Circulation: Heart Failure

ORIGINAL ARTICLE

Multiregional Implementation Initiative's Impact on Guideline-Based Performance Measures for Patients Hospitalized With Heart Failure: IMPLEMENT-HF

Andrew J. Sauer, MD; Chandler Beon, BA; Sruthi Cherkur, MPH, CPHQ; Lynn Mallas-Serdynski, BSN, RN, CPHQ; Kathie Thomas, DHA, MPH; John Spertus, MD, MPH; Georges Chahoud, MD; Kanika P. Mody, MD; Mitchell T. Saltzberg, MD, MSc; Lee R. Goldberg, MD, MPH; JoAnn Lindenfeld, MD; Nancy Sweitzer, MD, PhD; Javed Butler, MD; Michelle M. Kittleson, MD, PhD; Ileana Pina, MD, MPH; Sara Paul, DNP; Eldrin F. Lewis, MD, MPH; Joyce Wald, DO; Larry A. Allen, MD, MHS; Mariell Jessup, MD; Michelle Congdon, MBA, CPHQ; Robin Kiser, RN, BSN, CPHQ; Clyde Yancy, MD, MSc, MACC; Gregg C. Fonarow, MD

BACKGROUND: Despite randomized data for survival benefit (with class 1 recommendations) for treating heart failure (HF) with reduced ejection fraction using quadruple medical therapy (QMT)—defined as evidence-based β-blockers, sodium-glucose cotransporter 2 inhibitor, preferably angiotensin receptor/neprilysin inhibitor, and mineralocorticoid receptor antagonist—it is underutilized. IMPLEMENT-HF is a multiregional HF quality improvement initiative to improve care and outcomes for patients with HF by enhancing the use of QMT in routine practice.

METHODS: This analysis of HF with reduced ejection fraction treatment in patients from hospitals participating in the American Heart Association's Get With The Guidelines–HF who volunteered to participate in IMPLEMENT-HF in 7 US regions. IMPLEMENT-HF included multidisciplinary learning to share strategies for formulary changes, electronic health record tools, and patient resources with site-level feedback reports. Participants gathered QMT data at discharge and 30 days after discharge. We evaluated QMT utilization and variation, in addition to other prespecified performance measures, from Q1 2021 to Q2 2023.

RESULTS: The median (interquartile range) age of 43 558 admitted patients at 61 hospitals was 74 (63–83) years; 16 530 (38%) belonged to racial and ethnic minorities, and 22 228 (51%) were women. Between Q1 2021 and Q2 2023, defect-free QMT improved from 4.7% to 44.6% at discharge and from 0% to 44.8% at 30 days (both $P<0.0001$). There was also substantially improved incorporation of health-related social needs assessments. The magnitude of improvements was similar when stratified by sex or race and ethnicity, yet there was significant regional variation.

CONCLUSIONS: Among healthcare systems participating in IMPLEMENT-HF, there was a marked increase in QMT use among eligible patients over the course of the initiative. This quality improvement initiative supports a learning collaborative model to promote improvements in QMT use.

Key Words: guideline ■ heart failure ■ hospitals ■ quality improvement ■ social determinants of health

Correspondence to: Andrew J. Sauer, MD, St Luke's Mid America Heart Institute, 4401 Wornall Rd, Kansas City, MO 64111. Email asauer@St-lukes.org
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WHAT IS NEW?

- This study evaluates the effectiveness of the IMPLEMENT-HF initiative, a large-scale quality improvement program aimed at improving quadruple medical therapy for heart failure with reduced ejection fraction.
- It provides novel evidence of significant improvements in quadruple medical therapy implementation at discharge (from 4.7% to 44.6%) and at 30 days post-discharge (from 0% to 44.8%) across diverse populations in 7 US regions.
- The initiative uniquely integrates health-related social needs assessments into heart failure with reduced ejection fraction care, demonstrating substantial increases in their adoption alongside quadruple medical therapy utilization.

WHAT ARE THE CLINICAL IMPLICATIONS?

