

Cluster-Randomized Trial of Personalized Site Performance Feedback in Get With The Guidelines-Heart Failure

Adam D. DeVore, MD; Margueritte Cox, MS; Paul A. Heidenreich, MD, MS;
Gregg C. Fonarow, MD; Clyde W. Yancy, MD; Zubin J. Eapen, MD, MHS;
Eric D. Peterson, MD, MPH; Adrian F. Hernandez, MD, MHS

Background—There is significant variation in the delivery of evidence-based care for patients with heart failure (HF), but there is limited evidence defining the best methods to improve the quality of care.

Methods and Results—We performed a cluster-randomized trial of personalized site performance feedback at 147 hospitals participating in the Get With The Guidelines-Heart Failure quality improvement program from October 2009 to March 2011. The intervention provided sites with specific data on their heart failure achievement and quality measures in addition to the usual Get With The Guidelines-Heart Failure tools. The primary outcome for our trial was improvement in site composite quality of care score. Overall, 73 hospitals (n=33 886 patients) received the intervention, whereas 74 hospitals (n=37 943 patients) did not. One year after the intervention, both the intervention and control arms had a similar mean change in percentage points in their composite quality score (absolute change, +0.31 [SE, 1.51] versus +3.18 [SE, 1.68] in control; $P=0.21$). Similarly, none of the individual achievement measures or quality measures improved more at intervention versus control hospitals.

Conclusions—Our site-based intervention, which included personalized site feedback on adherence to quality metrics, was not able to elicit more quality improvement beyond that already associated with participation in the Get With The Guidelines-Heart Failure program.

Clinical Trial Registration—URL: <http://www.clinicaltrials.gov>. Unique identifier: NCT00979264.

(*Circ Cardiovasc Qual Outcomes*. 2015;8:421-427. DOI: 10.1161/CIRCOUTCOMES.114.001333.)

Key Words: heart failure ■ hospitals ■ quality of health care ■ quality improvement ■ randomized controlled trial

During the past decade, payers, providers, and health systems have increasingly focused on closing the quality chasm for health care in the United States. Heart failure (HF) is a classic depiction of the challenges involved in delivering high-quality care within our current healthcare environment. More than 5 million Americans have HF, and treatment for HF costs are ≈\$31 billion annually.¹ Despite the prevalence of this common and costly condition, delivery of evidence-based HF care varies significantly across hospitals, as do HF patient outcomes.²⁻⁴

Editorial see p 335

Improving adherence to evidence-based recommendations has been the focus of large quality improvement initiatives, such as the Get With The Guidelines-Heart Failure (GWTG-HF) program.⁵ GWTG-HF began in 2005 and provides clinical decision support tools, educational materials oriented to patients and providers, and the ability for hospitals

to compare performance against local, regional, and national benchmarks. Recent data suggest that hospitals participating in GWTG-HF have better processes of care compared with hospitals that are not participating in the program.⁶

We sought to evaluate whether quality of care could be further improved by providing sites with personalized performance feedback. To test the effect of our intervention, we performed a cluster-randomized trial. We hypothesized that sites receiving the intervention would have improved performance on achievement measures and quality metrics compared with sites that did not.

Methods

Get With The Guidelines-Heart Failure

Details of the GWTG programs have been previously published.^{5,7} Briefly, GWTG is a voluntary in-hospital quality improvement program sponsored by the American Heart Association and the American Stroke Association, with 1900 participating hospitals in the United States. The goal of GWTG is to improve care for patients with

Received August 5, 2014; accepted June 1, 2015.

From the Duke Clinical Research Institute, Durham, NC (A.D.D., M.C., Z.J.E., E.D.P., A.F.H.); Department of Medicine, Duke University School of Medicine, Durham, NC (A.D.D., Z.J.E., E.D.P., A.F.H.); Department of Medicine, Veterans Affairs Palo Alto Health Care System, CA (P.A.H.); Stanford University, CA (P.A.H.); Ahmanson-UCLA Cardiomyopathy Center, University of California, Los Angeles (G.C.F.); and Division of Cardiology, Northwestern University, Feinberg School of Medicine, Chicago, IL (C.W.Y.).

This article was handled independently by Javed Butler, MD, MPH, as a Guest Editor. The editors had no role in the evaluation of the manuscript or in the decision about its acceptance.

Correspondence to Adam D. DeVore, MD, Duke Clinical Research Institute, PO Box 17969, Durham, NC 27715. E-mail adam.devore@duke.edu

© 2015 American Heart Association, Inc.

Circ Cardiovasc Qual Outcomes is available at <http://circoutcomes.ahajournals.org>

DOI: 10.1161/CIRCOUTCOMES.114.001333

WHAT IS KNOWN

- The delivery of evidence-based heart failure care varies significantly across hospitals, as do patient outcomes.
- There is limited evidence defining the best methods to improve adherence to evidence-based recommendations.

