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Why patients stop using their home telehealth technologies over time: Predictors of discontinuation in Veterans with heart failure

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Abstract

Background: Daily use of home telehealth (HT) technologies decreases over time. Barriers to continued use are unclear.

Purpose: To examine predictors of drop-out from HT in Veterans with heart failure.

Methods: Data for Veterans with heart failure enrolled in the Veterans Affairs HT Program were analyzed using a mixed effects Cox regression model to determine risk of dropping-out over a 1-year period.

Findings: Older (hazard ratio [HR] 1.01), sicker (prior hospital readmission [HR 1.39]), higher probability of hospital admission/death [HR 1.23], functional impairments [1.14]) and white Veterans (compared to black; HR 1.41) had higher risk of drop-out in HT Programs. Users of VA's online patient portal (HR 0.90) had lower risk of drop-out.

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Discussion: Older and sicker patients are at most risk of stopping HT use, yet use of a patient portal shows promise in improving continued use. Interventions targeting patients at high risk for HT discontinuation are needed to promote ongoing engagement.

Keywords

Home telehealth; Drop-out; Heart failure; Veterans; Remote patient monitoring

Introduction

Remote patient monitoring with home telehealth (HT) for chronic disease management in the Department of Veterans Affairs (VA) has been increasing (2020) and has resulted in reduced VA hospital admissions and length of stay while maintaining high patient satisfaction (2019). However, evidence in support of the use of remote patient monitoring for heart failure has been inconsistent with randomized controlled trials (RCT) showing no change in outcomes compared to control groups while other RCTs show improvement in outcomes (Brahmbhatt & Cowie, 2019). A potential reason for negative studies and inconsistent results is poor adherence and subsequent drop-out of HT Program over time (Srivastava, Do, Sales, Ly, & Joseph, 2019). In one RCT using remote patient monitoring in patients with heart failure postdischarge in six academic medical centers, only 82.7% of the intervention patients used the telemonitoring technology and patients were adherent only 55.4% of the time at 30 days and 51.7% at 180 days showing decreasing engagement over time (Ong et al., 2016).

Specific to Veterans, a study in one VA facility of older rural Veterans enrolled in a Home Telehealth Program for polypharmacy (multidisease program) found that almost 23% of the sample dropped-out before the 10th daily session, 16% dropped-out between the 11th and 100th sessions, and, finally, 12% dropped-out after the 100th session (Luptak et al., 2010). Reasons for disenrollment were primarily patient refusal to continue, followed by having a change in the plan of care. A subsequent study that looked at Veterans enrolled in the same program over a 4-year time span found that almost 18% of the sample enrolled but never used the device and attrition leveled off after 250 days (Juretic et al., 2012). Only type of enrollment (i.e., enrollment done face-to-face vs. by phone) was found to consistently predict early drop-out from the HT program after controlling for demographics, health service use prior to enrollment, and frequency of responses (Juretic et al., 2012).

With the recent passing of the Centers for Medicare & Medicaid Services (CMS) Final Rule on Chronic Care Remote Physiologic Monitoring that allows for reimbursement for remote patient monitoring services (Federal Register, 2019) and the recent Coronavirus Aid, Relief and Economic Security (CARES) Act, which allows for public and nonprofit health care systems and/or providers in rural and urban areas to apply for funding to purchase connected devices for information services such as remote patient monitoring platforms and services (Federal Communications Commission, 2020), it is important to identify patients who are likely to drop-out early from HT Programs so that organizations can proactively develop interventions to promote continued engagement. With the current coronavirus pandemic, CMS has also released waivers so that payment can be provided for non-face-to-face services that involve remote patient monitoring (e.g., HT for chronic disease monitoring and management) for new (not just established) patients, for acute and chronic conditions, for physiologic monitoring and for less than 16 days (CMS, 2020). With the expanding use of telehealth services, new knowledge is needed to further understand potential predictors for continued engagement in HT. Understanding past discontinuation rates in long-standing HT programs and identifying patients at high risk for drop-out are important to guide remote patient monitoring programs that are rapidly being rolled out now in response to the novel coronavirus pandemic.

The purpose of this study is to examine predictors of discontinuation from HT in Veterans with heart failure. This study is the first national study of VA Home Telehealth Program that looks at predictors of HT Program drop-out in Veterans with heart failure. Compared to prior studies in Veterans (Juretic et al., 2012; Luptak et al., 2010), this current study expands on prior work by focusing on Veterans with heart failure (as opposed to multi-disease/ polypharmacy program) and enrolled in the VA HT Program throughout the nation (not just in one VA facility).