- This research highlights a scalable model to address the underutilization of guideline-directed medical therapy in heart failure with reduced ejection fraction, improving adherence to evidence-based care and equity across sex and racial and ethnic groups.
- The inclusion of health-related social needs assessments underscores the importance of addressing social determinants of health in optimizing patient outcomes.
- By implementing collaborative learning models and leveraging real-time data feedback, clinicians can enhance system-wide adherence to guideline-directed medical therapy, potentially reducing mortality and readmissions and improving the quality of life for patients with heart failure with reduced ejection fraction. This approach provides actionable insights for integrating similar initiatives into clinical practice.

Nonstandard Abbreviations and Acronyms

ACE	angiotensin-converting enzyme
AHA	American Heart Association
ARB	angiotensin receptor blocker
ARNI	angiotensin receptor–neprilysin inhibitor
BB	evidence-based specific β-blocker
GWTG	Get With The Guidelines
HF	heart failure
HFmrEF	heart failure with mildly reduced ejection fraction
HFpEF	heart failure with preserved ejection fraction
HFrEF	heart failure with reduced ejection fraction
MRA	mineralocorticoid antagonist
QI	quality improvement
QMT	quadruple medical therapy
SGLT2i	sodium-glucose cotransporter 2 inhibitor

Heart failure with reduced ejection fraction (HFrEF) comprises 46% of people hospitalized with worsening heart failure (HF) and experience a 75.3% mortality and 96.4% mortality/readmission rate at 5 years.[1] Clinical trials have demonstrated significant mortality reductions with 4 drug classes in patients with overt (stage C) HFrEF, which have been assigned class I guideline recommendations. Accordingly, defect-free care for patients with HFrEF should include quadruple medical therapy (QMT)—angiotensin receptor–neprilysin inhibitor (ARNI), evidence-based specific β-blocker (BB), mineralocorticoid antagonist (MRA), and sodium-glucose cotransporter 2 inhibitor (SGLT2i) in those without contraindications.[2] Although early initiation and optimization of these medical therapies have been shown to be safe, feasible, and to improve outcomes in patients hospitalized with worsening HFrEF,[3,4] it is used in <20% of patients hospitalized with HFrEF; significant variation across US hospitals has been documented.[5,6] Previous studies have demonstrated that initiatives employing interdisciplinary teams most consistently led to improvements in optimal therapy implementation.[7] In addition, the adverse effects of social determinants of health further compound the complexity of HF.[8]

In 2021, the American Heart Association (AHA) launched a 3-year multicenter quality improvement (QI) initiative, IMPLEMENT-HF, focused on further improving QMT, the assessment of health-related social needs, patient empowerment, and the education of healthcare professionals to increase healthy days at home. This multiregional QI program encompassed collaboration with healthcare organizations across 7 regions in the United States utilizing as a foundation the Get With The Guidelines–HF (GWTG-HF) program with further focus on early postdischarge guideline-directed medical therapy adherence and collection of 30-day postdischarge data on care quality (Figure 1).

The primary aims of this analysis were to (1) describe baseline patient and hospital characteristics for each region, (2) determine if participation in IMPLEMENT-HF is associated with increased application of guideline-based care as measured by specific process focus measures over time, and (3) assess variability in the adoption of and adherence to these measures stratified by age, sex, race and ethnicity, and geographic regions.

METHODS

Data Source

This retrospective analysis evaluated patients hospitalized for HF at selected IMPLEMENT-HF initiative sites participating in

