ORIGINAL RESEARCH

VA Home Telehealth Program for Initiating and Optimizing Heart Failure Guideline-Directed Medical Therapy

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Background: Heart failure (HF) is a chronic, progressive medical condition. Evidence suggests that guideline-directed medical therapy improves both morbidity and mortality in patients with HF with reduced ejection fraction when properly optimized. Unfortunately, many patients do not receive optimized therapy, highlighting the need to optimize clinicians' methods to more effectively and efficiently initiate and titrate medical therapy.
Methods: This single-center, retrospective study evaluated the rates of drug interventions prompted by the home telehealth monitoring program for veterans with HF with reduced ejection fraction. Rates of drug interventions were evaluated among those who enrolled and those who did not enroll in the program.
Results: There were 20 drug-related interventions in the home telehealth group compared with 11 interventions for the control group. One HF-related hospitalization occurred in the home telehealth program group compared with 6 in the control group.
Conclusions: This study demonstrates the potential of home telehealth to optimize veterans' medication regimens and to reduce HF-related hospitalizations. It also provides an additional catalyst to further develop home telehealth services specifically targeted at drug therapy initiation and optimization in patients with HF with reduced ejection fraction.

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Heart failure (HF) is a chronic, progressive condition that is characterized by the heart's inability to effectively pump blood throughout the body. In 2018, approximately 6.2 million US adults had HF, and 13.4% of all death certificates noted HF as a precipitating factor.[1] Patients not receiving appropriate guideline-directed medical therapy (GDMT) face a 29% excess mortality risk over a 2-year period.[2] Each additional GDMT included in a patient's regimen significantly reduces all-cause mortality.[3]

The Change the Management of Patients with Heart Failure (CHAMP) registry reports that only about 1% of patients with HF are prescribed 3 agents from contemporary GDMT at target doses, highlighting the need for optimizing clinicians' approaches to GDMT.[4] Similarly, The Get With The Guidelines Heart Failure Registry has noted that only 20.2% of patients with HF with reduced ejection fraction (HFrEF) are prescribed a sodium-glucose cotransporter 2 inhibitor (SGLT2i) following hospital discharge for HFrEF exacerbation.[5] Overall, treatment rates with GDMT saw limited improvement between 2013 and 2019, with no significant difference between groups in mortality, indicating the need for optimized methods to encourage the initiation of GDMT.[6]

Remote monitoring and telecare are novel ways to improve GDMT rates in those with HFrEF. However, data are inconsistent regarding the impact of remote HF monitoring and improvements in GDMT or HF-related outcomes.[6-10] The modalities of remote monitoring for GDMT vary among studies, but the potential for telehealth monitoring to improve GDMT, thereby potentially reducing HF-related hospitalizations, is clear.

Telemonitoring has demonstrated improved participant adherence with weight monitoring, although the withdrawal rate was high, and has the potential to reduce all-cause mortality and HF-related hospitalizations.[11,12] Telemonitoring for GDMT optimization led to an increase in the proportion of patients who achieved optimal GDMT doses, a decrease in the time to dose optimization, and a reduction in the number of clinic visits.[13] Remote GDMT titration was accomplished in the general patient population with HFrEF; however, in populations already followed by cardiologists or HF specialists, remote optimization strategies did not yield different proportions of GDMT use.[14] The aim of this study was to assess the impact of the home telehealth (HT) monitoring program on the initiation and optimization of HF GDMT among veterans with HFrEF at the Veterans Affairs Ann Arbor Healthcare System (VAAAHS) in Michigan.

METHODS

This was a single-center retrospective study of Computerized Patient Record System (CPRS) data. Patients at the VAAAHS were evaluated if

they were diagnosed with HFrEF and were eligible for enrollment in the HT monitoring program. Eligibility criteria included a diagnosis of stage C HF, irrespective of EF, and a history of any HF-related hospitalization. We focused on patients with HFrEF due to stronger guideline-based recommendations for certain pharmacotherapies as compared with HF with mildly reduced ejection fraction (HFmrEF) and preserved ejection fraction (HFpEF). Initial patient data for HT enrolling were accessed using the Heart Failure Dashboard via the US Department of Veterans Affairs (VA) Academic Detailing Service. The target daily doses of typical agents used in HFrEF GDMT are listed in the Appendix.