Materials and Methods

Research Design

The research design and sample were previously reported elsewhere (Guzman et al., 2020). To summarize, this is a retrospective cohort study design using administrative VA data. The Andersen Model was used to guide this study (Andersen, 1968, 1995). This model provides a framework to study the relationship between environment/patient characteristics and health behavior, namely discontinuation from the HT Program. It posits the relationship between predisposing, enabling and need factors contributing to the use of HT technology.

Sample

Veterans included in this study enrolled in the VA HT Program between January 1, 2014 and June 30, 2014 for heart failure disease management and were followed for 1 year from the date they first used their HT technology.

Setting

The VA Home Telehealth Program, the VA's national remote patient monitoring program, has been in existence since the early 2000s and uses Disease Management Protocols for specific diseases (e.g., heart failure, chronic obstructive lung disease, diabetes, etc.). The program utilizes asynchronous device monitoring where the Veteran submits vital signs and answers questions daily that are specific to the disease being monitored (VA Office of Academic Affiliations, 2019). HT Care Coordinators, often Registered Nurses due to their scope of practice, monitors responses Monday to Friday, and calls those with abnormal vital signs and/or answers to daily symptom questions for more information. Depending on further information provided and initial assessment, the nurse can reiterate the plan of care including adherence to medications, review nonpharmacologic management that the Veteran can use, forward their concerns to a medical provider for further evaluation and interventions, or direct the Veteran to seek emergency services. HT nurses works closely with the Veteran's primary care and/or specialty provider to ensure adequate monitoring and optimal management.

The program includes daily questions and education about the disease relayed through the telehealth technology for daily monitoring of health status and home vital signs which then drive care coordination and interventions. Veterans targeted for the HT Program are those who have high health services use (e.g., frequent emergency room visits) due to the disease(s), are at high risk for adverse events (e.g., polypharmacy), and agree to participate in daily submission of HT data for monitoring. HT technology used could be an in-home messaging device that allows for messaging and measurement of vital signs at home, a web browser, or interactive voice response (IVR) that allows for question and response messaging service. At the time, several vendors provided HT technologies to VA and included Cardiocom, Viterion, Health Hero, Vital Net, Authentidate, and American TeleCare Inc. The in-home messaging device is mailed to the Veteran and allows for education, promotion of self-management skills, messaging and attachment of peripheral devices for vital signs monitoring (VA Office of Connected Care, 2017). The web browser requires an Internet-enabled device and both the web browser and IVR device can use the Veteran's own mobile device for added flexibility (VA Office of Connected Care. 2017). In 2016, the program reported a 59% reduction in hospital length of stay and 31% decrease in hospital admissions overall among enrolled patients (2020).

Study Procedures

The study has Institutional Review Board approval and Data Use Agreements with the Office of Patient Care Services (stewards of VA HT Program and data) and VA Corporate Data Warehouse. This study utilized the HT program data linked to the VA electronic medical record data obtained through the Corporate Data Warehouse (Gonsoulin, 2017). Data were stored, cleaned, and analyzed in the VA Informatics and Computing Infrastructure (VINCI) platform using software available on VINCI space that can be used for queries and analyses (e.g., SAS, Stata and R to manipulate data and run statistical tests and models) (VA Health Services Research & Development, 2018).

Variables

The outcome variable is the time to discontinuation from HT program. Veterans in HT are expected to submit their data daily using their HT technology. Weekly compliance reports are created by the program office to monitor adherence to daily use. Time to HT drop-out is defined as the last week a report of HT use was submitted in the first year since first using their HT technology.

We examined the impact of patient-level characteristics on HT discontinuation based on the Andersen Model. *Predisposing* factors include age, race, gender, health service use during the year prior to HT use (e.g., number of emergency room visits, hospital admission and readmissions in the first 3 days after the index admission, length of stay, and primary care and cardiology clinic visits), and presence of an implantable cardiac device, pacemaker, or left ventricular assist device. *Enabling* factors include eligibility for VA services (service connection), familiarity with use of other health technology (i.e., having signed up for My

Health*e*Vet program, the VA’s electronic patient health portal (HealtheVet, 2020)), type of HT technology used (i.e., in-home messaging device vs. web browser or IVR), and average adherence at 12 months. Average adherence at 12 months (52 weeks) was calculated based on the weekly compliance to the use of HT devices with the numerator being the discreet number of days the patient logged-in using an HT device and the denominator being seven days in a week and reported as a percentage. The denominator was adjusted for VA hospitalizations and death (i.e., the denominator was reduced by subtracting the number of days the patient was in the hospital during that week). *Need* factors include comorbidity as measured by the Charlson Comorbidity Index using diagnostic administrative data (Quan et al., 2005), probability of hospital admission or death in 90 days as measured by the Care Assessment Need (CAN) score categorized to 95% and above vs. lower (Fihn & Box, 2013), depression diagnosis, ejection fraction, and category of care (i.e., noninstitutional care [NIC] vs. others). The category of care is assigned upon HT enrollment and includes NIC, acute care, chronic care management, or health promotion/disease prevention. Veterans assigned as a NIC patient have functional impairment and have higher needs for assistance to remain safely living in the community compared to the other categories of care (VA Office of Connected Care, 2017).

