Title

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ORIGINAL ARTICLE

DASH-HF Study: A Pragmatic Quality Improvement Randomized Implementation Trial for Patients With Heart Failure With Reduced Ejection Fraction

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BACKGROUND: Heart failure is a prevailing diagnosis of hospitalization and readmission within 6 months, and nearly a quarter of these patients die within a year. Guideline-directed medication therapies reduce risk of mortality by 73% over 2 years; however, the implementation of these therapies to their target dose in clinical practice continues to be challenging. In 2020, the Veterans Affairs (VA) Health Care System developed a HF dashboard to monitor and improve outpatient HF management. The DASH-HF (Dashboard Activated Services and Telehealth for Heart Failure) study is a randomized, pragmatic clinical trial to evaluate proactive dashboard-directed telehealth clinics to improve the use and dosing of guideline-directed medication therapy for patients with heart failure with reduced ejection fraction not on optimal guideline-directed medication therapy within the VA.

METHODS: Three hundred veterans with heart failure with reduced ejection fraction met inclusion criteria with an optimization potential score (OPS) of 5 or less out of 10, representing nonoptimal guideline-directed medication therapy. The primary outcome was a composite score of guideline-directed medical therapy, the OPS, 6 months after the end of the intervention. Secondary outcomes included active prescriptions for each individual guideline-directed medical therapy class, HF-related hospitalizations, deaths, and clinician time per patient during the intervention clinics.

RESULTS: There was no significant difference between the intervention arm and usual care group in the primary outcome (OPS, 2.9; SD=2.1 versus OPS, 2.6, SD=2.1); adjusted mean difference 0.3 (95% CI, −0.1 to 0.7) or in the prespecified secondary outcomes for hospitalization and all-cause mortality for the intervention of proactive dashboard-based clinics.

CONCLUSIONS: A dashboard-based clinic intervention did not improve the OPS or secondary outcomes of hospitalization and all-cause mortality. There remains a larger opportunity to better target patients and provide more intensive follow-up to further evaluate the utility of proactive dashboard-based clinics for HF management and quality improvement.

REGISTRATION: URL: https://www.clinicaltrials.gov; Unique identifier: NCT05001165.

Key Words: guideline-directed medical therapy ■ heart failure with reduced ejection fraction ■ medications ■ quality improvement ■ telehealth

See Editorial by DiDomenico and Vardeny

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WHAT IS NEW?

- We investigated the utility and outcomes of a dashboard-guided telehealth panel management clinic to improve use and dosing guideline-directed medication therapy for patients on suboptimal therapies based on the optimization potential score.

WHAT ARE THE CLINICAL IMPLICATIONS?

- There is a persistent gap in the implementation of guideline-directed medication therapy in patients in heart failure.
- We implemented a pragmatic, prospective quality improvement trial to explore strategies to bridge heart failure care gaps using EMR-based dashboards and structured telehealth programs to improve guideline-directed medication therapy rates and HF outcomes.

Nonstandard Abbreviations and Acronyms

ARNI	angiotensin receptor neprilysin inhibitor
DASH-HF	Dashboard Activated Services and Telehealth for Heart Failure
GDMT	guideline-directed medical therapy
HFrEF	heart failure with reduced ejection fraction
OPS	optimization potential score
SGLT2i	sodium glucose cotransporter-2 inhibitor

Heart failure (HF) is a leading diagnosis for hospitalization and is associated with a high risk for morbidity and mortality.[1,2] Approximately half of all patients hospitalized for HF are readmitted within 6 months of discharge, and nearly a quarter die within a year.[2–4] Guideline-directed medication therapy (GDMT) includes Class I indicated medications from the following classes: beta blockers, ACE (angiotensin-converting enzyme) inhibitors, angiotensin II receptor blockers, angiotensin receptor neprilysin inhibitors, mineralocorticoid receptor antagonists, SGLT2is (sodium glucose cotransporter-2 inhibitors) that together may reduce risk of mortality by 73% over 2 years.[5,6] However, the implementation of these therapies to their target dose in clinical practice continues to be challenging. Multiple studies have shown eligible patients with heart failure with reduced ejection fraction (HFrEF) are not receiving recommended HF therapy, those receiving HF therapy are not on target doses, and that little to no adjustment in GDMT are made longitudinally in outpatient settings.[7–9]

The United States Department of Veterans Affairs (VA) Health Care System provides care to more than 2 million veterans with cardiovascular disease, with HF being one of the most common diagnoses for hospitalization.[10] In 2020, the VA developed a HF dashboard using natural language processing derived left ventricular ejection fraction measurement and EHR data to monitor outpatient HF management.[11] There is an opportunity to leverage the HF dashboard to examine methods for improving HF care delivery. The DASH-HF (Dashboard Activated Services and Telehealth for Heart Failure) study is a randomized, pragmatic clinical trial to evaluate proactive dashboard-directed clinics to improve the use and dosing of GDMT for veterans with HFrEF who are not on optimal GDMT and do not have close scheduled follow-up with their cardiologist. The primary hypothesis is that the intervention can improve use and dosing of GDMT as measured on the VA dashboard over 6 months of follow-up compared with usual care. DASH-HF is registered on clinicaltrials.gov (identifier NCT05001165).