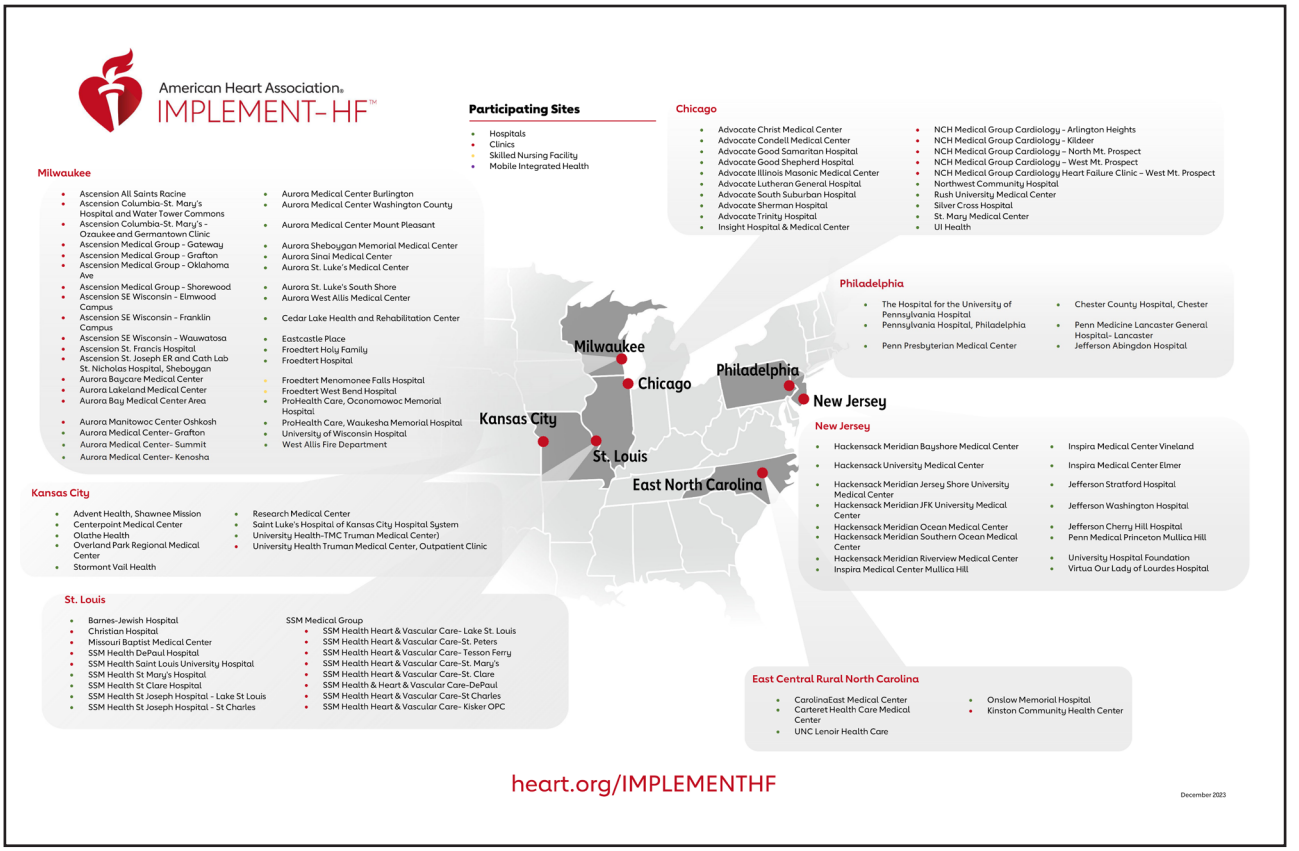

Figure 1. Participating IMPLEMENT-HF sites.
Sites participating in the IMPLEMENT-HF initiative included hospitals, clinics, skilled nursing facilities, and mobile integrated healthcare. For this analysis, only hospital data were included as the Get With The Guidelines–Heart Failure registry is designed for hospital data collection.

the AHA's GWTG-HF registry. The data that support the findings of this study are available from the corresponding author upon reasonable request.

Get With The Guidelines–HF

The GWTG-HF program is a voluntary, hospital-based QI program initiated in 2005 to improve the care of patients with HF by promoting consistent adherence to the latest scientific treatment guidelines.[9] As such, it did not involve research on human subjects outside the scope of routine clinical practice. Institutional review board approval was not required, as the project was designed to assess and enhance care processes and outcomes without introducing experimental interventions. Data collection and analysis adhered to all relevant ethical guidelines, including maintaining patient confidentiality and data security. Data are collected for hospitalized adult patients with a principal diagnosis of HF. Some of these data elements include medical history, patient demographic characteristics, vital and laboratory values, echocardiograph data, medications, and health-related social needs using standardized case report forms to record care during the hospital through 30 days after discharge. Participating hospitals in GWTG-HF are given resource documents to guide program participation, including patient entry criteria, data element definitions, and measure descriptions. IQVIA (Cambridge, MA) served as the data collection and coordinating center, and data were analyzed using the AHA's Precision Medicine Platform.[10]