The HT program is an embedded model in which HT nurses receive remote data from the patient and triage that with the VAAAHS cardiology team. Patients' questions, concerns, and/or vital signs are recovered remotely. In this model, nurses are embedded in the cardiology team, working with the cardiologists, cardiology clinical pharmacist, and/or cardiology nurse practitioners to make medication interventions. Data are recorded with an HT device, including weight, blood pressure (BP), heart rate, and pulse oximetry. HT nurses are also available to the patient via phone or video. The program uses a 180-day disease management protocol for HF via remote device, enabling the patient to answer questions and receive education on their disease daily. Responses to questions and data are then reviewed by an HT nurse remotely during business hours and triaged as appropriate with the cardiology team. Data can be communicated to the cardiology team via the patient record, eliminating the need for the cardiology team to use the proprietary portal affiliated with the HT device.

Study Sample

Patient information was obtained from a list of 417 patients eligible for enrollment in the HT program; the list was sent to the HT program for review and enrollment. Patient data were extracted from the VAAAHS HF Dashboard and included all patients with HFrEF and available data on the platform. The sample for the retrospective chart review included 40 adults who had HFrEF, defined as a left ventricular EF (LVEF) of ≤ 40% as evidenced by a transthoracic echocardiogram or cardiac magnetic resonance imaging. These patients were contacted and agreed to enroll in the HT monitoring program. The HT program population was compared against a control group of 33 patients who were ineligible for the HT program. Patients were deemed ineligible for HT if they resided in a nursing home, lacked a VAAAHS primary care clinician, or declined participation in the HT program.

TABLE 1 Baseline Characteristics

Demographics	Home telehealth (n = 40)	Control (n = 33)
Age, mean (SD), y	72.6 (6.9)	75.2 (8.9)
Male sex, No. (%)	40 (100)	33 (100)
Race and ethnicity, No. (%)		
American Indian or Alaska Native	1 (2)	0 (0)
Black or African American	2 (5)	1 (3)
White	32 (80)	28 (85)
Missing data	5 (12)	4 (12)

Procedures

Patients enrolled in the HT program were assigned a nurse who monitored and responded to changes in vital signs, such as an increase in weight of ≥ 3 lb in 24 hours or ≥ 5 lb in 7 days. Each participant in HT received a home BP machine to check BP and heart rates and a scale for daily weights. The patient also responded to questions on a tablet device with the BP machine and scale. The vital signs were put into the tablet device, and the patient answered questions about their symptoms for that day. If the patient endorsed any symptoms of HF, such as pedal edema, abdominal distention, orthopnea, paroxysmal nocturnal dyspnea, dyspnea on exertion, or orthopnea, they received a call from the nurse to discuss symptoms and make appropriate adjustments in the diuretic or HF regimen. The HF-trained pharmacist served as a resource for drug therapy management and provided recommendations for diuretic adjustments on an as-needed basis.

Patients who declined participation in the HT program followed the standard of care, which was limited to visits with primary care clinicians and/or cardiologists as per the follow-up plan. Patient data were collected over 12 months. The study was approved by the VAAAHS Institutional Review Board (reference number, 1703034), Research and Development Committee, and Research Administration.

Primary and Secondary Goals

The primary goal of the study was to assess the impact of the HT program on drug interventions,

TABLE 2 Studied Drug-Related Interventions

Interventions	Home telehealth No. (%)	Control No. (%)	Test statistic[a]	Adjusted *P* value
ACEi/ARB dose increase	1 (5)	0 (0)	—	.00
Angiotensin receptor-neprilysin inhibitor initiation	7 (35)	3 (27)	2.10	.50
β-blocker Initiation Dose increase	 2 (10) 3 (15)	 1 (9) 0 (0)	 1.67 —	 .99 .25
Sodium-glucose cotransporter 2 inhibitor initiation	2 (10)	4 (36)	0.39	.40
Aldosterone antagonist Initiation Dose increase	 4 (20) 1 (5)	 2 (18) 1 (9)	 1.71 0.82	 .68 .99
Heart failure–related hospitalization[b]	1 (3)	6 (18)	0.12	.04
Total primary	20	11	1.43	.23

Abbreviations: ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker.
[a]χ^2 test for total interventions and Fisher exact test for all others; odds ratios determined using Fisher exact test.
[b]Secondary intervention.

