BRIEF OBSERVATION

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Telehealth Protocol to Prevent Readmission Among High-Risk Patients With Congestive Heart Failure

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ABSTRACT

BACKGROUND: Congestive heart failure is the leading cause of hospital readmissions. We aimed to assess adherence to and effectiveness of a telehealth protocol designed to prevent hospital admissions for congestive heart failure.

METHODS: We recruited a random sample of 50 patients with congestive heart failure (mean age 61 years) from a managed care organization. We developed a telehealth platform allowing for daily, real-time reporting of health status and video conferencing. We defined adherence as the percentage of days on which the patient completed the daily check-in protocol. To assess efficacy, we compared admission and readmission rates between the 6-month intervention period and the prior 6 months. Primary outcomes were admissions and readmissions due to congestive heart failure, and secondary outcomes were admissions and readmissions due to any cause.

RESULTS: Forty-eight patients (96%) completed the protocol. Approximately half (46%) were at high risk for readmission according to standardized measures. Median 120-day adherence was 96% (interquartile range, 92%-98%), and adherence did not significantly differ across sex, race, age, living situation, depression, cognitive ability, or risk for readmission. Approximately equal proportions of patients were admitted for all causes during the 6-month intervention period versus the comparison period (37% vs 43%; $P = .32$). Half as many patients were admitted for congestive heart failure during the 6-month intervention period compared with the comparison period (12% vs 25%; $P = .11$).

CONCLUSION: Adherence to this telehealth protocol was excellent and consistent, even among high-risk patients. Future research should test the protocol using a more rigorous randomized design.

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KEYWORDS: Behavior change; Chronic disease management; Congestive heart failure; Hospital admission; Hospital readmission; Telehealth; Video conferencing

INTRODUCTION

Congestive heart failure affects nearly 6 million patients in the United States, and more than half of patients return to the hospital within 6 months of discharge.[1] Congestive heart failure is a leading cause of readmission,[2] and cost Medicare nearly $7.2 billion and Medicaid $1 billion in 2013.[3]

Half of hospital congestive heart failure readmissions result from inadequate discharge instructions from medical professionals, patient nonadherence to ongoing self-care, and patient failure to follow up appropriately with subsequent treatment.[4] Furthermore, readmission rates are even higher among

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high-risk patients, such as those with poor social support and cognitive impairment.[4] Previous recommendations to reduce nonadherence for individuals with congestive heart failure have included designing regimens that address pre-existing patient habits,[5] providing enhanced educational materials to patients,[6] improving psychosocial well-being,[7] and supporting communication between provider and patient for medical care.[8,9]

Telehealth protocols may serve as effective strategies for addressing the problem of readmission for high-risk populations.[10] Despite criticisms that health care technology reduces human interaction in the patient–doctor relationship,[11] research has demonstrated that the adoption of new technologies into medical practice can be leveraged to meet today's technological requirements while honoring the norms of social interaction. For example, technologies can automate medical monitoring, integrate health coaching, and facilitate communication between patients and health care providers.[12]

CLINICAL SIGNIFICANCE

- There was strong adherence to a congestive heart failure protocol with real-time symptom reporting.
- Adherence did not differ across readmission risk, demographics, or cognition.
- Half as many patients were admitted for congestive heart failure during the 6-month intervention period compared with the comparison period.

We developed a telehealth platform to reduce hospital admissions among congestive heart patients. Two behavioral health theories informed the development of our telehealth intervention. Social Cognitive Theory posits patients' self-efficacy as part of a system influenced by perceptions, goals, and environmental impediments.[13] Thus, to promote self-efficacy, one must equip individuals with motivation, self-management skills, and self-regulation capabilities.[13] In addition, the Health Belief Model posits that an individual's decision-making process consists of his or her ability to perceive health risks, progression of illness, and challenges facing behavior change.[14,15] Thus, to help facilitate informed decision making, one must create a process focused on an individual's ability to perceive health risks, severity of ill health, and barriers for change.[16]

Our primary purposes were to assess protocol adherence in a high-risk sample and to compare adherence across a range of patient characteristics. We hypothesized that the telehealth platform would have at least 80% adherence. Second, we hypothesized that patient adherence would not differ significantly by patient characteristics such as age and cognitive ability. Although a full-scale efficacy trial was out the scope of this pilot work, our exploratory aim was to assess intervention efficacy by comparing admissions and readmissions for patients during the intervention and a matched period before the intervention period, to inform future work.

