 home-based visits over a 3-month period. Some control group patients did not receive the full usual care service due to the following: (a) patients received fewer than three home care visits and were discharged to nursing home (*n* = 3) or (b) moved away (*n* = 2). Some control group patients were lost to follow-up due to the following: (a)

Table 2. Process of Care in Patients Receiving the Components of the tele-HEART Intervention

| Component  | Compliance<br>(%), Year 1<br>( <i>n</i> = 57) |
|--|---|
| Screening of high-risk patient by tele-HEART coordinator within 1 day of referral                                  | 92  |
| Home health intake worker completes initial clinical assessment within 3 days of referral                          | 84  |
| Assign a tele-HEART care manager within 4 days of referral   | 100   |
| Initiate tele-HEART visit within 5 days of referral for installation of telemonitoring equipment in patient's home | 94  |
| Initiation of tele-HEART protocols, %  |   |
| Health maintenance   | 100   |
| Medication management  | 64  |
| Psychoeducation on medical condition   | 81  |
| Depression care  | 28  |
| Problem solving strategies   | 76  |
| Behavioral activation  | 34  |

Note: Tele-HEART = Telehealth for Heart Education Activation Rehabilitation and Treatment.

rehospitalization (*n* = 3) or (b) unable to contact (*n* = 4).

### Treatment Outcomes

Pre and post means on outcomes of the CES-D, PHQ-9, Health-Related Quality of Life, and Satisfaction with Care scales for the tele-HEART and Usual Care plus education groups are reported in Table 3. Baseline values of patient-centered outcomes showed no statistical differences between groups. Patients had high depression scores and low self-rated health scores, which was concordant with their functioning disabilities and hospital utilization.

At 3 months, patients in the tele-HEART intervention group improved significantly in depression symptom scores on the PHQ-9 ( $F = 6.47, p < .008$ ) and the CES-D (7.81,  $p < .004$ ) scales as compared with the usual care control group. Specifically, telehealth patients reported more interest in daily activities, less sadness, and increased energy than controls. The intervention group experienced significantly greater increases in two of the three SF-36 scales: general health ( $F = 3.91, p < .016$ ) and social functioning ( $F = 3.64, p < .014$ ) but not bodily pain. With respect to the Satisfaction with Care survey, the data presented in Table 3 indicate that both groups were generally satisfied with their care with no observed significant differences. Patients reported that they were very satisfied with the instructions they were provided by the home care workers about their care

Table 3. Baseline Values and Impact of Treatment on Patient Outcomes by Study Group

|   | Tele-HEART<br>intervention | Usual care<br>+ Ed control<br>group |
|---|----------------------------|-------------------------------------|
|   | M (SD)                     | M (SD)                              |
| Depression score                                |                            |                                     |
| PHQ-9 baseline                                  | 14.9 (6.4)                 | 15.2 (5.8)                          |
| Posttreatment                                   | 7.4 (5.7)                  | 13.6 (5.6)                          |
| CES-D baseline                                  | 19.9 (5.1)                 | 20.5 (8.8)                          |
| Posttreatment                                   | 10.4 (5.8)                 | 18.7 (9.4)                          |
| Quality of life (SF-36<br>subscales)            |                            |                                     |
| General health                                  |                            |                                     |
| Baseline  | 41.5 (21.1)                | 40.6 (21.7)                         |
| Posttreatment                                   | 48.4 (31.2)                | 41.1 (32.4)                         |
| Social functioning                              |                            |                                     |
| Baseline  | 46.4 (29.2)                | 45.1 (29.6)                         |
| Posttreatment                                   | 56.3 (31.9)                | 46.7 (32.3)                         |
| Bodily pain                                     |                            |                                     |
| Baseline  | 46.9 (32.4)                | 45.4 (30.4)                         |
| Posttreatment                                   | 49.4 (31.8)                | 47.3 (32.5)                         |
| Satisfaction with care,<br>(posttreatment only) |                            |                                     |
| Satisfied with instructions<br>by provider      | 48.5                       | 46.3                                |
| Instructions on privacy<br>issues               | 56.0                       | 55.2                                |
| Care helped me stay<br>healthier                | 51.4                       | 49.6                                |
| Better understanding<br>of condition            | 47.2                       | 46.1                                |
| Care made life better                           | 44.3                       | 43.4                                |
| Overall satisfaction                            | 45.6                       | 44.8                                |

Note: CES-D = Center for Epidemiologic Studies of Depression scale; PHQ-9 = Patient Health Questionnaire 9-items; SF-36 = Medical Outcomes Study of Health Related Quality of Life subscales; Tele-HEART = Telehealth for Heart Education Activation Rehabilitation and Treatment.

and privacy issues. The participants also reported satisfaction with care due to a better understanding of their medical condition.