TABLE 3 Home Telehealth Group Secondary Outcomes

Outcomes	Result
Adherence, No. (%)[a]	
Yes	36 (90)
No	1 (2)
Not applicable	3 (8)
Time, mean (SD)	
To enrollment, d[b]	5.5 (6.4)
To laboratory test after new medication, d[c]	17 (9.8)
Total enrolled, mo[d]	5.3 (3.5)

[a]Adherence defined as a documented medication refill within 30 d after anticipated refill date.
[b]Six patients never enrolled (n = 34).
[c]Eleven patients had new medications; 1 did not have laboratory results (n= 10).
[d]Six patients never enrolled, and 1 died (n = 33).

specifically initiating and titrating HFrEF pharmacotherapies. Interventions were based on GDMT with known mortality- and morbidity-reducing properties when used at their maximum tolerated doses, including angiotensin-converting enzyme inhibitors (ACEi), angiotensin receptor-neprilysin inhibitor (ARNi), or angiotensin receptor blockers (ARB), with a preference for ARNi, β-blockers for HFrEF (metoprolol succinate, bisoprolol, or carvedilol), aldosterone antagonists, and SGLT2is.

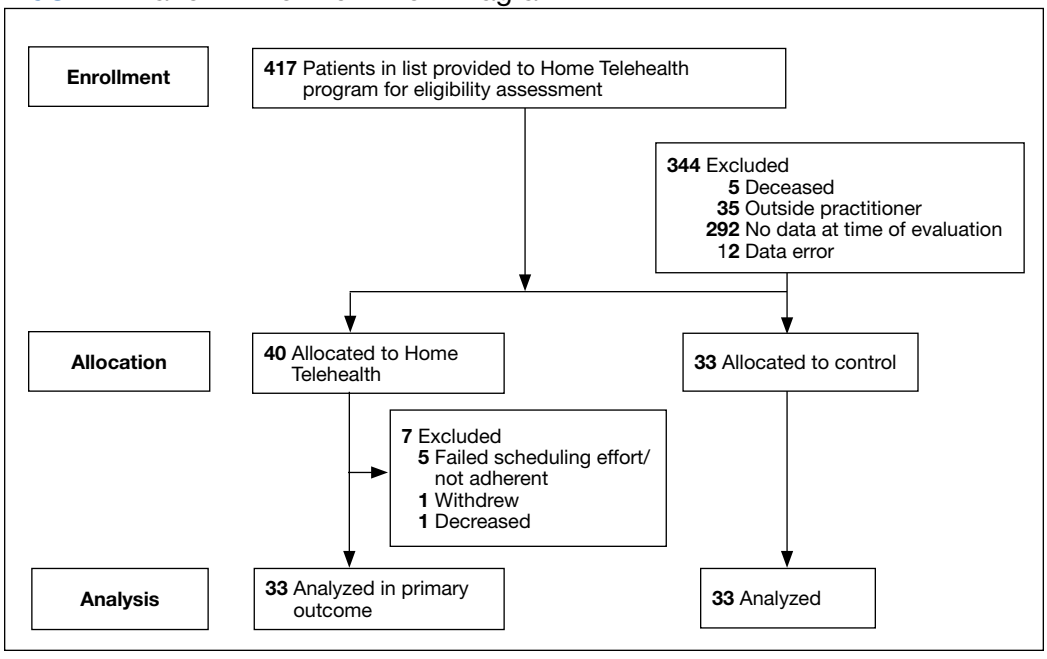
Secondary goals included HF-related hospitalizations, medication adherence, time to enrollment in HT, time to laboratory analysis after the initiation or titration of an ACEi/ARB/ARNi or aldosterone antagonist, and time enrolled in the HT program. Patients were considered adherent if their drug refill history showed consistent fills of their medications. The χ^2 test was used for total interventions made during the study period and Fisher exact test for all others.

RESULTS

Patient data were collected between July 2022 and June 2023. All 73 patients were male, and the mean age in the HT group (n = 40) was 72.6 years and 75.2 years for the control group (n = 33). Overall, the baseline demographics were similar between the groups (Table 1). Of 40 patients screened for enrollment in the HT program, 33 were included in the analysis (Figure 1).