WHAT THE STUDY ADDS

- We performed a cluster-randomized trial of personalized site feedback on adherence to quality metrics at hospitals participating in the Get With The Guidelines-Heart Failure quality improvement program.
- Our intervention provided sites with specific data on their heart failure achievement and quality measures in addition to the usual Get With The Guidelines-Heart Failure tools but was not able to elicit more quality improvement beyond that already associated with participation in the Get With The Guidelines-Heart Failure program.
- Our study demonstrates the feasibility and importance of a rigorous evaluation of quality improvement interventions and highlights the low adherence rates to many discharge quality measures including the use of aldosterone antagonists, cardiac resynchronization therapy, and implantable cardioverter defibrillators.

(Quintiles, Cambridge, MA). From the submitted data, GWTG-HF provides hospitals with real-time, quality improvement, and guideline adherence reports that are easily available online by site request.

Institutions participating in GWTG-HF are required to comply with local regulatory and privacy guidelines and to obtain institutional review board approval, when necessary. Because the data are used primarily at the local site for quality improvement, sites are granted a waiver of informed consent under the common rule for usual GWTG-HF practices and for this intervention. Quintiles (Cambridge, MA) serves as the registry coordinating center, and the Duke Clinical Research Institute (Durham, NC) serves as the data analysis center. Institutional review board approval was granted to analyze aggregate deidentified data for research purposes.

Participating Hospitals

All 434 hospitals participating in the GWTG-HF program were invited to participate in the study via email and were provided with the ability to opt out of participation. Of the 434 hospitals, 75 (17%) declined participation or did not have available contact information to receive an invitation. Of the remaining 359 hospitals, 165 (46%) had at least 30 patient records for the preceding 12 months and at least 1 admission per quarter. These hospitals were randomized on a 1:1 basis to the control or intervention arm. The study design is displayed in Figure 1.

Study Intervention

For this study, the control hospitals continued to receive access to the usual on-demand reports, GWTG-HF quality improvement tools, and publicly available GWTG-HF webinars. These reports continued to be available on request but were not actively pushed to the sites on a routine basis. These reports also focused on composite and specific metrics based on recommendations from the 2006 American College of Cardiology/American Heart Association Clinical Performance Measures (evaluation of left ventricular systolic function, angiotensin-converting enzyme inhibitor/angiotensin receptor blocker use, anticoagulants use for patients with atrial fibrillation, discharge instructions, and smoking cessation).⁸

Our intervention added to the current baseline reports with personalized quality improvement reports pushed directly to the site by email each quarter, as well as tailored teleconferences, webinars, and specialized tool kits. The personalized reports were designed to describe the site's HF patient population compared with other GWTG-HF hospitals, highlight performance on both GWTG-HF achievement measures and 9 GWTG-HF quality metrics (Outcomes section).^{8,9}

coronary artery disease, HF, and stroke. GWTG-HF specifically assists hospitals in improving the care of patients with HF.

GWTG-HF collects data on 188 variables, including patient demographics, medical history, in-hospital treatments, and discharge treatments. Institutions submit information either on consecutive patients or by random sample (a sample is permitted if the institution has a large volume of patients [ie, >75 cases per year]) using an online interactive case report form and Patient Management Tool

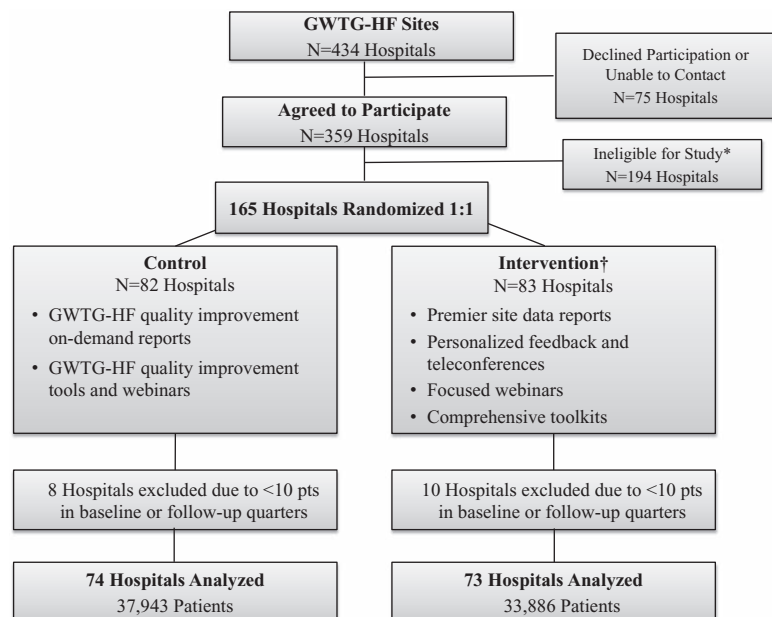


Figure 1. Flow diagram of the study design. This figure displays the initial study population, through exclusions, to the final study population. *Get With The Guidelines-Heart Failure (GWTG-HF) hospitals with >30 patient records over the preceding 12 months and >1 admission per quarter were eligible for the study. †Hospitals in the intervention arm also continued to receive access to GWTG-HF quality improvement reports, tools, and webinars.