IMPLEMENT-HF

IMPLEMENT-HF is an AHA national collaborative of healthcare organizations comprising 7 regions throughout the United States, including Chicago, Kansas City, Milwaukee, New Jersey, Philadelphia, St. Louis, and rural east-central North Carolina (Figure 1). Participating hospitals received enhanced quality consultation from AHA team leads, access to an initiative-specific regional and national learning collaborative environment, and accelerated QI strategies beyond the scope of standard GWTG-HF participation, which consists of hospital-specific data monitoring and quality consultation. The initiative's exclusive unique learning healthcare system model that occurred regionally and initiative-wide facilitated an all-teach, all-learn environment, which allowed for the sharing of common barriers through the identification of gaps in care and successful strategies to improve care (Figure 2; Figures S1A, S1B, and S2). Data and performance of IMPLEMENT-HF hospitals were analyzed and continuously monitored and compared between regions and to the larger cohort of patients from the GWTG-HF population.

Performance Measures

The GWTG-HF program performance measures, developed through expert consensus, were built on the AHA/American College of Cardiology/Heart Failure Society of America guidelines and performance measures.[11] From these, a volunteer advisory group consisting of key multidisciplinary experts

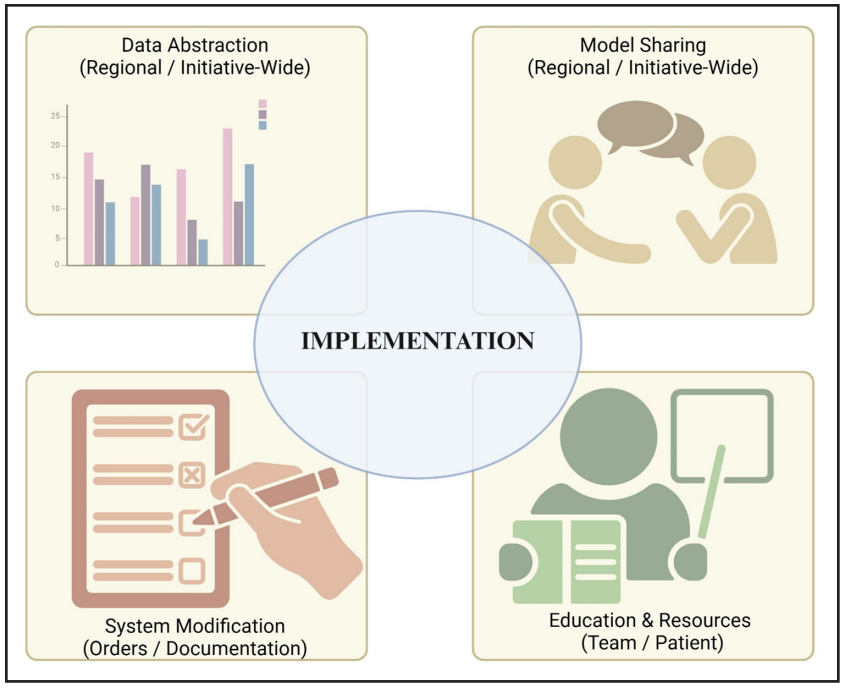

Figure 2. Categories of implementation initiative activities: quality improvement strategies utilized by participating sites during the IMPLEMENT-HF initiative (specific domains, definitions, and initiative examples are outlined in Figures S1A, S1B, and S2).
Data abstraction best practices were shared with sites to allow report generation and dash boarding in real time to allow for targeted interventions. Model sharing existed locally and initiative-wide, focusing on opportunities to improve systems of care involving targeted protocols, documentation improvements, standardizing order sets, and/or smart phrases. System modification categories of intervention included targeting domains involved with care pathway protocols, documentation standards, electronic medical records, pharmacy formularies, etc. Education and resources focused on how to support both the care team and the patient.