At baseline, the HT group included more individuals than the control group on ACEi/ARB/ARNi (24 vs 19, respectively), β-blocker (28 vs 24, respectively), SGLT2i (14 vs 11, respectively), and aldosterone antagonist (15 vs 9, respectively) (Figure 2). There were 20 interventions made in the HT group compared with 11 therapy changes in the control arm during the study (odds ratio, 1.43; *P* = .23) (Table 2). In the HT group, 1 patient achieved an ACEi target dose, 3 patients achieved a β-blocker target dose, and 7 achieved a target dose of spironolactone (titration is not required for SGLT2i therapy and is counted as target dose). In the HT group, 17 patients were on ≥ 3 recommended agents,

FIGURE 1 Patient Enrollment Flow Diagram



while 9 patients were taking 4 agents. Seven of 20 HT group interventions resulted in titration to the target dose. In the control group, no patients achieved an ARNi target dose, 3 patients achieved a β-blocker target dose, and 2 patients achieved a spironolactone antagonist target dose. In the control arm, 7 patients were on ≥ 3 GDMTs, and 2 were taking 4 agents. No patient in either group achieved a target dose of 4 agents. Five of 11 control group interventions resulted in initiation or titration of GDMT to the target dose.

One HF-related hospitalization occurred in the HT group and 6 in the control arm (odds ratio, 0.12; $P = .04$). Most patients (90%) were adherent to their GDMT regimen, 3 patients not on any GDMT for HFrEF at the end of the review were excluded, and 1 patient was deemed not adherent to medication therapy (Table 3). The mean (SD) time-to-enrollment in the HT program was 5.5 (6.4) days after consultation for 34 patients who were assessed. Ten patients had laboratory tests within a mean (SD) of 17 (9.8) days after the intervention, 29 patients did not require routine laboratory monitoring, and 1 did not follow through.

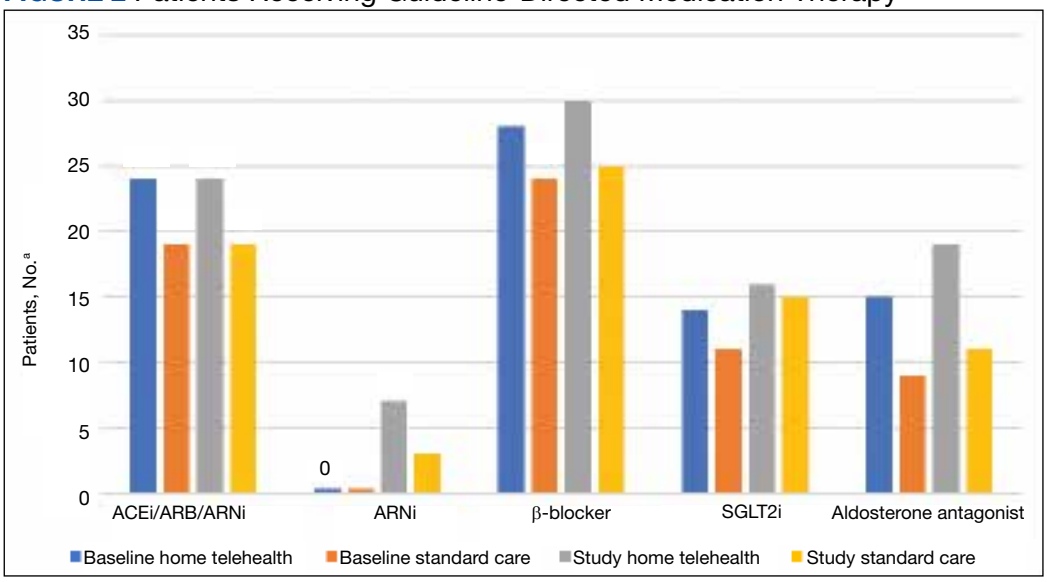
Of the 40 HT group patients, 7 were excluded from analysis (3 failed to schedule HT, 1 was at a long-term care facility, 1 was nonadherent, 1 declined participation, and 1 died) and 33 remained in the program for a mean (SD) 5.3 (3.5) months. Death rates were tracked during the study: 1 patient died in the HT group and 3 in the control group.