METHODS

Trial Design and Oversight

Details on the design of the DASH-HF trial have been described.[12] The data that support the findings of this study are available from the corresponding author upon reasonable request. We conducted a single center, prospective, randomized open-label trial to evaluate the effectiveness of a panel management intervention.

DASH-HF is designed as a pragmatic trial to include participants across various home settings, including nursing homes, and to be implemented by clinicians from different disciplines (eg, physicians, nurse practitioners, and clinical pharmacists). The study incorporates the existing VA HF dashboard to target actionable patients with gaps in performance measures for GDMT. The outcomes of the study were pragmatically captured from routinely collected data and quality measures from the VA dashboard. The dashboard data includes demographics, hospitalization risk scores, VA hospitalizations in the past 12 months, vital signs, laboratory values, active GDMT prescriptions, and upcoming appointments. The intervention includes audio telehealth panel management clinics led by clinicians. A central institutional review board provided approval of the study (IRB No. 1616104-1). Waiver of patient consent was granted for the intervention since it did not include experimental medical therapies and was of minimal risk to patients randomized to the novel clinic format.

Patients

Patients with HFrEF receiving care at a Greater Los Angeles (GLA) VA primary care facility were considered for inclusion, an automated definition within the VA HF dashboard. The VA GLA is 1 of the largest and most comprehensive health care facilities within the VA network, serving 1.5 million veterans residing in 5 counties. The VA GLA offers 6 half-day clinics for HF or general cardiology accessible to veterans with HF. GLA currently serves 2 ambulatory care centers and 8 community-based outpatient clinics. Included patients were those over the age of 18 years, with a primary diagnosis of HFrEF with