selected specific IMPLEMENT-HF measures from within GWTG-HF that were most aligned with initiative goals. To drive rapid adherence to selected IMPLEMENT-HF measures, participating hospitals utilized various comprehensive QI strategies. Sites were required to capture 30-day measure data; however, due to challenges with postdischarge data availability, the 30-day data volume was lower than inpatient data. Participating in IMPLEMENT-HF helped establish processes to capture this data and track performance. The initiative focused on 30-day measure collection, including multiple educational efforts and model shares on abstracting this data. In addition, abstraction training on the 30-day measures was provided through a virtual abstraction course.

IMPLEMENT-HF participating hospital data from GWTG-HF included patients that were over 18 years of age discharged with a primary diagnosis of HF between January 1, 2021 and June 30, 2023. Initiative implementation team leads at each participating center collected patient-level data, including patient demographics, admission vital signs, laboratory data, medical history, and HF treatment and hospital-level demographic data using the GWTG's point-of-care, interactive, internet-based patient management tool. Deidentified patient care data were retrospectively abstracted for the analysis. Patients were excluded from the analysis for missing data, specifically race and ethnicity, discharge disposition status, insurance status, or when at least 25% of past medical history variables were missing. Additional exclusion criteria were gender identities other than male/female, patients transferred during hospitalization, or those discharged against medical advice.

Fourteen GWTG-HF process measures selected as key focus areas for IMPLEMENT-HF were evaluated and stratified by initiative geographic region, age, sex, and race and ethnicity, including (1) ACE (angiotensin-converting enzyme) inhibitor, angiotensin receptor blocker (ARB) or ARNI at discharge, (2) evidence-based specific beta blocker, (3) MRA at discharge, (4) ARNI at discharge, (5) defect-free care for QMT, (6) SGLT2i at discharge, (7) health-related social needs assessment at discharge, (8) 30-day ACE inhibitor/ARB/ARNI, (9) 30-day evidence-based specific β-blocker, (10) 30-day MRA, (11) 30-day ARNI, (12) 30-day defect-free care for QMT, (13) 30-day SGLT2i, and (14) 30-day health-related social needs assessment.

Except for health-related social needs assessment at discharge and 30-day health-related social needs assessment, all of these performance measures focused on the HFrEF patient population. Although IMPLEMENT-HF primarily focused QI efforts on these performance measures, the initiative also introduced HF with preserved ejection fraction (HFpEF)/HF with mildly reduced ejection fraction (HFmrEF) measure set in GWTG-HF, encouraging participating sites to increase awareness and assess performance for management of patients with HFpEF/HFmrEF. This measure set included (1) mineralocorticoid receptor antagonist at discharge for patients with HFmrEF/HFpEF, (2) ARBs at discharge for patients with HFmrEF/HFpEF, (3) ARNI at discharge for patients with HFmrEF/HFpEF, and (4) SGLT2i at discharge for patients with HFmrEF/HFpEF.

Statistical Analyses

To describe baseline patient and hospital characteristics for each IMPLEMENT-HF region, categorical data are reported as counts and percentages, while continuous data are reported as medians with 25th and 75th percentiles. Between-group differences (comparing IMPLEMENT-HF regions for each covariate) were assessed using the χ^2 test or Fisher exact test as appropriate for categorical variables and the Kruskal-Wallis test for continuous variables. IMPLEMENT-HF performance was assessed by calculating measure outcome percentages. Measure outcome percentages were calculated by dividing the number of patients with completion of the measure process (numerator) by the total number of patients eligible for the

measure (denominator). Each measure had unique inclusion and exclusion criteria for the numerator and denominator. We calculated measure outcome percentages (±95% CIs) by quarter after participation in IMPLEMENT-HF to assess improvements in measure performance rates over time. To assess variability in the adoption of and adherence to specific process measures stratified by age, sex, race/ethnicity, and geographic regions, we calculated measure outcome percentages by quarter after participation in IMPLEMNET-HF stratified by age, sex, race and ethnicity, and IMPLEMENT-HF region.