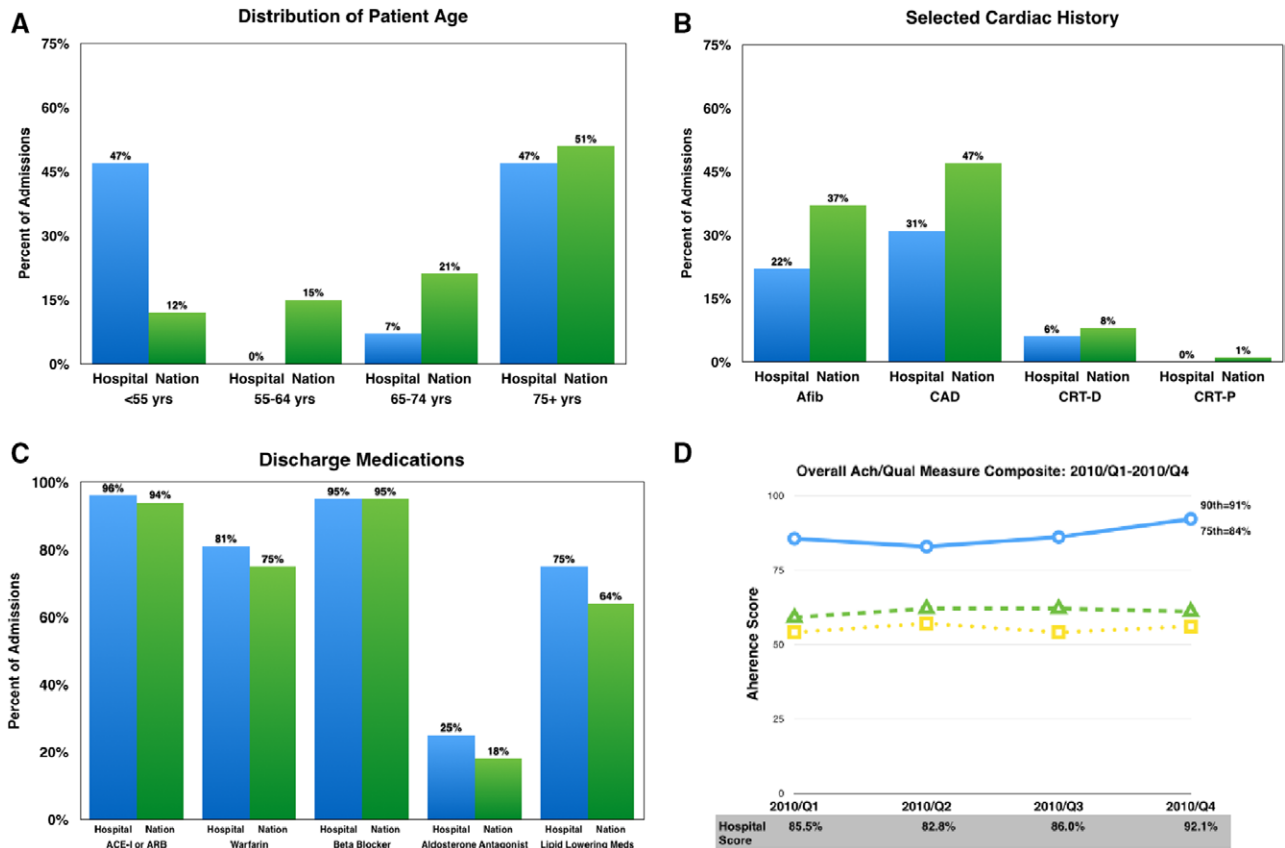


Figure 2. Selected data from a deidentified site report. This figure displays selected data from a deidentified site report. Reports were designed to describe the local heart failure (HF) population relative to other GWTG-HF hospitals (**A** and **B**), compare performance on both achievement measures and quality metrics (**C**), and (**D**) demonstrate trends in hospital care over time (blue circles) benchmarked against Get With The Guidelines-Heart Failure (GWTG-HF) regional (green triangles) and national (yellow squares) hospitals. ACE-I indicates angiotensin-converting enzyme inhibitor; Afib, atrial fibrillation; ARB, angiotensin receptor blocker; CAD, coronary artery disease; CRT-D, cardiac resynchronization therapy defibrillator; and CRT-P, cardiac resynchronization therapy pacemaker.

and to suggest process improvement targets based on site adherence trends during the past year compared with other GWTG-HF hospitals in the region and nation-wide (Figure 2). GWTG-HF project coordinators and quality improvement leaders at each site were then invited to webinars. The webinars were conducted by a study coordinator and clinician and were designed to provide education on the personalized reports and the newer process measures. The webinar presentations also stressed the importance of accurate data collection, offered general suggestions for quality improvement, and provided a forum for quality improvement leaders to network and share experiences on successful improvement strategies. The lowest performers (bottom 25% of intervention sites for the opportunity-based composite score) were also targeted with additional phone calls and webinars to develop solutions for improvement. The specialized tool kits were administered to all intervention sites and provided resources, such as patient instructions and order set templates.