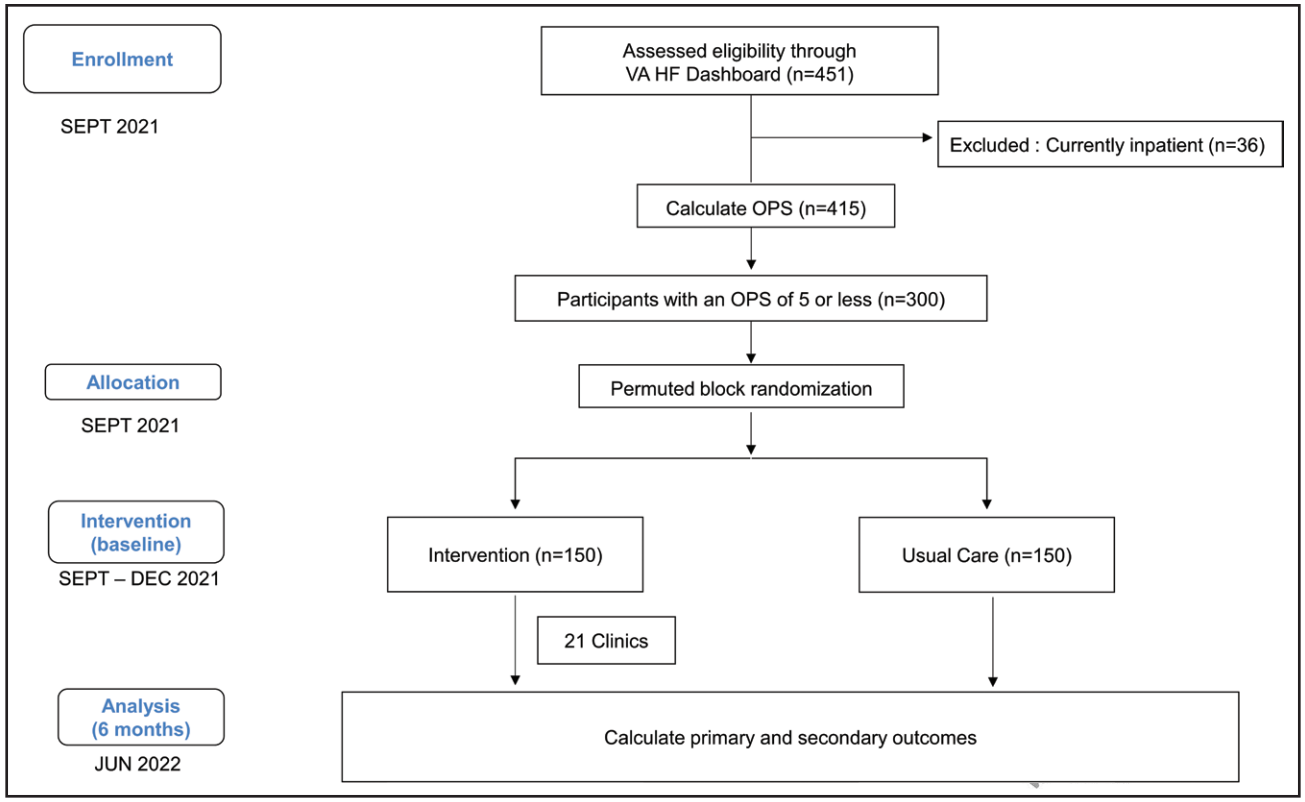

Figure 1. CONSORT diagram of trial.
CONSORT indicates Consolidated Standards of Reporting Trials; HF, heart failure; OPS, optimization potential score; and VA, Veterans Affairs.

a last documented left ventricular ejection fraction ≤35%, an estimated glomerular filtration rate ≥30 mL/minuter, and optimization potential score (OPS) of less than or equal to 5 out of 10, and no general cardiology or HF appointments in the upcoming 2 weeks (Figure 1). Exclusion criteria included if the dashboard indicated that the patient was currently hospitalized at the GLA VA.

The OPS was created by the investigators, using an approach similar to that used to characterize baseline GDMT use and dosing of clinical trial participants[13–15] to quantify GDMT optimization (Table 1). It was calculated based on the presence of each class of GDMT and total daily dose of each medication as listed on the patient's active medications in the VA dashboard (Figure S1). The OPS ranged from 0 to 10. Scores of 0 indicated the highest potential for further optimization and a score of 10 indicated that the patient is on all recommended medications at target doses. Other scores described in the literature include the optimal medical therapy score, which defined a score of 5 or more out of 8 as optimal.[13] Similarly, our study targeted patients who scored 5 or less out of 10 on the OPS. The goal of the OPS was to underscore the value of patients being on not only each class of GDMT, but also on the target doses used in landmark clinical trials. At the time of the study, a clinician in the VA was recommended to optimize ACE inhibitor/angiotensin II receptor blocker and beta blocker for outpatients before switching to an angiotensin receptor neprilysin inhibitor, so 2 additional points were granted to reflect the complexity of titration. Since the study's completion, the recommendations have been updated to no longer require optimization of ACE inhibitor/angiotensin II receptor blocker and beta blocker doses before initiating angiotensin receptor neprilysin inhibitor.

Table 1. Optimization Potential Score

	Points		
	None	Low dose	Target dose
ACEI/ARB/ARNI	0	1	2
Beta blocker	0	1	2
MRA	0	1	2
ARNI	0	1	2
SGLT2i	0	…	2

The OPS ranges from 0 to 10, with 0 indicating the largest gap in GDMT. ACEI indicates angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; ARNI, angiotensin receptor neprilysin inhibitor; GDMT, guideline-directed medical therapy; MRA, mineralocorticoid receptor antagonist; OPS, optimization potential score; and SGLT2i, sodium-glucose cotransporter-2 inhibitor.

Randomization

Randomization with permuted blocks (size=6) was used to assure that treatment allocations were balanced. The study statistician generated concealed randomization assignments by participant identification numbers.

Quality Improvement Intervention

The intervention included telehealth-based clinics, or DASH-HF clinics, for the target population. The clinics were led by clinicians (board-certified cardiologist, advanced HF cardiologist,

nurse practitioner, cardiology fellow, advanced HF fellows [2], internal medicine resident and clinical pharmacists [2]).

Clinicians staffing the clinic were provided a list of 10 to 15 intervention patients and worked at their own pace. The clinicians reviewed dashboard data and EHR and decided whether to proceed with a telehealth encounter. If the clinician did not have sufficient time to review all patients assigned to that day's clinic, the remaining patients were redistributed to future clinics. Patients who did not answer phone calls received mailed patient letters to encourage cardiology follow-up. Patients that were not able to be contacted were not reassigned to future panel management clinics. DASH-HF clinics were held until all subjects assigned to the intervention group had a chart review or attempted telephone contact.

The study's lead author and principal investigator (A.V., B.Z.) provided patient interview templates and GDMT optimization resources based on the latest professional guidelines to ensure consistency across all providers. If a patient did not qualify for further optimization (ie, chart documentation of prior intolerance or patient preference), clinicians documented a brief note in the EHR that informed the patient's existing providers that based on chart review, no opportunity currently existed for GDMT titration. If a patient appeared to have an opportunity for optimization, the clinician contacted the patient impromptu via telephone to see if they were available to discuss their HF care. Patients provided verbal consent to proceed with the study intervention once the purpose of the phone call was explained. If the patient agreed, a formal telehealth cardiology visit took place over the phone.