### Service Utilization Outcomes

The impact on hospital emergency department visits, readmissions, and home care episodes by treatment group for all patients at 12 months posttreatment is reported in Table 4. The control group had significantly more visits to the emergency department than the teletherapy intervention group. There was an observed trend toward fewer hospital days for the intervention group as compared with the control group, but it was not significant at 12 months. Similarly, no significant group differences

were observed in the number of episodes of home health care received over the 12-month period.

### Discussion

This randomized controlled trial reports on the use of a home-based teletherapy technology intervention designed to improve the health status of medically ill older home care patients diagnosed with heart or chronic respiratory failure. Home health care services for older adults, who are confined to their home by illness and disability, are an important component of the overall health care system. This group makes up approximately 69% of the home health care population in the United States and is associated with significant health care costs (U.S. Department of Health and Human Services, 2002). Yet, despite its notable contribution to the care of medically disabled older adults, the home health care sector often remains hidden from much of the research world. Home care patients generally have intricate medical needs, medical comorbidities, high rates of depression, and are frequent users of health services. Left untreated, their health status may lead to exacerbation of medical conditions, deterioration in physical and social functioning, and an increased risk for mental health problems, rehospitalization, and mortality.

The design of the study included random assignment, examination of health and mental health outcomes, process outcomes of care, and acute care service utilization measures. These outcomes included health-related quality of life, depression, and satisfaction with care measures. This study demonstrated that the tele-HEART program had significant positive effects on the older medically ill patient experimental group who participated in the study. Intervention participants experienced significant reductions in depression symptoms. They also reported significant increases in quality of life on two SF-36 subscales, general health and social functioning, than patients in the control condition. These positive outcomes for intervention patients were accompanied by a reduction in the number of emergency department visits and a trend, though not significant, toward a reduction in number of days during hospital readmissions.

The findings of improved general health and social functioning are noteworthy. These patients are mainly older women managing their daily living activities while coping with functional limitations. With assistance from the telehealth nurse, participants were educated and coached on ways to monitor



Table 4. Effect of Treatment on ER Visits, Readmissions, and Episodes of Home Care by Group

| Variable  | Months 1–12                       |                                | <i>p</i> Value |
|---|-----------------------------------|--------------------------------|----------------|
|   | Tele-HEART group ( <i>n</i> = 57) | Control group ( <i>n</i> = 58) |                |
| No. of ER visits                                | 0.6 (1.6)                         | 1.4 (1.2)                      | .03            |
| Rehospitalization, <i>M</i> ( <i>SD</i> ), days | 7.5 (4.3)                         | 10.5 (6.5)                     | .06            |
| No. of episodes of home care                    | 1.3 (1.0)                         | 1.8 (1.5)                      | .10            |

Note: ER = emergency room; Tele-HEART = Telehealth for Heart Education Activation Rehabilitation and Treatment.

their medical symptoms, adhere to their medication regimen, monitor their weight, increase their physical activity, improve their diet, and solve personal daily problems related to their medical condition that may influence their psychological distress.

Based on telehealth nurse reports, several themes surfaced with regards to patient care. Patients reported to the nurses a positive reception and satisfaction knowing that they could access the telehealth nurse at any time during the day to ask questions or draw attention to a problem they encountered. Building on the model of patient-centered care and its derivative relationship-centered care, which are based on universal counseling integrated approaches that include many nonspecific therapeutic factors, we propose an overarching integrated model for home health care, an empowering-centered care approach, where the patient is coached to find their strengths and be self-directed in problem solving and management of the chronic illness with a telehealth nurse as a coach.

Several limitations of the study should be noted. The components (i.e., telehealth vs. the intensive practice protocols) of the Tele-HEART intervention require further clarity because it may be difficult to parse out each of their effects on the study outcomes. A deconstruction study would be recommended. The telehealth intervention was designed to be multifaceted in order to provide a tailored, flexible, and comprehensive service for older patients with chronic medical conditions, such as HF and COPD, and thus support patient care in the home setting. Another area that our research group did not examine was the degree of influence and impact of the relationship-communication variable between the telehealth interventionist and the medically ill older patient. Specifically, it would be important to understand this variable in relation to patient motivation for behavioral change and the patient perceptions of the utility of telehealth on outcomes.

Our research group believes that an economic analysis is important for this line of inquiry. This study does not report cost outcomes. Our team

is currently analyzing the patient utilization data from the hospital-based financial decision support system, which we plan to publish in the future. Multifaceted telehealth interventions are an innovative approach of delivering care to those medically ill complex patients who may need more intensive interventions. Telehealth interventions are demonstrated to be cost-effective in the home health care setting because they are brief, low intensity, delivered by nonphysicians in the community rather than hospital- or outpatient-based pointing to lower overall health costs. Utilization of telehealth technology has demonstrated early detection, treatment, and management of a deteriorating medical condition and thus avoidance or reduction of emergency room use or hospitalization. Evidence of significant health cost savings using telehealth has been reported in the specialized primary and networked care in heart failure multicenter trial (Weintraub et al., 2005) and in the home care setting (Myers, Grant, Lugin, Holbert, & Kvedar, 2006; Noel, Vogel, Erdos, Cornwall, & Levin, 2004; Pare, Sicotte, St Jules, & Gauthier, 2006; Schneider, 2004). On a national scale, cost effectiveness has been reported by the Veteran's Administration's Home Telehealth (HT) program with substantial cost savings in HT delivery versus home-based primary care services and reduction in hospital days and admissions (Barnett et al., 2006; Chumbler et al., 2005; Darkins et al., 2008; Hill et al., 2010).