We analyzed the overall percentage of VAAAHS patients with HFrEF who were on appropriate GDMT. Given the ongoing drive to improve HF-related outcomes, HT interventions could not be compared to a static population, so the HT and control patients were compared with the rates of GDMT at VAAAHS, which was available in the Academic Detailing Service Heart Failure Dashboard (Figure 3). Titration and optimization rates were also compared (Figure 4). From July 2022 to June 2023, ARNi use increased by 16.6%, aldosterone antagonist by 6.8%, and β-blockers by 2.4%. Target doses of GDMTs were more difficult to achieve in the hospital system. There was an increase in aldosterone antagonist target dose achievement by 4.7%, but overall there were decreases in target doses in other GDMTs: ACEi/ARB/ARNi target dose use decreased by 3.2%, ARNi target dose use decreased by 2.7% and target β-blocker use decreased by 0.9%.

DISCUSSION

Telehealth yielded clinically important interventions, with some titrations bringing patients to their target doses of medications for HFrEF. The 20 interventions made in the HT group can be largely attributed to the nurses' efforts to alert

FIGURE 2 Patients Receiving Guideline-Directed Medication Therapy



Abbreviations: ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; ARNi, angiotensin receptor-neprilysin inhibitor; SGLT2i, sodium-glucose cotransporter-2 inhibitor.
[a]Both telehealth and standard of care groups had 33 participants.

clinicians to drug titrations or ACEi/ARB to ARNi transitions. Although the findings were not statistically significant, the difference in the number of drug therapy changes supports the use of the HT program for a GDMT optimization strategy. Patients may be difficult to titrate secondary to adverse effects that make medication initiation or titration inappropriate, such as hypotension and hyperkalemia, although this was not observed in this small sample size. Considering a mean HT enrollment of 5.3 months, many patients had adequate disease assessment and medication titration. Given that patients are discharged from the service once deemed appropriate, this decreases the burden on the patient and increases the utility and implementation of the HT program for other patients.

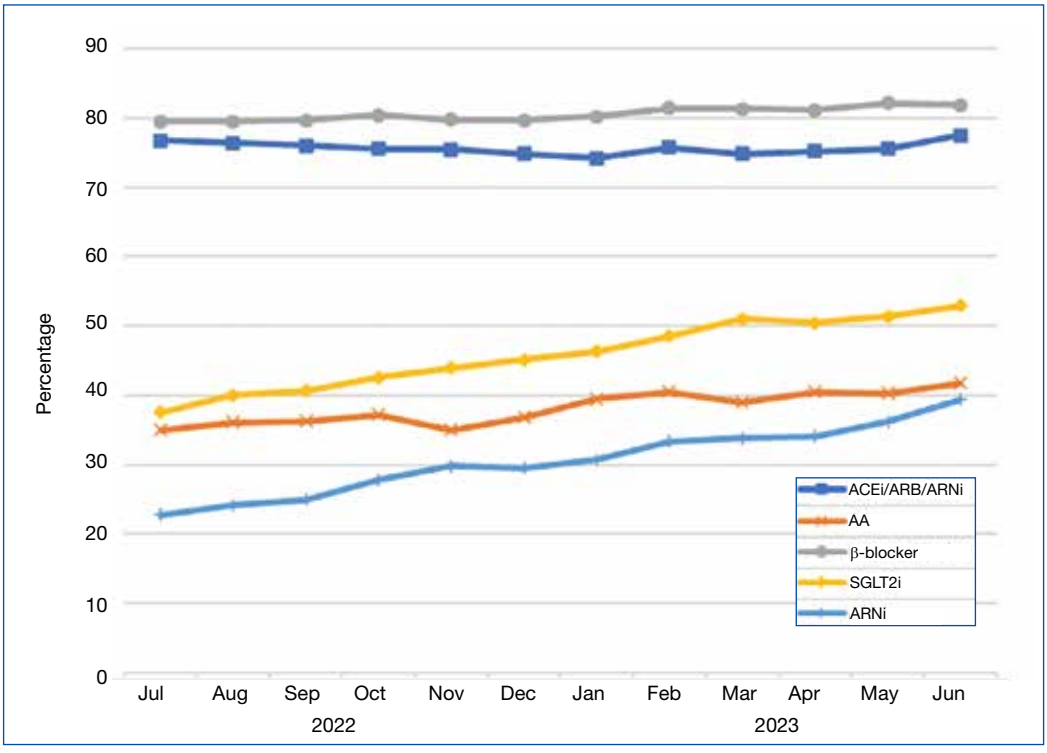
A surprising finding of this study was the lower rate of HF-related hospitalizations in the HT group. Although not the primary subject of interest in the study, it reinforced the importance of close health care professional follow-up for patients living with HF. Telehealth may improve communication and shared decision making over medication use. Because the finding was unanticipated, the rate of diuretic adjustments was not tracked.