If a formal telehealth visit occurred, clinicians inquired about symptoms, medication adherence, and adverse events based on the clinician interview template (Figure S2). Clinicians then provided their recommendations based on the patient interview. Any medication addition or titration with laboratory and diagnostic tests, return-to-clinic orders, and referrals to HF or general cardiology clinic were ordered per usual care.

Outcomes

The primary outcome of the study was the OPS 6 months after the end of the intervention and represented the composite score of all active prescriptions and prescribed doses for each class of GDMT. Secondary outcomes were active prescriptions for each individual class of GDMT, HF-related hospitalizations, all-cause death, and clinician time per patient during the intervention clinics. Clinical events were determined by blinded reviewers. There was an opportunity for a qualitative evaluation of feedback from participants who received the intervention.

Study end points were pragmatically captured from the VA dashboard by a VA data analyst outside of the study who was unaware if participants were assigned to the intervention or control group. 6 months after the last intervention clinic, dashboard data was downloaded for all study participants by personnel outside of the study. The dashboard data were used to pragmatically ascertain all study end points. Patients no longer listed on the dashboard were chart reviewed in a blinded fashion to abstract relevant end points. If patients died before the end of the period observations, active prescriptions before death were recorded as their most recent GDMT. The most common reason for patients to be removed from the dashboard was death or moving to another VA health care system.

Statistical Analysis

The study was powered to detect superiority of the intervention compared to usual care with respect to the primary outcome using the OPS. Using a baseline average OPS of 2.5 and SD of 1.5 as calculated for the population of patients with an OPS of 5 or less at a single center, we estimated a sample of 300 patients to have 83% power to detect an absolute difference of 0.625 between groups, which corresponds to a 25% improvement upon an assumed baseline mean of 2.5 (SD assumed 1.9 for the intervention arm).

The primary analysis was performed using linear regression with covariate adjustment for age and baseline OPS. $P<0.05$ significance threshold was used for all analyses. After randomization, no further modifications were made to the randomization assignments, and effectiveness was evaluated based on an intention-to-treat principle. Outcomes were determined based on redownloading of the VA HF dashboard. A blinded chart review was performed to identify the presence of concomitant psychosocial factors including housing insecurity, substance use disorder, and severe psychiatric illness. A post hoc exploratory per protocol analysis was conducted comparing only those intervention group patients who were able to be contacted compared with the control group. We conducted the analysis using R version 4.1.2.

RESULTS

Patients

In September 2021, among 451 eligible participants identified from the HF dashboard, 300 participants who scored an OPS of 5 or less out of 10 were included. One hundred fifty veterans were randomized to receive the intervention across 21 DASH-HF clinics over a 12-week period from September to December 2021. One hundred fifty veterans were randomized to the usual care group. Among the enrolled participants, the mean (SD) age was 71.1 (11.5) in the intervention arm and 72.1 (10.6) in the control arm and the baseline OPS was 2.5 (1.5) for both groups. The intervention and usual care groups were similar in baseline demographics, vitals, and past hospitalizations (Table 2).[16]

Clinic Workflow

On average, 7 patients were seen per DASH-HF clinic, ranging widely between 3 and 12 patients per clinic. DASH-HF clinics were designed as half-academic days so on average, 2 patients were seen per hour. The fewest patients were seen by pharmacists.

Outcomes

The composite OPS for the intervention group was 2.9 (SD=2.1) and 2.6 (SD=2.1) for the control group; adjusted mean difference 0.3 (95% CI, −0.1 to 0.7). The rates for active prescriptions for all classes of GDMT