Implications for telehealth protocols in "real-world practice" include better understanding of the mechanisms of behavioral change that link intervention processes including, nonspecific therapeutic factors (working alliance, communication, and social/psychological issues) to telehealth outcomes. Further examination of patient-centered or relationship-centered care models may provide a foundation for understanding these potential treatment variables.

This study compared a multifaceted telehealth intervention to usual care with an added component, and thus, the control condition may not have received

significant attention. Although it is preferable to have a head-to-head comparison group in a "real-world" home health care setting, it was not feasible at the time of the study due to the time and financial constraints of the study site. However, it should be noted that the home care site did agree to enhance the usual care condition by providing an additional component of psychoeducation. This is a known and well-established health services intervention, and we believe a reasonable comparable in this setting.

Our results demonstrated differences in emergency room visits among both patient groups. One explanation for why there were more emergency room visits among the controls as compared with the intervention groups may be that the home care provider experienced competing demands or job tasks on her/his home visit face-to-face time (e.g., travel, scheduled appointments with other patients during the day limiting access to long visits, spending excessive amounts of time with caregiver instead of patient). Home care nurses on average scheduled at most 5–6 patients per day. These demands limit the ability of the home care nurse to provide complete support or daily access to the service. As a consequence, this may lead to a patient experiencing or reporting problems at times when the home care provider is unavailable resulting in a patient or caregiver-perceived health crisis.

The study provides an example of a real-world intervention research within a community-based setting and with a medically frail homebound older population that is hidden from much of the research world, and thus, our research group tested against usual care practice and add a readily available psychoeducational component that can be incorporated into routine care. Further research should consider testing two or more theoretically driven evidence-based technological interventions (e.g., health coaching, videoconferencing, internet communication).

Our study is different from many previous reports in that it uses a randomized control design in a real-world setting with a home health care control group. The tele-HEART model is a nurse-led telehealth home care service that provides an intensive level of protocol-based health services for frail medically ill older patients with multiple comorbidities. An additional strength of the study is the central role of the telehealth nurse team in decision making, efficient communication flow between referring sources and the nurse supervisor regarding patient referrals, efficient turnaround time for

initial patient encounter, initiation of tele-HEART practice protocols, and high compliance rates in the processes of care.

Home care agencies are frequently under economic constraints to provide more services with fewer resources. Telehealth therapy is emerging as one viable service alternative (Whitten, 2007). Recent studies using telehealth care models have demonstrated positive clinical outcomes of care in various patient populations, and the cost of care using telehealth is significantly decreased as compared with in-person visits, with fewer admissions and shorter lengths of hospital stay (Bowles & Baugh, 2007; Clark et al., 2007; Dellifraigne & Dansky, 2008; Vitacca et al., 2009). However, most of these studies used pretest–posttest or matched controls with small samples rather than randomized control designs.

The literature on outcomes of heart and chronic respiratory failure patients is well-known with frequent patient deterioration resulting in frequent hospitalizations (Polisena et al., 2010). Researchers suggest that inadequate medical follow-up, lack of integrated services, lack of psychoeducation on daily patient self-management tasks (symptom recognition, medication use nutrition, physical exercise, behavioral activation, stress reduction), patient non-compliance, and failure to promptly seek medical attention are among contributing factors leading to rehospitalizations (Ditewig et al., 2010; McAlister, Stewart, Ferrua, & McMurray, 2004). Yet, many of these negative and costly outcomes can be diminished with less severe symptoms and shorter inpatient admissions.

Findings from this randomized study may be generalizable to other Medicare-certified home health care agencies public or private because they all utilize a uniform centralized system to support the delivery of home-based nursing skilled care. Organizational structures, staffing, and reimbursement mechanisms are standardized across home healthcare agencies, thus facilitating implementation nationally. The tele-HEART intervention itself is designed to be organizationally and environmentally practice sensitive to maximize the feasibility and generalizability to other homecare agencies. However, the study may not be generalizable to non-Medicare-certified home care agencies nor to different diagnostic patient groups. The intervention team was unblinded to the patient intervention condition, though the research assistants who conducted the outcome assessments were blinded.

The tele-HEART program is an example of a real-world model on how to integrate telehealth into home health care settings to serve homebound patients diagnosed with heart or chronic respiratory failure with the goals of screening for risk factors, integrating the processes of care including referral, documentation, team communication, evaluation of health and mental health outcomes, examination of episodes of home care, emergency department use and hospital readmissions, and achieving cost effectiveness over time.

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