Outcomes

The prespecified primary outcome of the study was improvement in an opportunity-based composite score for adherence to 5 achievement measures and 9 quality measures that were based on published quality performance measures.^{8,9} The opportunity-based composite score counted the number of times a quality metric was performed and divided by the total number of instances in which care processes were required. This is in contrast to the defect-free composite score that counted the number of patients that received all achievement and quality measures divided by the total number of patients eligible for these measures.¹⁰

For both composite scores, we specifically assessed 5 GWTG-HF achievement measures: (1) angiotensin-converting enzyme

inhibitor/angiotensin receptor blocker prescription at discharge in patients with a left ventricular ejection fraction (LVEF) <40%; (2) β -blocker prescription at discharge in patients with an LVEF of <40%; (3) discharge instructions addressing activity level, diet, discharge medications, follow-up appointment, weight monitoring, and how to respond to a change in symptoms; (4) LVEF assessment performed or planned for after discharge; and (5) current or recent smokers who received smoking cessation advice or counseling during a hospital stay. We also specifically assessed 9 GWTG-HF quality metrics: (1) aldosterone antagonist prescription at discharge in patients with an LVEF of <40%; (2) anticoagulation prescription at discharge for patients with atrial fibrillation; (3) cardiac resynchronization therapy placed or prescribed at discharge in patients with an LVEF of <35% and a QRS of >120 ms without reason for exclusion; (4) use of deep vein thrombosis prophylaxis by the end of hospital day 2 in patients with HF who were nonambulatory; (5) evidence-based specific β -blockers (ie, bisoprolol, carvedilol, and metoprolol) at discharge; (6) hydralazine and nitrate combination use in black patients with an LVEF of <40% and no contraindications; (7) implantable cardioverter defibrillator placed or prescribed at discharge in patients with an LVEF of <35% without reason for exclusion; (8) influenza vaccine administration before discharge during flu season; and (9) pneumococcal vaccine before discharge. Secondary outcomes for the study included improvements in a defect-free composite score and in-hospital mortality.

Statistical Methods

All statistical analyses of the aggregate deidentified data were performed by the Duke Clinical Research Institute using SAS software

(version 9.3; SAS Institute, Cary, NC). Calculation of the sample size was based on the expected improvement in opportunity-based composite scores. The planned enrollment of 160 hospitals was estimated to provide 98% power to detect a difference between groups, assuming 400 care opportunities per hospital, of 7.5%. This calculation was based on hospital-aggregated summary data instead of one observation per care opportunity and used the Wilcoxon signed-rank test and a 2-sided α of 0.05.

We randomized 165 sites. Of these, 12 sites had <10 patients during the baseline quarter (Q4 2009) and 6 sites (3 in the control group and 3 in the treatment group) did not contribute any patients in the follow-up quarter (Q4 2011). We had no reason to think our intervention or the lack of intervention would affect a site's participation in GWTG-HF, and we assumed this missing data pattern was missing completely at random and excluded these sites. Therefore, 147 sites were available for our analysis (Figure 1).

Baseline patient and hospital characteristics were summarized for the control and treatment groups. Continuous variables were reported as medians and 25th and 75th percentiles and categorical variables as counts and percentages. Hospital-level aggregated percentages were calculated for each measure and reported as means with SEs. Some sites did not have patients eligible for each measure in every quarter. For these sites, we imputed missing data using multiple imputation involving treatment group and all measures in all 6 study period quarters. We imputed all measures, including the composite, at once. Twenty imputations were performed with a maximum number of iterations set at 25 000. We assumed that the missing data pattern was missing completely at random, and Markov chain Monte Carlo methods with ridge priors were used.

At the conclusion of the study, we noted small imbalances in the baseline quality metrics and opportunity-based composite scores. We also noted that patient opportunities varied by site. Our final analysis assessed for differences in the absolute change from the baseline quarter (Q4 2009) to the follow-up quarter (Q4 2011) between control and treatment groups using linear regression weighted by the total site size during the study period.

In a sensitivity analysis for the 6 sites not contributing patients in the follow-up quarter, we used multiple imputation of the outcome with fully conditional specification methods given baseline patient and hospital characteristics. Results reflect the summary of 25 imputations accounting for uncertainty because of nonresponse.

Results

The study was conducted from October 1, 2009 to March 31, 2011 and included data from 71 829 patients hospitalized for HF at a total of 147 hospitals (74 controls and 73 interventions) across the United States. Patient characteristics are shown in Table 1. There were no major differences between patients at hospitals randomized to the control or the intervention, although small differences were noted in the medical history. Patients in the control group were more likely to have a history of HF, ischemia, diabetes mellitus, hyperlipidemia, hypertension, and chronic kidney disease. Hospital characteristics are shown in Table 2. There were more hospitals in the Western United States in the intervention arm and more hospitals in the Southern United States in the control arm.

The baseline adherence to achievement measures and quality metrics along with absolute change over the study period are displayed in Table 3. The mean baseline performance on achievement measures, such as β -blocker prescription at discharge in patients with an LVEF of <40%, and discharge instructions were similar in the control and intervention groups. In contrast, the baseline performance on quality metrics was different in the 2 groups. Cardiac resynchronization therapy use was lower in the control group, but the use of deep vein thrombosis prophylaxis, hydralazine and nitrate medications,

implantable cardioverter defibrillators, influenza vaccines, and pneumococcal vaccines was higher in the control group. The baseline overall composite scores were similar in both groups, but the mean opportunity-based score across hospitals was higher in the control group (61.1% versus 56.6%). The baseline inpatient mortality rates were similar in both groups.