Table 2. Baseline Characteristics of Enrolled Patients

Characteristic	n (%)	
	Intervention	Usual care
No. patients	150	150
Age, y	71.1 (11.5)	72.1 (10.6)
Sex, male	148 (98.7)	148 (98.7)
Race		
Black	49 (32.7)	43 (28.7)
White	74 (49.3)	82 (54.7)
Asian	5 (3.3)	2 (1.3)
Native Hawaiian or Other Pacific Islander	2 (1.3)	2 (1.3)
American Indian or Alaska Native	0 (0)	1 (0.7)
Unknown	20 (13.3)	20 (13.3)
3 mo (3M) hospitalization rank*	92 (83–97)	91 (81–97)
>1 HF admissions (VA-1Y) (%)†	4.7%	4.7%
Baseline OPS (mean, SD)	2.5 (1.5)	2.5 (1.5)
Baseline OPS		
0	19 (12.7)	18 (12.0)
1	22 (14.7)	24 (16.0)
2	38 (25.3)	36 (24.0)
3	31 (20.7)	32 (21.3)
4	22 (14.7)	21 (14.0)
5	18 (12.0)	19 (12.7)
Baseline medications		
ACEI/ARB/ARNI	102 (68.0)	99 (66.0)
BB	118 (78.7)	120 (80.0)
MRA	44 (29.3)	44 (29.3)
SGLT-2i	16 (10.7)	17 (11.3)
GDMT target dose achieved, %		
ACEI/ARB/ARNI	15 (10.0)	15 (10.0)
BB	15 (10.0)	18 (12.0)
MRA	16 (10.7)	14 (9.3)
SGLT2i	16 (10.7)	17 (11.3)
Systolic blood pressure‡ (IQR), mm Hg	125 (111–134)	119 (107–135)
Diastolic blood pressure‡ (IQR), mm Hg	69 (59–77)	69 (58–79)
Pulse‡ (IQR), bpm	75 (66–85)	74 (67–85)
Weight‡ (IQR), lb	187 (158–222)	188 (157–225)
Housing insecurity		
Prior history	37 (25)	30 (20)
Currently homeless	10 (7)	15 (10)
Active substance use	30 (20)	25 (17)
Severe psychiatric illness	17 (11)	11 (7)
Any 3 above psychosocial factors present	61 (41)	56 (37)

ACEI indicates angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; ARNI angiotensin receptor neprilysin inhibitor; BB beta blocker; HF, heart failure; MRA mineralocorticoid receptor antagonist; OPS, optimization potential score; and SGLT2i, sodium-glucose cotransporter-2 inhibitor.

*3M rank is the risk percentile with 99% representing the greatest risk of being admitted within the next 3 months.[16]

†HF admissions are all discharges from an inpatient VA setting in the past year with a primary discharge diagnosis of HF.

‡Blood pressure and pulse are the most recent values extracted into the VA dashboard in the past year. Weight as reported in the past 3 years.

was higher in the intervention group than the control group, however, it did not reach statistical significance for any of the individual medications (Figure 2). The number of total hospitalizations at a VA hospital was 29 in the intervention group and 17 in the usual care group; adjusted odds ratio, 1.87 (95% CI, 0.99–3.64). Of these hospitalizations, 12 and 6 were related to HF in the intervention and usual care group, respectively; adjusted odds ratio, 2.06 (95% CI, 0.78–6.09). Mortality was lower in the intervention group, but not statistically significant; adjusted odds ratio, 0.68 (95% CI, 0.34–1.33; Tables 3 and 4).

Out of the 150 veterans randomized to the intervention group, 60 veterans, or 40%, were successfully contacted over phone. The baseline OPS for the contacted veterans was 2.3 (SD=1.6) and 2.6 (SD=1.5) for the remaining veterans (Table S1). At the end of the study, the composite OPS for the successfully contacted group only was 3.2 (SD=2.1) and 2.7 (SD=2.1) for the remaining 90 participants. The treatment effect estimate for intervention participants who were successfully contacted compared with the 150 control patients was 0.60 ([95% CI, 0.1–1.2]; *P*=0.02; Tables S2 and S3 and Figures S3 and S4). The comparisons were adjusted for the same covariates as in the primary analysis, age, and baseline OPS. There were 10 hospitalizations in the contacted group, 19 in the remaining intervention patients, and 17 in the control arm. Among these hospitalizations, there were 4, 8, and 6 related to HF, in the contacted, not contacted, and control arm, respectively. When comparing the 60 treatment patients who were successfully contacted against the 150 control patients, the adjusted odds ratio for hospitalizations was 1.56 ([95% CI, 0.65–3.60]; *P*=0.30) and 1.72 ([95% CI, 0.43–6.27]; *P*=0.41) for HF hospitalizations. The number of deaths appeared to favor the group of intervention patients who were contacted in the per protocol analysis, but this is a limitation of the analysis; patients in the intervention group who died early in the study were not contacted.

There was a large prevalence of psychosocial barriers, defined as housing insecurity, active substance use, and severe psychiatric illness with 41% having any 1 of these factors in the intervention arm and 37% in the control arm. An analysis of the subgroup of patients who could not be contacted demonstrated that 42% of patients experienced 1 or more of these factors versus 38% in the subgroup that was contacted. Within the group of patients who could not be reached, 17% experienced housing instability, 14% severe psychiatric illness, and 11% substance use. In the contacted group, 18% of patients experienced housing instability, 12% severe psychiatric illness, and 8% substance use. In addition, 8% of patients who could not be contacted passed away in the period between randomization and the intervention. Excluding those patients who passed away, 46%