METHODS

Participants

Congestive heart failure patients were identified through claims data provided by a regional managed care organization. Eligible patients had a diagnosis of congestive heart failure and at least 1 emergency room visit or hospitalization in the past 3 years. A random sample of these patients received a recruitment letter, and interested patients consented to be screened for the study. The enrollment phase closed once 50 patients had been recruited.

Intervention Protocol

Wellbridge Health, a care management company, transformed a standardized congestive heart failure self-care protocol into a telehealth platform. All patients were provided with a touchscreen computer tablet with software designed for high-risk patients with poor health literacy. The software application allowed for real-time reporting of patient-supplied health status and Health Insurance Portability and Accountability Act–compliant video conferencing. The software also included an interface to engage patients with educational information around congestive heart failure self-care. Patients also received a Bluetooth-enabled weight scale that synchronized with the tablet software. The total cost for all equipment for each patient was under $400. Patients were automatically prompted every day by the software application to report relevant information, such as difficulty breathing and medication compliance, and this information was transmitted through a secure data network.

This patient-provided digital information was sent directly to social workers who were trained as congestive heart failure health coaches and provided with a protocol for interacting with patients over a video-conferencing application. The social workers also conducted weekly video sessions focused on health education and behavior change. A social worker also made an initial in-home visit to assist in equipment setup in the patient's home and collection of demographic and clinical information. Deidentified data were presented to university researchers for analyses. This was deemed a Quality Improvement Study by the University of Pittsburgh Institutional Review Board.

Measures

Dependent Variables. Adherence was defined as the percentage of the initial 120 days of the protocol that patients successfully completed the software application. This included standing on the Bluetooth-enabled scale and responding to several multiple-choice items related to factors such as whether they had taken their medicine and how they were feeling. For example, the software application presented 3 images representing swelling of the ankles due to fluid accumulation. Patients, who had been trained in how to check their ankles for water retention as a sign of worsening heart

failure, touched the image that best represented their ankles that day.

Primary efficacy variables were admissions and readmissions specifically for congestive heart failure. Secondary efficacy variables were admissions and readmissions due to all causes. Admission was defined as a hospital stay beyond the emergency department of any length (including 1 day). Readmission was defined as an additional admission 30 days or fewer from discharge.[1] An admission specific to congestive heart failure was one in which congestive heart failure was the primary admitting diagnosis. When a patient was released but readmitted on the same day, this was defined as a continuation of the original admission.

Covariates. To characterize the sample, demographic variables included sex, race, age (<65 years old vs 65 years old and older), living status (lives alone vs does not live alone), and insurance type (dual eligible vs not dual eligible for Medicaid and Medicare). These variables are standard risk factors for readmission. We assessed depression with the Patient Health Questionnaire-2[17] and cognitive impairment with the Mini-Cognitive Battery.[18] We also used the LACE (Length of stay/Acute admission/Comorbidities/Emergency department visits) index scoring tool, a standardized measure to assess each patient's risk for readmission,[19] and a measure to assess fall risk.[20]

Analysis

We computed adherence for the whole sample and for each demographic subgroup. We then used Mann-Whitney *U* tests to determine whether adherence scores were significantly different for any of the patient characteristics. Nonparametric testing was used owing to nonnormality of the dependent variable. Adherence rates were divided into 30-day increments over the 120-day assessment period to examine changes in adherence over time.