The primary outcome for the trial was the change in the overall opportunity-based composite score. The absolute change in the opportunity-based score was slightly larger in the control group than the intervention group (+3.18 compared with +0.31 percentage points), although there was no statistical difference ($P=0.21$) between the 2 groups. The estimated treatment effect in our model was -2.87 favoring the control although the 95% confidence interval (-7.32 to 1.58) included zero. Similarly, for the defect-free score, the improvement was slightly larger in the control group than the intervention group (+4.50 compared with +1.14 percentage points; $P=0.31$), and the estimated treatment effect favored the control, -3.36 , although the 95% confidence interval (-9.88 and 3.17) again included zero. For the achievement measures, the absolute scores had small increases over time in both groups for most measures, but there were no statistical differences between the groups. For the quality metrics, the absolute changes over the study period favored the control group for 8 of the 9 metrics, but there were no statistical differences between the groups. The inpatient mortality rates remained stable over time with no significant changes in either group. Given that the lowest performers at baseline (bottom 25%) received a slightly different intervention, we also looked for improvement in that subgroup. There was no statistical difference in improvement between these groups for the overall opportunity-based score (absolute change, +8.66 versus +5.86 percentage points in the control group; $P=0.62$). In a sensitivity analysis with multiple imputation of the outcomes for the 6 sites with no patients in the follow-up quarters, we noted no qualitative changes in the composite score or individual achievement or quality measures.

Discussion

Several hospital-based quality improvement programs, including GWTG-HF, have helped improve HF quality of care,¹¹ yet significant gaps and variations in HF care persist.^{2-4,6,12} Our study evaluated whether a novel intervention of personalized performance feedback could improve performance of HF achievement measures and quality metrics above current levels at hospitals participating in GWTG-HF. The intervention specifically focused on pushing detailed reports on a quarterly basis to quality leaders at sites that provided detailed information on both standard HF achievement measures and newer quality metrics. In an environment with existing quality improvement efforts, we did not find that a more tailored intervention improved the overall composite quality score nor did we find that it significantly changed any of the achievement or quality measures. However, our study demonstrates the feasibility and importance of a rigorous evaluation of quality improvement interventions and highlights the low adherence rates to many discharge quality measures, including the use of aldosterone antagonists, cardiac resynchronization therapy, and implantable cardioverter defibrillators.

Table 1. Patient Characteristics

	Control, n=37 943	Intervention, n=33 886
Demographics		
Age, y, median (IQR)	74 (62–83)	75 (63–84)
Female, sex, %	48.8	48.3
Race, %		
White	66.5	66.1
Black	23.2	18.2
Other	10.3	15.7
Insurance, %		
Medicare	56.1	53.1
Medicaid	11.5	10.9
Medical history, %		
Previous history of HF	64.4	61.7
History of ischemia*	50.5	47.4
CRT use	6.8	6.5
ICD use	15.4	12.9
Valvular disease	16.9	18.4
Diabetes mellitus	42.2	39.0
Hyperlipidemia	45.5	43.1
Hypertension	73.6	71.0
Chronic kidney disease, %	21.8	20.8
Tobacco use	16.9	16.1
Atrial fibrillation/flutter	36.0	34.1
Previous stroke or TIA	13.7	13.6
Anemia	17.3	17.3
COPD or asthma	28.5	27.2
LVEF, %, median (IQR)	40 (25–55)	40 (25–55)
LVEF <40%	49.1%	47.3%
LOS, d, median (IQR)†	4 (3–7)	4 (2–6)
LOS >4 d, %†	47.4	42.9

COPD indicates chronic obstructive pulmonary disease; CRT, cardiac resynchronization therapy; HF, heart failure; ICD, implantable cardioverter defibrillator; IQR, interquartile range; LOS, length of stay; LVEF, left ventricular ejection fraction; and TIA, transient ischemic attack.

*History of ischemia includes the following: coronary artery disease, previous myocardial infarction, or previous revascularization (percutaneous coronary intervention or bypass surgery).

†Transfers in and out of the hospital were excluded.

Our study adds to the literature on hospital-based interventions to improve the quality of care for patients with HF. The Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients with Heart Failure (OPTIMIZE-HF) was one of the first large-scale national quality improvement registries for patients with HF, which was associated with increased use of evidence-based therapy and adherence to quality measures.¹³ Similar to the current GWTG-HF program, this program provided feedback on specific HF quality measures and provided general quality improvement tools and education. In contrast, our intervention added to this by providing personalized and tailored feedback on specific quality measures with poor performance. The Enhanced Feedback for Effective Cardiac Treatment (EFFECT) study assessed whether publicly released hospital report cards could improve

Table 2. Hospital Characteristics

	Control, n=74	Intervention, n=73
Hospital no. of beds, median (IQR)	296 (210–491)	294 (162–406)
US geographic region, %		
West	10.8	22.5
South	44.6	28.2
Midwest	20.3	21.1
Northeast	24.3	28.2
Hospital setting, %		
Rural	19.7	12.7
Urban	80.3	87.3
Teaching hospital, %	57.8	50.8
Cardiac surgery, %	65.6	60.9
Heart transplantation, %	8.7	6.1

IQR indicates interquartile range.

hospital quality of care for patients hospitalized with acute myocardial infarction or congestive HF in Ontario, Canada. The investigators found no improvement in a composite score of 6 HF performance measures.¹⁴ Nevertheless, the EFFECT study (like ours) highlights the importance of conducting a rigorous evaluation to assess the effect of quality improvement interventions before widespread dissemination of these interventions.