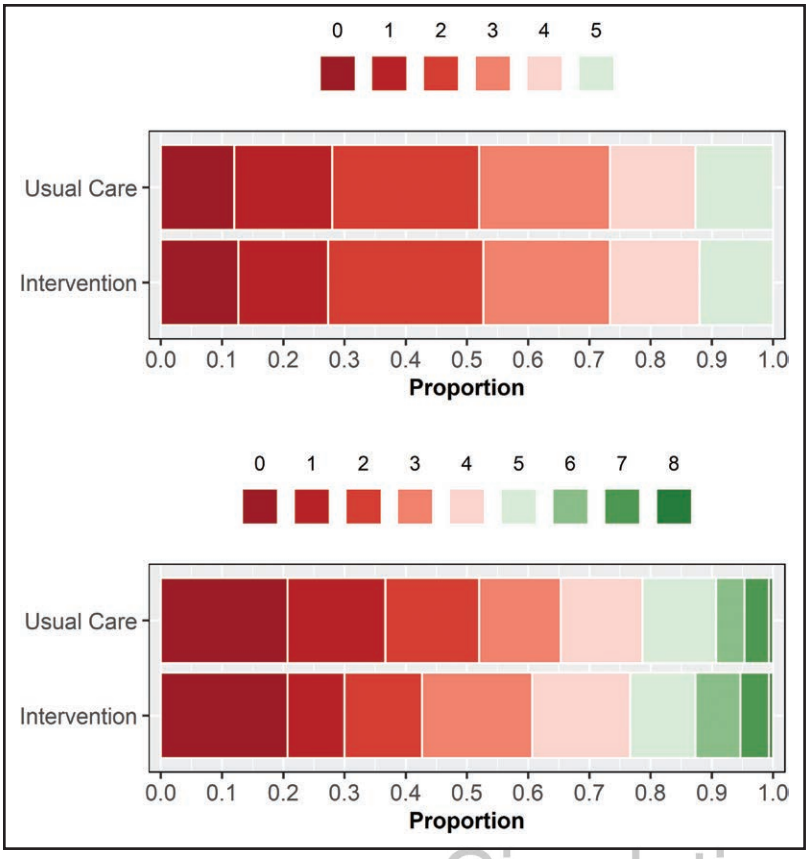

Figure 2. Distribution of baseline and follow-up optimization potential score (OPS) by treatment group. OPS distribution in the usual group vs intervention group at baseline (top) and 6 months post-intervention (bottom). Note that the baseline OPS ranges from 0 to 5 based on the study design.

of patients who could not be reached experienced 1 or more psychosocial barriers.

DISCUSSION

In this single center, randomized pragmatic quality improvement trial of patients with HFrEF, a single-point intervention did not significantly improve use and dosing of GDMT for HFrEF patients on nonoptimal therapies nor were prescription rates of individual GDMT classes increased. All active prescriptions of GDMT and the composite OPS were numerically higher in the intervention group, but the differences were not statistically significant. There was no difference between the 2 groups for the other prespecified secondary outcomes including total and HF-related hospitalizations and death. A numerically higher hospitalization rate was noted in the intervention arm, which may be expected in an intervention of this nature that intends to engage patients with the largest care gaps.

Dashboards that incorporate structured electronic health information can produce patient-specific risk assessments to aid in adherence to guidelines and reveal gaps in management.[17–20] In the context of HF, dashboards have been shown to support GDMT recommendations and reduce HF admissions.[21–23] In the VA, dashboards can provide continuous feedback and support to improve the quality, safety, and value of health care to veterans.[24] Several studies have suggested that treatment of patients in specialized HF clinics reduce frequency of HF readmission, optimize GDMT and education, and result in improved functional status.[25–27] The effect on all-cause mortality and all-cause hospitalization is less clear.[27–29] The rapid adoption of telehealth during the COVID-19 pandemic[30] served as an impetus to leverage telehealth to engage veterans with HF. Findings in this study demonstrate potential of leveraging the HF dashboard and panel management clinics to optimize GDMT; however, the quality improvement intervention must be modified to more effectively reach the target population or refine the patient population that will benefit from this type of an intervention.

The study participants in DASH-HF were veterans on the least optimal rates of GDMT as represented by an OPS of 5 or lower, and only about 10% of patients in both the intervention and control arms were treated with target doses of any 1 class of GDMT. These estimates were comparable to those identified in the CHAMP-HF registry.[8] Similar baseline GDMT adherence rates with modest postintervention improvements were seen with other novel approaches to GDMT optimization such as patient activation tools[31] and electronic alerts.[32] One-point changes in GDMT scoring systems such as the OPS have been described as clinically meaningful.[13] DASH-HF participants experienced a large burden of complicating psychosocial factors, which was hypothesized to