Patients were reevaluated every 6 months for willingness to continue the program, adherence, and clinical needs. These results are similar to those of other trials that demonstrated improved rates of GDMT in the setting of pharmacist- or nurse-led HF treatment optimization.[15,16] These positive results differ from other trials incorporating remote monitoring regarding patient continuation in HT programs. For example, in a study by Ding and colleagues, the withdrawal rate from their monitoring service was about 22%, while in our study only 1 patient withdrew from the HT program.[11]

The HT program resulted in fewer hospitalizations than the control arm. There were 6 HF-related hospitalizations in the control group, although 5 involved a single patient. Typically, such a patient would be encouraged to follow HT monitoring after just 1 HF-related hospitalization; however, the patient declined to participate.

Early optimization of GDMT in patients who were recently discharged from the hospital for an HF-related hospitalization yields a reduction in hospital rehospitalization.[17] GDMT optimization has unequivocal benefits in HF outcomes. Unfortunately, the issues surrounding methodologies on how to best optimize GDMT are lacking. While HT has been found to be feasible in the aid of optimizing medical therapy, the TIM-HF trial concluded that remote monitoring services had no significant benefit in reducing mortality.[7,8] On the other hand, the OptiLink HF Study showed that when clinicians respond to remote monitoring prompts from fluid index threshold crossing alerts, these interventions are associated with

FIGURE 3 Rates of Guideline-Directed Medical Therapy Use at VAAAHS



Abbreviations: AA, aldosterone antagonist; ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; ARNi, angiotensin receptor-neprilysin inhibitor; SGLT2i, sodium-glucose cotransporter 2 inhibitor; VAAAHS, Veterans Affairs Ann Arbor Healthcare System.

significantly improved clinical outcomes in patients with implantable cardioverter-defibrillators and advanced HF.[9] In contrast to previous trials, the AMULET trial showed that remote monitoring compared with standard care significantly reduced the risk of HF hospitalization or cardiovascular death during the 12-month follow-up among patients with HF and LVEF ≤ 49% after an episode of acute exacerbation.[10] Additionally, patients who received skilled home health services and participated in remote monitoring for their chronic HF experienced a reduction in all-cause 30-day readmission.[18]

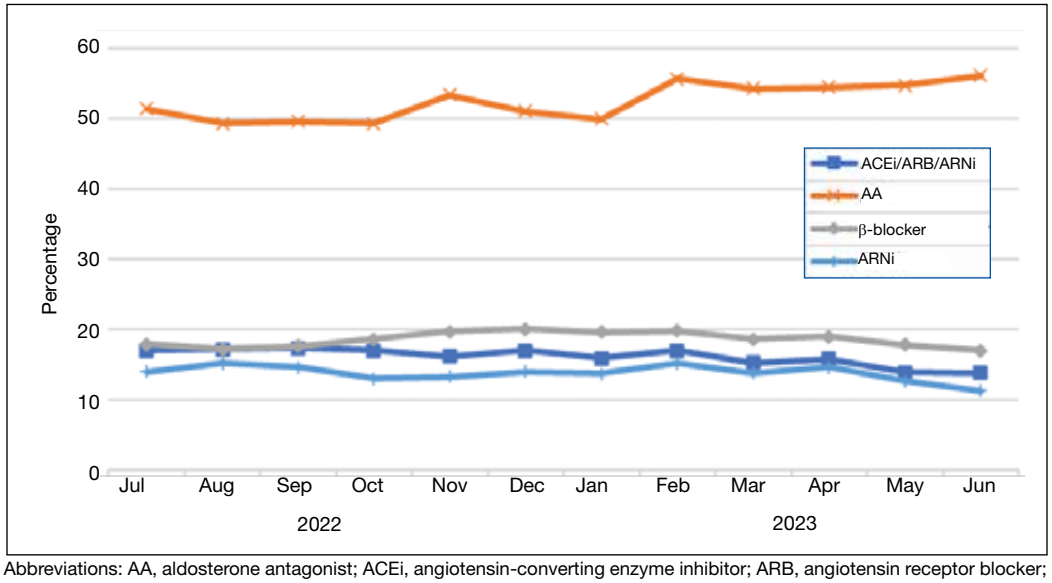
Given the contrasting evidence regarding remote monitoring and variable modalities of implementing interventions, we investigated whether HT monitoring yields improvements in GDMT optimization. We found that HT nurses were able to nearly double the rate of interventions for patients with HFrEF. The HT program in providing expanded services will require adequate staffing responsibilities and support. The HT program is geared toward following a large, diverse patient population, such as those with chronic obstructive pulmonary disease, hypertension, and HF. We only evaluated services for patients with HFrEF, but the program also follows patients with HfmrEF and HfpEF. These patients were not included as GDMT optimization differs for patients with an LVEF > 40%.[19,20]