For the primary and secondary efficacy-related dependent variables, the McNemar test of 2 binary outcomes was used to test whether there were significant differences in numbers of admissions when comparing the intervention and control periods. The intervention period was defined as the 6 months during which each participant received the intervention, and the control period was defined as the 6 months immediately before enrollment. All statistical tests were evaluated based on a .05 significance level. *P* values were 1-sided because there were a priori directional hypotheses.

RESULTS

During the first month 1 patient withdrew for medical reasons. The remaining 49 patients (98%) completed the study; therefore, there were no missing or incomplete data to manage. The mean age of participants was 61 years (standard deviation, 12 years). One-third of participants were Medicaid eligible (33%, n = 16), and two-thirds were dually eligible (Medicaid and Medicare) (67%, n = 32). Almost one-quarter of patients (23%, n = 11) exhibited symptoms of depression as evidenced by a score of 1 or greater on the Patient Health Questionnaire-2, more than one-third (40%, n = 19) lived alone, and nearly half (46%, n = 22) were at risk for readmission on the basis of LACE scores of 11 or more (**Table**).

One patient was removed from the adherence analysis because of moving out of the catchment area after 60 days. For the remaining 48 patients, median adherence for the complete period was 96% (interquartile range, 92%-98%). Adherence did not differ significantly across sex, race, age, living situation, depression, cognitive ability, or risk for readmission (**Table**). Adherence also did not change across each 30-day increment over the 120-day period (**Table**).

Approximately equal proportions of patients were admitted to inpatient care for reasons other than congestive heart failure during the 6-month intervention period and the comparison period (18 of 49 [37%] vs 21 of 49 [43%]; *P* = .32). However, approximately half as many patients were admitted for congestive heart failure during the 6-month intervention period compared with the 6 months before the initiation of the intervention (6 of 49 [12%] vs 12 of 49 [25%]; *P* = .11).

More patients were readmitted for all causes during the intervention period versus the comparison period (6 of 49 [12%] vs 3 of 49 [6%]; *P* = .25). Similarly, more patients were readmitted for congestive heart failure–related causes during the intervention period versus the comparison period (3 of 49 [6%] vs 1 of 49 [2%]; *P* = .31).

DISCUSSION

Adherence to this telehealth protocol was excellent despite the relatively intensive daily attention required by the protocol. Further, there were no significant differences in adherence by patient characteristics. There were no significant differences in admissions or readmissions for patients during the intervention period versus the comparison period. Although only 12% of patients were readmitted during the intervention period versus 25% in the comparison period, the *P* value of .11 did not reach statistical significance.

Because morbidity from congestive heart failure tends to be higher among patients with certain risk factors, it is particularly notable that this cohort successfully adhered to the protocol.[21,22] This strong adherence may be due to the fact that the intervention was tailored to those with low health literacy and was very easy to use. It may have also been valuable that the health coaches we employed were social workers who have specialized training around addressing psychosocial and environmental barriers to behavior change and identifying successful educational opportunities.

Despite excellent adherence, there were no significant differences between admission or readmission rates in the intervention and comparison periods. However, because we had relatively few patients in this cohort, even what seemed like relatively large differences (eg, 12% vs 25% admission rates) did not reach statistical significance. Thus, it will be valuable to conduct similar studies with larger groups in the future.

Table Patient Engagement With Intervention Protocol by Demographic and Personal Characteristics