All statistical tests were 2-tailed and were evaluated at a significance level of 0.05 as the nominal significance level (alpha) without any adjustment for multiple comparisons. All analyses were completed using R statistical software version 4.2.0 and Python.

RESULTS

Among 2 518 542 patients and 1317 sites participating in the GWTG-HF program, 43 558 patients and 67 sites were included in the IMPLEMENT-HF initiative analysis after meeting inclusion criteria without exclusions (Table S1). Baseline characteristics for all patients, stratified by IMPLEMENT-HF initiative region, are summarized in Table 1. Patients were generally elderly, with relatively similar age and sex representation across all regions. Significant variation in race and ethnicity mix was noted between regions, with non-Hispanic Black patient proportions ranging from 14.9% to 45.7%. Insurance status also varied between the 7 regions, with Medicare making up only 15.1% to 35.4%, despite a predominantly Medicare age-eligible population. Comorbid conditions, including atrial fibrillation, chronic obstructive pulmonary disease, diabetes, hypertension, hyperlipidemia, cerebrovascular accident or transient ischemic attack, anemia, renal insufficiency, renal insufficiency, coronary artery disease, valvular heart disease, presence of implantable defibrillator, and smoking status were largely comparable between regions. Site characteristics varied widely in terms of the total number of beds, but with most hospitals being nonprofit, teaching status in urban locations (Table 2).

Adherence to performance measures at hospital discharge, including defect-free QMT, is reported by quarter from Q1 2021 to Q2 2023 (Figure 3). For representative purposes, the raw numerator and denominator for each measure are shown for the second quarter of 2023 (Table S2). Defect-free QMT at discharge improved from 4.7% to 44.6%. At the same time, multiple individual performance measures also improved during the IMPLEMENT-HF initiative (with hospital discharge utilization of MRA, ARNI, and SGLT2i increasing from 55.6%–74.4%, 40.2%–63.7%, and 4.7%–60.3%, respectively). Health-related social needs assessment at discharge increased from 4.0% to 75.7% over the same period. Adherence to performance measures at 30 days post-discharge, including defect-free QMT, is reported by a quarter from Q1 2021 to Q2 2023 (Figure 4). Defect-free QMT improved from 0% to 44.8%. At the same time, multiple individual performance measures also improved during the initiative (with 30-day utilization of BB, ARNI, MRA, and SGLT2i increasing from 79.8% to 90.7%, 41.3% to 54.4%, 63.4% to 78.4%, and 0.5% to 68%, respectively). Health-related social needs assessment at 30 days post-discharge increased from 0% to 48.5% over the same period.

When quarterly performance measures at hospital discharge and 30 days were stratified by age, ACE inhibitor/ARB and evidence-based BB utilization were generally consistent across age subgroups, while a stepwise decrement was observed in defect-free QMT along with MRA, ARNI, and SGLT2i utilization, particularly for the oldest patients aged >85 years (Figures S3A and S4A). However, sex and race and ethnicity stratification demonstrated no significant disparities in defect-free QMT utilization over time and individual performance measures (including health-related social needs assessment) at hospital discharge and 30 days (Figures S3B, S3C, S4B, and S4C). When examining the hospital discharge quarterly utilization of defect-free QMT by geographic region, all regions demonstrated a general increase from Q1 2021 to Q2 2023. Still, notable variation was observed by a quarter during the IMPLEMENT-HF initiative (Figure S3D). We observed regional variation in specific performance measures, specifically MRA, ARNI, SGLT2i, and health-related social needs assessment. A general quarterly improvement in all performance measures, despite significant regional variation, was also observed at 30 days (Figure S4D).

DISCUSSION

Implementing class I recommended guideline-directed medical therapy for patients with HFrEF has been challenged by clinical inertia perpetuated by actual or perceived prescribing barriers.[12,13] A recent registry-based study observed that patients eligible for all classes of medication rarely (1%) simultaneously received target doses of ACE inhibitor/ARB/ARNI, BB, and MRA.[14] We report novel findings of the IMPLEMENT-HF multidisciplinary initiative (which involved 7 regions, 85 hospitals, and 43 558 patients treated from Q1 of 2021 to Q2 of 2023) to improve performance measures. Notably, the overall defect-free QMT adherence rate at hospital discharge improved from 4.7% in Q1 of 2021 to 44.6% in q2 of 2023. We also observed a >10% increase in prescribing of each class of guideline-based BB, ARNI, MRA, and SGLT2i at 30-day follow-up from Q1 of 2021 to Q2 of 2023.