We used variables reported closest to the date of the first report of HT use or within the prior 12 months. Missing ejection fractions were imputed using mortality, CAN score, and having a cardiac device or not. Due to the skewness of the distribution and the bimodal nature of the data, length of stay, emergency room visits, and hospital admissions and readmissions were categorized to none or any, while number of primary care and cardiology clinic visits were log transformed prior to analysis. In addition, available organizational variables (i.e., rurality of the patient’s VA facility, HT program size [number of patients enrolled at the end of June 2014], and academic affiliation) were obtained as control variables to account for contextual issues.

Data Analysis

Descriptive statistics were used to summarize the data. Potential predictors were included in the model if their p value was <.05 with regards to their relationship with the outcome of interest using a mixed effects Cox regression model or if thought to be clinically significant. Multicollinearity was evaluated using the variance inflation factor. The Cox regression model was used for the time-to-event analysis. Adjusting for clustering by facility did not change the results, thus the unadjusted Cox model output is presented. R statistical package was used for the analysis (Horikoshi & Tang, 2016; R Core Team, 2017; Tang, Horikoshi, & Li, 2016; Therneau, 2015, 2018; Therneau & Grambsch, 2000; Wickham, 2009).

Findings

The final sample consisted of 3,449 patients enrolled in VA HT program for heart failure. They were older (mean age 70.8 years), mostly white (74.7%) and male (97.9%). Table 1 lists patient characteristics including the health services use in the prior year. Close to 47% were enrolled in the patient portal, My Health*e*Vet, and 58% had high risk for hospital admission or death in the next 90 days with a CAN score equal to or greater than 95%.

About a third of the patients had depression and approximately 13% died in the first year after HT enrollment. Thirty-eight percent were categorized as NIC upon HT enrollment based on their functional impairment and 78% were assigned an in-home messaging device as their HT technology. The mean percent average adherence was 57.1% with a median of 30.6% and a range of 34.9% to 84%. The average number of weekly reports of HT use submitted was 33.8 with a median of 19.4 and range of 14 and 52 weeks.

Table 2 shows the Cox regression model for discontinuation from the HT Program. Holding other variables constant, an additional year of patient's age increases the weekly hazard of drop-out from HT Program by 1% (hazard ratio [HR] 1.01, 95% confidence interval [CI] 1.01–1.02). Compared to black Veterans, white Veterans have a higher risk of drop-out from HT Program by 41% (HR 1.41, CI 1.25–1.59) after controlling for other variables. Sicker Veterans, specifically those with prior hospital readmissions (HR 1.39, CI 1.13–1.72), higher probability of hospital admission or death with higher CAN scores (HR 1.23, CI 1.12–1.36), and functional impairment with a NIC designation (HR 1.14, CI 1.04–1.26) have higher risk of dropping-out holding all other variables constant. Veterans who are enrolled in the My Health*e*Vet patient portal (HR 0.90, CI 0.82–0.99), uses an in-home messaging device as opposed to a web browser or IVR (HR 0.79, CI 0.71–0.88), and have higher average adherence (HR 0.97, CI 0.97–0.97) have a lower hazard of discontinuation from HT Program.

Discussion

This study is the first to describe predictors of discontinuation in a national HT program, highlighting the importance of enabling, predisposing and need factors among Veterans with heart failure. By using a time-to-event model that also incorporates adherence into the model, our analysis allows the study of the sample as a whole instead of grouped by adherence to the use of HT technology as a prior study had done (Juretic et al., 2012). This allowed individual variables to be studied holding other variables constant in the model.