The reasons our intervention was not successful are not entirely clear. One possibility is that hospitals participating in GWTG-HF have previously been shown to have higher compliance with quality of care measures than those not participating in the program.⁶ Our intervention may have had a larger and more discernible effect if tested in hospitals that are not already participating in GWTG-HF. In addition, even control GWTG-HF hospitals may have already implemented programs to improve the targeted measures before randomization. A thorough assessment of ongoing quality improvement efforts before implementation of the intervention may have been helpful. Another possibility is that the study follow-up was not long enough to detect a change in performance. Our intervention provided information and did not mandate behaviors, allowing for local experimentation with innovations most useful to the local healthcare environment. This process may take months of planning, implementation, and improvement through different iterations before noting a change, although this is speculative. Future interventions that provide performance feedback should consider eliciting organizational readiness to act on this data at the onset of the study. Our study was designed to improve local HF care delivery, yet the reports were designed at a national level. Finally, it is possible that our intervention did not provide actionable information at a local level and that soliciting feedback from local quality improvement leaders during initial study planning or the initial roll-out phase may have improved the quality of the feedback and the success of the intervention.

Improving the quality of care for patients with HF is an essential goal, but the results of our study raise questions about best practices for hospital-based quality improvement interventions. Our study highlights that providing additional

Table 3. Baseline Performance on Achievement and Quality Metrics and Postintervention Changes

	Baseline, Mean (SE)		Postintervention Absolute Change, Mean (SE)		Estimated Treatment Effect (95% CI)	P Value
	Control, n=74	Intervention, n=73	Control, n=74	Intervention, n=73		
Achievement measures						
ACE-I/ARB at discharge*	93.9 (1.11)	92.8 (1.02)	1.36 (1.16)	2.11 (1.30)	0.75 (−2.66 to 4.16)	0.67
β-Blocker at discharge*	95.0 (0.57)	95.3 (0.76)	0.49 (0.73)	1.54 (0.87)	1.05 (−1.17 to 3.27)	0.36
Discharge instructions	93.2 (1.03)	91.8 (1.19)	1.27 (1.06)	2.44 (1.06)	1.16 (−1.79 to 4.11)	0.44
Assessment of LV function	98.7 (0.46)	98.8 (0.44)	−0.03 (0.69)	0.38 (0.44)	0.41 (−1.22 to 2.05)	0.62
Smoking cessation†	98.9 (0.56)	97.3 (1.37)	0.15 (0.64)	1.71 (1.40)	1.55 (−1.41 to 4.51)	0.30
Achievement composite scores						
Opportunity-based score	95.8 (0.54)	95.3 (0.58)	0.67 (0.53)	1.62 (0.56)	0.95 (−0.57 to 2.48)	0.22
Defect-free score (ie, all-or-none)	89.6 (1.14)	88.4 (1.30)	1.87 (1.18)	3.84 (1.28)	2.07 (−1.34 to 5.48)	0.23
Quality metrics						
Aldosterone antagonist at discharge*	19.6 (2.70)	16.2 (2.85)	3.93 (2.37)	−0.18 (1.75)	−4.10 (−9.95 to 1.74)	0.17
Anticoagulation for a-fib at discharge	63.7 (4.26)	65.1 (7.12)	−3.00 (6.03)	−3.47 (10.88)	−0.47 (−19.71 to 18.78)	0.96
Cardiac resynchronization therapy‡	32.7 (7.93)	44.9 (12.67)	9.31 (10.34)	−7.16 (13.94)	−16.47 (−43.21 to 10.27)	0.22
DVT prophylaxis if nonambulatory	43.3 (4.07)	34.0 (4.68)	2.70 (3.26)	1.72 (2.84)	−0.98 (−9.54 to 7.59)	0.82
Evidence-based β-blockers§	75.4 (3.03)	73.5 (3.81)	10.79 (3.34)	7.96 (4.49)	−2.82 (−13.43 to 7.78)	0.60
Hydralazine and nitrate at discharge	15.7 (3.24)	9.1 (3.35)	1.93 (4.19)	3.03 (5.00)	1.11 (−11.63 to 13.84)	0.86
Implantable cardioverter defibrillator§	30.8 (3.90)	24.5 (4.31)	1.10 (2.94)	−4.28 (3.00)	−5.37 (−13.57 to 2.83)	0.20
Influenza vaccine during flu season	40.6 (5.59)	34.4 (5.43)	6.94 (3.87)	−1.30 (3.04)	−8.23 (−17.98 to 1.52)	0.10
Pneumococcal vaccine	40.6 (5.59)	34.5 (5.44)	6.66 (3.84)	−1.31 (3.05)	−7.98 (−17.68 to 1.73)	0.11
Overall composite scores#						
Opportunity-based score	61.1 (2.30)	56.6 (2.73)	3.18 (1.68)	0.31 (1.51)	−2.87 (−7.32 to 1.58)	0.21
Defect-free score (ie, all-or-none)	19.7 (2.90)	18.9 (3.41)	4.50 (2.43)	1.14 (2.25)	−3.36 (−9.88 to 3.17)	0.31
Inpatient mortality rates	2.9 (0.28)	2.9 (0.26)	0.48 (0.34)	0.49 (0.44)	−0.03 (−1.12 to 1.05)	0.96

a-fib indicates atrial fibrillation; ACE-I, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; CI, confidence interval; CRT, cardiac resynchronization therapy; DVT, deep venous thrombosis; ICD, implantable cardioverter defibrillator; LV, left ventricular; and LVEF, left ventricular ejection fraction.