Across all 7 regions, QMT improved from 0% to 44.8% at 30-day follow-up. This is the first time an AHA QI initiative has expanded its scope to a 30-day follow-up measure capture. This served 2 purposes: (1) a

Table 1. Baseline Patient Characteristics by IMPLEMENT-HF Region

	Chicago; N=10 282	East-central rural North Carolina; N=1113	Kansas City; N=5690	Milwaukee; N=9173	New Jersey; N=3267	Philadelphia; N=5925	St. Louis; N=8108	*P* value	Overall
Demographics									
Age								<0.0001	
Median	73	71	72	75	78	76	72		74
Q1.25%	62	62	62	64	68	65	61		63
Q3.75%	82	81	82	84	86	85	81		83
Sex								0.3338	
Male	5037 (48.99%)	544 (48.88%)	2792 (49.07%)	4409 (48.06%)	1663 (50.90%)	2911 (49.13%)	3974 (49.01%)		21 330 (48.97%)
Female	5245 (51.01%)	569 (51.12%)	2898 (50.93%)	4764 (51.94%)	1604 (49.10%)	3014 (50.87%)	4134 (50.99%)		22 228 (51.03%)
Race and ethnicity								<0.0001	
Non-Hispanic Black	4442 (43.20%)	509 (45.73%)	1384 (24.32%)	1853 (20.20%)	486 (14.88%)	2069 (34.92%)	2925 (36.08%)		13 668 (31.38%)
Non-Hispanic White	4412 (42.91%)	589 (52.92%)	4111 (72.25%)	6882 (75.02%)	2452 (75.05%)	3493 (58.95%)	5089 (62.77%)		27 028 (62.05%)
Hispanic	1105 (10.75%)	9 (0.81%)	116 (2.04%)	295 (3.22%)	191 (5.85%)	198 (3.34%)	56 (0.69%)		1970 (4.52%)
Other	323 (3.14%)	6 (0.54%)	79 (1.39%)	143 (1.56%)	138 (4.22%)	165 (2.78%)	38 (0.47%)		892 (2.05%)
Insurance status								<0.0001	
Private/VA/ Champus/other	2221 (21.60%)	353 (31.72%)	2014 (35.40%)	1524 (16.61%)	933 (28.56%)	2332 (39.36%)	2631 (32.45%)		12 008 (27.57%)
Medicaid	3073 (29.89%)	307 (27.58%)	1075 (18.89%)	1756 (19.14%)	312 (9.55%)	975 (16.46%)	952 (11.74%)		8450 (19.40%)
Medicare	2358 (22.93%)	307 (27.58%)	1079 (18.96%)	3249 (35.42%)	962 (29.45%)	896 (15.12%)	2646 (32.63%)		11 497 (26.39%)
Self-pay/no insurance	2630 (25.58%)	146 (13.12%)	1522 (26.75%)	2644 (28.82%)	1060 (32.45%)	1722 (29.06%)	1879 (23.17%)		11 603 (26.64%)
Comorbidities									
Atrial fibrillation	2795 (27.18%)	335 (30.10%)	1438 (25.27%)	2621 (28.57%)	1208 (36.98%)	1874 (31.63%)	2791 (34.42%)	<0.0001	13 062 (29.99%)
COPD or asthma	3530 (34.33%)	429 (38.54%)	2301 (40.44%)	3612 (39.38%)	975 (29.84%)	2206 (37.23%)	3489 (43.03%)	<0.0001	16 542 (37.98%)
Diabetes	5206 (50.63%)	590 (53.01%)	2810 (49.38%)	4435 (48.35%)	1386 (42.42%)	2797 (47.21%)	3918 (48.32%)	<0.0001	21 142 (48.54%)
Hypertension	9283 (90.28%)	896 (80.50%)	4982 (87.56%)	8150 (88.85%)	2954 (90.42%)	5401 (91.16%)	7247 (89.38%)	<0.0001	38 913 (89.34%)
Hyperlipidemia	6312 (61.39%)	603 (54.18%)	4014 (70.54%)	6591 (71.85%)	1779 (54.45%)	4220 (71.22%)	5247 (64.71%)	<0.0001	28 766 (66.04%)
CVA/TIA	1827 (17.77%)	126 (11.32%)	1020 (17.93%)	1670 (18.21%)	434 (13.28%)	1268 (21.40%)	1730 (21.34%)	<0.0001	8075 (18.54%)
Anemia	2776 (27.00%)	202 (18.15%)	1551 (27.26%)	2991 (32.61%)	732 (22.41%)	1947 (32.86%)	3045 (37.56%)	<0.0001	13 244 (30.41%)
Renal insufficiency–chronic (SCr>2.0)	2597 (25.26%)	177 (15.90%)	1386 (24.36%)	2753 (30.01%)	821 (25.13%)	2169 (36.61%)	1537 (18.96%)	<0.0001	11 440 (26.26%)
CAD	4289 (41.71%)	427 (38.36%)	2715 (47.72%)	4015 (43.77%)	1578 (48.30%)	2689 (45.38%)	3595 (44.34%)	<0.0001	19 308 (44.33%)
Ischemic heart failure	492 (4.79%)	47 (4.22%)	1202 (21.12%)	389 (4.24%)	375 (11.48%)	1230 (20.76%)	27 (0.33%)	<0.0001	3762 (8.64%)
Valvular heart disease	1412 (13.73%)	77 (6.92%)	803 (14.11%)	1777 (19.37%)	793 (24.27%)	1061 (17.91%)	1247 (15.38%)	<0.0001	7170 (16.46%)
ICD or CRT-D	1376 (13.38%)	89 (8.00%)	736 (12.93%)	977 (10.65%)	389 (11.91%)	958 (16.17%)	1062 (13.10%)	<0.0001	5587 (12.83%)