Since heart failure is a chronic progressive disease that has been associated with high mortality (Groeneveld et al., 2018) and readmission rates (Kaboli et al., 2012), it is not surprising to find that older adults and sicker patients drop-out of HT Programs faster compared to younger and healthier counterparts. Compared to those with no hospital readmissions in the prior year, those who had any hospital readmission in this study had a 39% higher risk of dropping-out of the HT program. This finding is similar to findings in a prior study that found readmission after hospitalization in patients with heart failure is common and is highest at day 4 postdischarge, usually to causes other than heart failure that are thought to be preventable (Fernandez-Gasso, Hernando-Arizaleta, Palomar-Rodriguez, Abellan-Perez, & Pascual-Figal, 2017). Furthermore, this present study found that Veterans with higher risk of hospital admission and/or death in 90 days at the time of HT enrollment, as evidenced by a CAN score greater than or equal to 95%, had a 23% higher risk of dropping-out. These are concerning as the target Veteran for most remote patient monitoring are those who are at high risk and are high utilizers of health services. With the recent improvements in reimbursement and funding for new remote patient monitoring programs (CMS, 2020; Federal Communications Commission, 2020; Federal Register, 2019), it is important to understand predictors of discontinuation in well-established programs such as the VA HT Program to improve use and decrease drop-out rates. Remote patient monitoring programs should develop individualized interventions to promote continued engagement over time and address potential barriers to quality care, especially during transitions of care and postdischarge.

The current study found that Veterans with functional impairment and deficits in activities of daily living (NIC designation at HT enrollment) are likely frail and have a 14% higher risk of discontinuation from the HT Program. Frailty in patient with heart failure is common with up to 79% of patients with heart failure being frail (Vitale, Spoletini, & Fosano, 2018). Frailty has been associated with poor quality of life and prognosis. A comprehensive, multidimensional approach should be considered when patients with heart failure are identified to be frail and include rehabilitation program to delay and/or prevent further functional decline, and possibly prolong continued engagement with HT.

It is unclear why white Veterans would have a 41% higher risk of dropping-out of the HT Program compared to black Veterans. The literature is limited when looking at racial differences and discontinuation from HT programs. This may be an indicator of differences in socioeconomic status; however in this current study, socioeconomic variables (e.g., income) were not reliable in the electronic medical record and thus were not included. Further study is needed to determine reasons behind racial differences in readmission rates for heart failure.

Predictors of lower drop-out from HT Programs were enrollment in a patient portal, use of an in-home messaging device as opposed to a web browser or IVR, and higher percent average adherence. Compared to those not enrolled in the VA patient portal, My Health*e*Vet, those Veterans enrolled in My Health*e*Vet patient portal have 10% lower hazard risk of dropping-out of the HT program. This is not surprising as prior studies that looked at the impact of patient portals have found improvement in communication with clinicians and likely adherence to treatment recommendations when patients engage in electronic patient portals (Ammenwerth, Schnell-Inderst, & Hoerbst, 2012). Patients who use My HealtheVet are thought to be more engaged as well (Turvey et al., 2012) and likely more comfortable with technology. As the use of electronic patient health portals become more common, it is likely that more patients will become more comfortable with use of electronic and telehealth technologies.

Type of HT device matters as this study found that compared to those who use a web browser or IVR, those who use an in-home messaging device have a lower risk of dropping-out from HT by 21%. There is limited research on the relationship between type of HT device use and discontinuation from a remote patient monitoring program. Veterans are matched to HT technology assigned to them based on their ability and need (VA Office of Connected Care, 2017). It may be that Veterans assigned an in-home messaging device develop a home routine that promotes daily use as opposed to those assigned a Web browser or IVR, which allows for flexibility in where and when to perform their daily HT data submission, but may limit their ability to incorporate this practice in their daily routine.

Finally, the current study found that an additional percentage of average adherence decreases the hazards of dropping-out of the HT program by 3%. Looking at the survival curves for Veterans with high (greater than 70% or more) vs. low (69% or less) average adherence (data not shown), those with high average adherence, stay in the program longer. Poor adherence to the use of daily HT has been posited as potential reason for lack of benefit found in randomized controlled trials (Ong et al., 2016; Srivastava et al., 2019). Remote patient monitoring programs should develop standardized interventions to promote and address poor adherence.

The study has a few limitations including a limited time frame for enrollment in the HT program (6-month period in 2014) with a 1-year follow-up, and video visits were not included at that time. This study only uses VA data, thus health services use (e.g., emergency room visits, hospital readmissions, etc.) in non-VA facilities were not included. As with projects utilizing administrative data, other potential important predictors, such as reason for discontinuation from the HT Program, Internet accessibility, other sociodemo-graphic variables, availability of a caregiver, living alone status and type of enrollment (face to face or by phone) could not be included, and some of our data definitions were limited (e.g., rurality was based on the facility address as the home address listed during the analysis may not have been the same address that the Veteran was residing in during HT enrollment). Although this study focuses on one national remote patient monitoring program, the VA HT Program is one of the long-established remote patient monitoring programs in the nation. Thus, the rest of the country who are now rolling out increasing numbers of remote patient monitoring programs, can to learn from the VA long-term experience.