*For patients with an LVEF of <40%.

†For current or recent smokers.

‡Placed or prescribed at discharge in patients with an indication and no reason for exclusion. For ICD, this included an LVEF of <35%, and for CRT, this included an LVEF of <35% and a QRS of >120 ms.

§Use of bisoprolol, carvedilol, or metoprolol at discharge.

||For black patients with an LVEF of <40% and no contraindications.

#Overall composite scores were calculated using both achievement and quality measures. The opportunity-based score was the primary outcome of the trial and was calculated from the number of times a quality metric was performed and divided by the total number of instances required, and the defect-free score was calculated from that number of patients that received all achievement and quality measures divided by the total number of patients eligible.

information on quality performance alone may not necessarily translate to better performance, an important lesson for quality improvement efforts. Unfortunately, we did not collect data on interventions implemented as a result of our feedback and cannot comment on the efficacy of local interventions. Our study also highlights that more work is needed to identify performance measures that can be reliably assessed and accurately reflect the quality of care provided to patients with HF. Furthermore, additional studies are needed to better understand the effect of policies that are designed to improve quality.

Our study had several limitations. First, GWTG-HF is conducted at a wide range of hospitals throughout the United States. Nevertheless, the GWTG-HF program is voluntary and participation may select for hospitals where quality improvement initiatives are already active, consequently making interventions like ours less effective. Second, despite

randomization, conformity with many of the quality metrics was different at baseline. Third, the available sample size (<75 hospitals in each arm) may have been inadequate to detect small improvements in the composite quality of care scores. We initially intended to analyze 160 hospitals and estimated 98% power to detect a difference of 7.5% in the primary end point, what we determined to be a clinically meaningful difference. Given the nature and scope of the intervention though even smaller improvements could have a large public health effect. Finally, we were unable to determine why certain treatments were not used in eligible patients despite targeted feedback; this gap in understanding needs to be investigated in future research.

In conclusion, reliably incorporating evidence-based recommendations into routine clinical care in eligible patients remains an elusive but important goal. Our study demonstrates the importance of scientific evaluation of quality

improvement efforts before widespread adoption through rigorously designed and well-controlled studies. Lessons from this trial can be used to better inform hospital-based quality improvement interventions in the future and for evidence development for other strategies of care that are deployed at the hospital-level.

Acknowledgments

We thank Erin Hanley, MS, for her editorial contributions to this article. Hanley did not receive compensation for her contributions, apart from her employment at the institution where this study was conducted.

Sources of Funding

This project was funded by the Agency for Healthcare Research and Quality Centers for Effectiveness and Research in Therapeutics. The Get With The Guidelines-Heart Failure (GWTG-HF) program was provided by the American Heart Association (AHA). GWTG-HF has been funded in the past through support from Medtronic, GlaxoSmithKline, Ortho-McNeil, and the AHA Pharmaceutical Roundtable.

Disclosures

Dr DeVore reports receiving research support from the American Heart Association, Novartis Pharmaceuticals, and Thoratec. Dr Fonarow reports serving as a consultant for Amgen, Bayer, Janssen, Gambro, Medtronic, and Novartis. Dr Eapen reports serving as a consultant for Novartis, Cytokinetics, and Janssen. Dr Peterson reports receiving research grants from Lilly, Johnson & Johnson, Bristol-Myers Squibb, Sanofi-Aventis, and Merck-Schering Plough partnership; and serving as principal investigator of the data analytic center for the American Heart Association/American Stroke Association's Get With The Guidelines-Heart Failure. Dr Hernandez reports receiving research support from the AHA, Amgen, and Novartis.