Table 3. Primary and Secondary Outcomes

	Intervention	Usual care	Treatment effect estimate	*P* value
Primary outcome			**Adjusted mean difference (95% CI)**	
Composite OPS (mean, SD)	2.9 (2.1)	2.6 (2.1)	0.3 (−0.1 to 0.7)	0.18
Composite OPS (n, %)				
0	31 (20.7)	31 (20.7)		
1	14 (9.3)	24 (16.0)		
2	19 (12.7)	23 (15.3)		
3	27 (18.0)	20 (13.3)		
4	24 (16.0)	20 (13.3)		
5	16 (10.7)	18 (12.0)		
6	11 (7.3)	7 (4.7)		
7	4 (4.7)	6 (4.0)		
8	1 (0.7)	1 (0.7)		
Secondary outcomes			**Adjusted odds ratio (95% CI)**	
ACEI/ARB/ARNI	97 (64.7)	86 (57.3)	1.34 (0.84 to 2.14)	0.23
BB	109 (72.7)	107 (71.3)	1.06 (0.64 to 1.76)	0.81
MRA	53 (35.3)	47 (31.3)	1.19 (0.73 to 1.93)	0.48
ARNI	35 (23.3)	31 (20.7)	1.18 (0.68 to 2.05)	0.55
SGLT2i	44 (29.3)	33 (22.0)	1.48 (0.88 to 2.51)	0.14

ACEI indicates angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; ARNI, angiotensin receptor neprilysin inhibitor; BB, beta blocker; MRA, mineralocorticoid receptor antagonist; OPS, optimization potential score; and SGLT2i, sodium-glucose cotransporter-2 inhibitor.

contribute to the persistently low rates of GDMT and variable telehealth response rates.

The process of promoting health and managing illness depends on a patient's ability to focus on and prioritize self-care. Major depressive disorder is associated with increased hospitalization and mortality in patients with HF.[33,34] Substance abuse and homelessness is associated with increased frequency of hospitalizations and readmissions for HF.[35–37] These factors can also contribute to difficulties in accessing regular care, with many homeless patients being lost to follow-up until exacerbations necessitate increased visits to the emergency department and hospitalization.[36,38]

In addition, only 40% of participants assigned to the intervention were successfully contacted despite multiple attempts to reach the veterans over telephone. In prospective trials attempting to contact patients in the post-hospitalization setting, successful telephone contact rates have been cited as a range from 35%[39] to 58%,[40] comparable to the response rate in this study. Based on the per protocol analysis, the postintervention OPS was significantly higher in the subset of veterans who were contacted than those who were not, such that the treatment effect between those who were contacted versus the usual group was statistically significant. One concern in this form of a per protocol analysis is that patients who were contacted were on more optimal GDMT than those assigned to the intervention who could not be contacted, however, the baseline OPS of the 2 groups suggests against this. Nevertheless, this form of per protocol analysis might overestimate the treatment effect of the intervention.

All patient contact in the intervention group consisted of ad-hoc telephone calls, meaning the patients contacted were not informed beforehand that they would be receiving a call from our group and may have been unprepared to answer the phone call. Low telephone response rates have been previously described in the literature. In 1 quality improvement study, patients were instructed before discharge that they should anticipate a postdischarge call to review home care instructions and address any remaining questions. In this study, 35% of patients were successfully contacted.[39] The pragmatic nature of the study design did not include an opportunity to inform patients to expect a phone call from providers nor were we able to ensure that we had the most updated contact information for veterans.

In their 2020 article on understanding the complexity of HF risk, Nayak et al[41] aptly conclude that since the causes for health disparities are multifactorial,

Table 4. Safety Outcomes

	Intervention	Usual care	Treatment effect estimate (95% CI)	*P* value
Hospitalization (any)	29 (19.3)	17 (11.3)	1.87 (0.99–3.64)	0.06
Hospitalization (count)				
0	121 (80.7)	133 (88.7)		
1	14 (9.3)	11 (7.3)		
2	10 (6.7)	6 (4.0)		
3	2 (1.3)	0 (0.0)		
4	0 (0.0)	0 (0.0)		
5	1 (0.7)	0 (0.0)		
6	0 (0.0)	0 (0.0)		
7	2 (1.3)	0 (0.0)		
HF hospitalization (any)	12 (8.0)	6 (4.0)	2.06 (0.78–6.09)	0.16
HF hospitalization (count)				
0	138 (92.0)	144 (96.0)		
1	6 (4.0)	5 (3.3)		
2	4 (2.7)	1 (0.7)		
3	0 (0.0)	0 (0.0)		
4	1 (0.7)	0 (0.0)		
5	1 (0.7)	0 (0.0)		
6	0 (0.0)	0 (0.0)		
7	0 (0.0)	0 (0.0)		
Death	17 (11.3)	24 (16.0)	0.68 (0.34–1.33)	0.27

HF indicates heart failure.

the solutions will need to be multifactorial as well. The authors review interventions at the community, organizational, and the policy level to characterize and address the socioeconomic factors that affect HF outcomes. Not infrequently, the DASH-HF participants had inconsistent and sparse health care contact. These veterans might have benefited more from resources for basic needs such as housing to ultimately build the foundation needed for a robust HF care plan. While there was a system for HF clinic coordinators and social workers to contact the intervention participants to schedule follow-up and mail letters, the frequency of touchpoints was potentially insufficient for this population. While this trial demonstrated feasibility to recruit and contact participants, it was limited in the extent of multilevel case management resources to address socioeconomic barriers and novel strategies to successfully contact the patient population.