Conclusions

This study is the first to look at potential predictors of drop-out from a national remote patient monitoring program, specifically the VA HT Program. Older and sicker patients are at most risk of stopping the use of their HT technologies, yet use of a patient portal and in-home messaging device show promise in improving continued use. Nurses working in remote patient monitoring program need to identify individualized plan of care to provide support to specific subgroups (i.e., older, sicker patients) of patients at high risk of dropping-out of remote patient monitoring programs for continued engagement. This may involve looking beyond the disease, but also looking at potential functional needs and social determinants of health and resources that will allow for continued safe community-dwelling and self-management of chronic conditions in the home setting. Recruitment of patients to remote patient monitoring programs who already use patient health portals may increase the likelihood of staying in the program longer, and thus promote effective monitoring and management.

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Abbreviations:

CAN	Care Assessment Need score
CARES	Coronavirus Aid, Relief and Economic Security Act
CMS	Centers for Medicare & Medicaid Services
CI	confidence interval
HR	hazard ratio
HT	home telehealth
IVR	interactive voice response
NIC	noninstitutional care
RCT	randomized controlled trial
VA	Department of Veterans Affairs
VHA	Veterans Health Administration
VINCI	VA Informatics and Computing Infrastructure

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Table 1 –

Sample Characteristics (n = 3,449)

	n (%)	Mean ± Standard Deviation
Age	—	70.8 ± 10.4
Race White	2,577 (74.7)	—
Black	645 (18.7)	
Other	227 (6.6)	
Sex male	3,377 (97.9)	—
Emergency room visit in the prior year		2.2 ± 3.4
0	1,138 (33.0)	
≥1	2,311 (67.0)	
Hospital admissions in the prior year		1.2 ± 1.6
0	1,503 (43.6)	
≥1	1,946 (56.4)	
Hospital readmission within 3 days of discharge in the prior year		
0	3,313 (96.1)	0.04 ± 0.2
>1	136 (3.9)	
Length of hospital stay		7.3 ± 16.9
0 days	1,514 (43.9)	
1–7 days	857 (24.9)	
≥8 days	883 (25.6)	
Cardiology clinic visits		3.0 ± 4.1
0	1,094 (32)	
≥1	2,355 (68)	
Primary care clinic visits		8.9 ± 7.1
0	88 (2.6)	
≥1	3,361 (97.4)	
Presence of cardiac device	1,063 (30.8)	—
Service connection	2,324 (67.4)	35.7 ± 42.8
<70%	1,125 (32.6)	
≥70%		

	n (%)	Mean ± Standard Deviation
Enrolled in My HealtheVet patient portal	1,602 (46.5)	—
Technology type in-home messaging device	2,678 (77.7)	—
Other	758 (21.99)	
Average adherence to daily HT use up to 1 year (%)	—	57.1 ± 62.7
Charlson Comorbidity Index		6.5 ± 3.2
1–3 (lower comorbidity)	1,002 (29.1)	
4–5	793 (23.0)	
6–7	779 (22.6)	
8–22 (high comorbidity)	855 (24.8)	
Care Assessment Need (CAN) score		—
<95%	1,308 (37.9)	
≥95%	2,008 (58.2)	
Has depression	1,1016 (29.5)	—
Ejection fraction (%)	—	42.7 ± 15.8
Category of care noninstitutional care	2,058 (59.7)	—
Other	1,391 (40.3)	
Rurality rural	298 (8.6)	—
Urban	3,151 (91.4)	
Program size small	1,139 (33.0)	—
Medium	1,155 (33.5)	
Large	1,155 (33.5)	
Goes to a facility with an academic affiliation	3,324 (96.0)	—
Number of weekly reports of HT use submitted up to 1 year	—	33.8 ± 19.4

Table 2 –

Cox Regression Model

Model Construct	Concept	Hazard Ratio	Confidence Interval
Predisposing	Age	1.01*	1.01–1.02
	Race (ref: Black) Other	1.03	0.83–1.28
	Race (ref: Black) White	1.41*	1.25–1.59
	Sex male	0.78	0.58–1.05
	Hospital readmission within 3 days of an index hospitalization in the prior year	1.39*	1.13–1.72
	My HealtheVet enrollment	0.90*	0.82–0.99
Enabling	Care Assessment Need score ≥95%	1.23*	1.12–1.36
	In-home messaging device	0.79*	0.71–0.88
	Average adherence	0.97*	0.97–0.97
Need	Have depression	0.97	0.88–1.07
	Noninstitutional care (NIC)	1.14*	1.04–1.26

* $p < .05$.