References

- Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, de Ferranti S, Despres J, Fullerton HJ, Howard VJ, Huffman MD, Judd SE, Kissela BM, Lackland DT, Lichtman JH, Lisabeth LD, Liu S, Mackey RH, Matchar DB, McGuire DK, Mohler ER, 3rd, Moy CS, Muntner P, Mussolino ME, Nasir K, Neumar RW, Nichol G, Palaniappan L, Pandey DK, Reeves MJ, Rodriguez CJ, Sorlie PD, Stein J, Towfighi A, Turan TN, Virani SS, Willey JZ, Woo D, Yeh RW and Turner MB. Heart disease and stroke statistics-2015 update: a report from the American Heart Association. *Circulation*. 2014;129: e28-e292. doi: 10.1161/01.cir.0000441139.02102.80.
- Fonarow GC, Yancy CW, Heywood JT; ADHERE Scientific Advisory Committee, Study Group, and Investigators. Adherence to heart failure quality-of-care indicators in US hospitals: analysis of the ADHERE Registry. *Arch Intern Med*. 2005;165:1469-1477. doi: 10.1001/archinte.165.13.1469.
- Piccini JP, Hernandez AF, Dai D, Thomas KL, Lewis WR, Yancy CW, Peterson ED, Fonarow GC; Get With the Guidelines Steering Committee and Hospitals. Use of cardiac resynchronization therapy in patients hospitalized with heart failure. *Circulation*. 2008;118:926-933. doi: 10.1161/CIRCULATIONAHA.108.773838.
- Albert NM, Yancy CW, Liang L, Zhao X, Hernandez AF, Peterson ED, Cannon CP, Fonarow GC. Use of aldosterone antagonists in heart failure. *JAMA*. 2009;302:1658-1665. doi: 10.1001/jama.2009.1493.
- Ellrodt AG, Fonarow GC, Schwamm LH, Albert N, Bhatt DL, Cannon CP, Hernandez AF, Hlatky MA, Luepker RV, Peterson PN, Reeves M, Smith EE. Synthesizing lessons learned from get with the guidelines: the value of disease-based registries in improving quality and outcomes. *Circulation*. 2013;128:2447-2460. doi: 10.1161/01.cir.0000435779.48007.5c.
- Heidenreich PA, Hernandez AF, Yancy CW, Liang L, Peterson ED, Fonarow GC. Get With The Guidelines program participation, process of care, and outcome for Medicare patients hospitalized with heart failure. *Circ Cardiovasc Qual Outcomes*. 2012;5:37-43. doi: 10.1161/CIRCOUTCOMES.110.959122.
- Smaha LA; American Heart Association. The American Heart Association Get With The Guidelines program. *Am Heart J*. 2004;148(5 suppl):S46-S48. doi: 10.1016/j.ahj.2004.09.015.
- Bonow RO, Ganiats TG, Beam CT, Blake K, Casey DE Jr, Goodlin SJ, Grady KL, Hundley RF, Jessup M, Lynn TE, Masoudi FA, Nilasena D, Piña IL, Rockswold PD, Sadwin LB, Sikkema JD, Sincak CA, Spertus J, Torcson PJ, Torres E, Williams MV, Wong JB; American College of Cardiology Foundation; American Heart Association Task Force on Performance Measures; American Medical Association-Physician Consortium for Performance Improvement. ACCF/AHA/AMA-PCPI 2011 performance measures for adults with heart failure: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Performance Measures and the American Medical Association-Physician Consortium for Performance Improvement. *Circulation*. 2012;125:2382-2401. doi: 10.1161/CIR.0b013e3182507bec.
- Bonow RO, Masoudi FA, Rumsfeld JS, DeLong E, Estes NA 3rd, Goff DC Jr, Grady K, Green LA, Loth AR, Peterson ED, Piña IL, Radford MJ, Shahian DM; American College of Cardiology/American Heart Association Task Force on Performance Measures. ACC/AHA classification of care metrics: performance measures and quality metrics: a report of the American College of Cardiology/American Heart Association Task Force on Performance Measures. *Circulation*. 2008;118:2662-2666.
- Peterson ED, DeLong ER, Masoudi FA, O'Brien SM, Peterson PN, Rumsfeld JS, Shahian DM, Shaw RE. ACCF/AHA 2010 Position Statement on Composite Measures for Healthcare Performance Assessment: a report of American College of Cardiology Foundation/American Heart Association Task Force on Performance Measures (Writing Committee to Develop a Position Statement on Composite Measures). *J Am Coll Cardiol*. 2010;55:1755-1766. doi: 10.1016/j.jacc.2010.02.016.
- Fonarow GC, Peterson ED. Heart failure performance measures and outcomes: real or illusory gains. *JAMA*. 2009;302:792-794. doi: 10.1001/jama.2009.1180.
- Chan PS, Oetgen WJ, Buchanan D, Mitchell K, Fiochi FF, Tang F, Jones PG, Breeding T, Thrutchley D, Rumsfeld JS, Spertus JA. Cardiac performance measure compliance in outpatients: the American College of Cardiology and National Cardiovascular Data Registry's PINNACLE (Practice Innovation And Clinical Excellence) program. *J Am Coll Cardiol*. 2010;56:8-14. doi: 10.1016/j.jacc.2010.03.043.
- Fonarow GC, Abraham WT, Albert NM, Gattis Stough W, Gheorghiadu M, Greenberg BH, O'Connor CM, Pieper K, Sun JL, Yancy CW, Young JB; OPTIMIZE-HF Investigators and Hospitals. Influence of a performance-improvement initiative on quality of care for patients hospitalized with heart failure: results of the Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients With Heart Failure (OPTIMIZE-HF). *Arch Intern Med*. 2007;167:1493-1502. doi: 10.1001/archinte.167.14.1493.
- Tu JV, Donovan LR, Lee DS, Wang JT, Austin PC, Alter DA, Ko DT. Effectiveness of public report cards for improving the quality of cardiac care: the EFFECT study: a randomized trial. *JAMA*. 2009;302:2330-2337. doi: 10.1001/jama.2009.1731.