The lower rates of achieving target doses of GDMTs were likely obstructed by continuous use of initial drug doses and further limited by lack of follow-up. When compared with the rest of the VAAAHS, there was a greater effort to increase ARNi use in the HT group as 7 of 33 patients (21%) were started on ARNi compared with a background increase of ARNi use of 17%. There was a lower mortality rate observed in the HT group compared with the control group. One patient in each group died of unrelated causes, while 2 deaths in the control group were due to worsening HF. The difference in mortality is likely multifactorial, possibly related to the control group's greater disease burden or higher mean age (75.2 years vs 72.6 years).

Limitations

This was an observational cohort design, which is subject to bias. Thus, the findings

FIGURE 4 Rates of Guideline-Directed Medical Therapy Use at Target Doses at VAAAHS



Abbreviations: AA, aldosterone antagonist; ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; ARNi, angiotensin receptor-neprilysin inhibitor; VAAAHS, Veterans Affairs Ann Arbor Healthcare System.

of this study are entirely hypothesis-generating and a randomized controlled trial would be necessary for clearer results. Second, low numbers of participants may have skewed the data set. Given the observational nature of the study, this nonetheless is a positive finding to support the HT program for assisting with HF monitoring and prompting drug interventions. Due to the low number of participants, a single patient may have skewed the results with 5 hospitalizations.

CONCLUSIONS

This pilot study demonstrates the applicability of HT monitoring to optimize veteran HFrEF GDMT. The HT program yielded numerically relevant interventions and fewer HF-related hospitalizations compared with the control arm. The study shows the feasibility of the program to safely optimize GDMT toward their target doses and may serve as an additional catalyst to further develop HT programs specifically targeted toward HF monitoring and management. Cost-savings analyses would likely need to demonstrate the cost utility of such a service.

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Ethics and consent

This study was approved by the Veterans Affairs Ann Arbor Healthcare System Institutional Review Board (reference number, 1703034) and Research and Development Committee.

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APPENDIX Guideline-Directed Reference Goal Medication Dosages for Heart Failure With Reduced Ejection Fraction

Class	Medication	Dosage	Daily frequency
Angiotensin-converting enzyme inhibitors	Captopril	50 mg	3
	Enalapril	10-20 mg	1
	Lisinopril	20-40 mg	1
	Ramipril	10 mg	1
Angiotensin receptor blockers	Candesartan	32 mg	1
	Losartan	150 mg	1
	Valsartan	160 mg	2
Angiotensin receptor-neprilysin inhibitor	Sacubitril/valsartan	97-103 mg	2
β-blocker	Bisoprolol	10 mg	1
	Carvedilol		
	Patient weight: < 85 kg	25 mg	2
	Patient weight: ≥ 85 kg	50 mg	2
	Metoprolol succinate	200 mg	1
Aldosterone antagonist	Spironolactone	25-50 mg	1
	Eplerenone	50 mg	1
Sodium-glucose cotransporter-2 inhibitor	Empagliflozin	10 mg or 12.5 mg[a]	1

[a]US Department of Veterans Affairs dose per price savings initiative.