Limitations

DASH-HF is limited as a single large health system randomized controlled trial. The study allowed us to assess the feasibility and implementation of a pragmatic, randomized health services intervention. A large sized trial with randomization at the point of care and longer follow-up may have improved the power to detect the advantage of care organized under proactive dashboard management. Additionally, the study did not exclude patients from analysis where lack of GDMT was appropriate when it did not align with the veteran's goals of care such as adults who were on hospice. The study could not systematically assess reasons for suboptimal GDMT optimization (eg, patient preference) due to lack of contact with all patients and incomplete chart documentation from chart review.

One major limitation of the study was the ability to contact 40% of the veterans in the intervention arm over telephone. In the instances that the veteran could not be reached by telephone after several attempts, providers mailed letters and flagged recent primary care and cardiology providers in the EHR to encourage discussion around GDMT optimization. Other forms of telehealth contact (eg, email, text) could be explored in subsequent trials. An intervention of this nature may also need to exclude patients with significant socioeconomic barriers such as severe mental illness, homelessness, and substance use who would require specialized teams and wraparound services to effectively integrate those patients back into outpatient HF care.

Based on DASH-HF clinics designed as half-academic days, approximately 2 patients were seen per hour, which mirrors the workflow in our usual subspecialty outpatient clinic. Given the nature of the intervention, these patients had large care gaps in HF and many were lost to care, requiring more intensive chart review and patient interface. Even after successfully reaching patients, care coordination and patient counseling was time intensive. For example, providers spent extra time outside of the telephone encounter for patients in extended care facilities who required communication with facility personnel to arrange diagnostic testing or changes in medications. On the other hand, an advantage of the clinic was the flexibility to providers in scheduling clinics based on their own time and preference. In doing so, we completed the intervention in a timely manner over 3 months despite limited resources and volunteer staff.

These results may not be generalizable to other health systems or patient populations. Notably, the VA health system is an integrated system with a public formulary list that included all classes of GDMT with no or minimal cost requirements to veterans. Outside of the VA health system, a 2018 cost assessment of sacubitril/valsartan found that affordability remains a barrier to adoption. Medicare patients prescribed an angiotensin receptor neprilysin inhibitor could face annual costs of $1685 (nearly $1400 more than those prescribed an angiotensin II receptor blocker)[42] and about $50 monthly for SGLT2i.[43] Performing the study in the VA health system helped bypass the complexities of insurance and medication costs, focusing efforts on leveraging the VA dashboard and telehealth for HF management.

DASH-HF was passive in evaluating clinical outcomes using the established VA HF dashboard. The ability to include community hospitalizations or Medicare data in a timely fashion would have improved event capture and power of the study. There was a numerically higher hospitalization rate in the intervention arm although this did not meet statistical significance. The higher hospitalization rate likely does not represent harm from the intervention. The increase in healthcare contact might have encouraged patient engagement and evaluation as suggested by scenarios where providers in the intervention arm recommended evaluation in the Emergency Department based on the telehealth encounter. A similar phenomenon was noted in EPIC-HF which similarly intended to actively engage patients in their care.[31]

Conclusions

DASH-HF was a prospective, single center, randomized pragmatic quality improvement trial that utilized the VA HF dashboard to reduce gaps in GDMT using telehealth panel management clinics. This pilot study attempted to design and study a dashboard-guided telehealth clinic to engage with patients with the largest HF care gaps. The prespecified outcomes criteria were not met for the change in OPS or secondary outcomes for hospitalization and all-cause mortality for the intervention of proactive dashboard-based clinics. There remains a larger opportunity to tailor interventions and better target patient populations such as individuals with psychosocial barriers to their care. Future quality improvement efforts

for high-risk patients, such as those in DASH-HF, could integrate holistic efforts such as with the Patient Aligned Care Teams and mental health providers.

ARTICLE INFORMATION

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Disclosures

Dr Fonarow reports consulting for Abbott, Amgen, AstraZeneca, Bayer, Cytokinetics, Edwards, Janssen, Medtronic, Merck, and Novartis. There are no disclosures for the other authors.

Supplemental Material

Figures S1–S4
Tables S1–S3

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