Characteristic	N (%)	Engagement* 30 d, median (IQR)	Engagement* 60 d, median (IQR)	Engagement* 90 d, median (IQR)	Engagement* 120 d, median (IQR)
Sex					
Male	14 (29)	97 (93-100)	97 (95-98)	96 (91-98)	96 (93-98)
Female	34 (71)	97 (93-100)	95 (88-98)	97 (88-99)	96 (89-98)
Race					
White	22 (46)	95 (90-100)	95 (88-98)	94 (88-99)	95 (86-98)
Black	26 (54)	97 (93-100)	97 (93-98)	97 (92-98)	96 (93-98)
Age (y)					
<65	30 (63)	95 (93-100)	97 (90-98)	97 (90-98)	96 (92-98)
≥65	18 (38)	98 (93-100)	96 (88-100)	96 (92-99)	95 (93-98)
Lives alone					
No	29 (60)	93 (93-100)	97 (90-98)	94 (90-98)	95 (92-98)
Yes	19 (40)	100 (93-100)	97 (90-100)	97 (92-99)	96 (93-98)
Dual eligible					
No	16 (33)	95 (92-100)	95 (92-97)	95 (91-97)	96 (89-98)
Yes	32 (67)	98 (93-100)	97 (89-98)	97 (91-99)	96 (92-98)
PHQ-2					
Negative	37 (77)	100 (93-100)	97 (90-98)	97 (91-99)	96 (93-98)
Positive	11 (23)	93 (90-97)	95 (83-97)	97 (88-98)	96 (86-97)
Mini-Cognitive Battery					
Negative	38 (79)	97 (93-100)	97 (92-98)	97 (92-99)	96 (93-98)
Positive	10 (21)	93 (93-100)	94 (90-98)	93 (90-96)	93 (86-95)
LACE					
0-10	26 (54)	97 (93-100)	97 (83-98)	97 (86-99)	97 (86-98)
≥11	22 (46)	97 (93-100)	96 (92-98)	95 (92-98)	95 (93-98)
Fall risk					
No	29 (60)	100 (93-100)	97 (93-98)	97 (93-99)	97 (93-98)
Yes	19 (40)	97 (93-100)	95 (83-98)	94 (88-98)	94 (86-98)

P values were computed using Mann-Whitney *U* tests comparing engagement scores by each characteristic. Nonparametric testing was indicated because of nonnormality of the dependent variable (adherence).

Dual eligible = (NO, Medicaid; YES, both Medicaid and Medicare); IQR = interquartile range; LACE = Length of stay/Acute admission/Comorbidities/Emergency department visits in the past month; PHQ-2 = patient health questionnaire screening instrument.

*Engagement was defined as the percentage of days since discharge on which the patient successfully completed the intervention protocol.

The protocol involved providing technology to patients who historically have not had equal access to technology.[23] Although this technology was not extremely expensive, future cost-effectiveness research may be valuable in assessing whether this investment of machinery and personnel resulted in sufficient cost savings in health care.

Similar protocols could be developed for other high-cost chronic health issues with frequent hospital admissions, such as chronic obstructive pulmonary disease or rheumatoid arthritis. Although specific target symptoms would be different, the overall strategy of providing tailored education and surveillance based on the biopsychosocial model would remain the same.

Limitations

This study used a comparison period instead of a randomized clinical trial or a randomized cross-over trial. Future research could use a more rigorous design including the use of a cross-over design to ensure that all patients eventually receive access to the intervention. This study also focused on outcomes of adherence and readmission rates. Although these are useful outcomes to examine at this stage of research, future research could focus on more distal outcomes, such as admission rates after the intervention period has ended, to assess retention of self-care skills. Subsequent studies could determine patient risk from the New York Heart Association function class and from information on medications and comorbidities.

Conclusion

Congestive heart failure continues to be a persistent problem in the United States,[24] contributing to increased hospitalizations and significantly higher health care costs, particularly among African Americans and those with depression.[25,26] Avoidable hospital stays place a great burden on family members and caregivers.[26] A change in clinical practice is necessary to adequately address this patient population that is at risk for poor outcomes, including decreased quality of life and premature mortality, along with additional high costs for the health care system. Clinicians should be aware of the need to adequately address the training required for a telehealth protocol for a low-income population that may not be as familiar with the most recent technology.

Telehealth programs that combine useful technologies with best practices for at-risk populations can maintain excellent adherence, even for individuals at high risk for readmission. These programs can reduce both congestive heart failure–related and all-cause admissions. Most importantly, telehealth programs have the ability to be scaled and reach more patients for more frequent provider interactions. It may be valuable for future work in this area to examine cost-effectiveness and to use more rigorous randomized designs.

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