(*Continued*)

Table 1. Continued

	Chicago; N=10 282	East-central rural North Carolina; N=1113	Kansas City; N=5690	Milwaukee; N=9173	New Jersey; N=3267	Philadelphia; N=5925	St. Louis; N=8108	*P* value	Overall
Smoking (past 12 mo)	1496 (14.55%)	237 (21.29%)	1200 (21.09%)	1463 (15.95%)	368 (11.26%)	708 (11.95%)	1647 (20.31%)	<0.0001	7119 (16.34%)
Vaping/e-cigarette use (past 12 mo)	24 (0.23%)	2 (0.18%)	36 (0.63%)	54 (0.59%)	7 (0.21%)	15 (0.25%)	2 (0.02%)	<0.0001	140 (0.32%)
Medication at admission									
BB	1522 (14.80%)	85 (7.64%)	2442 (42.92%)	1209 (13.18%)	571 (17.48%)	1381 (23.31%)	333 (4.11%)	<0.0001	7543 (17.32%)
ACE inhibitor	465 (4.52%)	28 (2.52%)	731 (12.85%)	297 (3.24%)	99 (3.03%)	303 (5.11%)	75 (0.93%)	<0.0001	1998 (4.59%)
ARB	565 (5.50%)	45 (4.04%)	824 (14.48%)	376 (4.10%)	121 (3.70%)	431 (7.27%)	78 (0.96%)	<0.0001	2440 (5.60%)
ARNI	249 (2.42%)	20 (1.80%)	209 (3.67%)	92 (1.00%)	81 (2.48%)	150 (2.53%)	40 (0.49%)	<0.0001	841 (1.93%)
SGLT2 inhibitor	601 (5.85%)	55 (4.94%)	474 (8.33%)	497 (5.42%)	124 (3.80%)	348 (5.87%)	180 (2.22%)	<0.0001	2279 (5.23%)
Hydralazine	224 (2.18%)	16 (1.44%)	284 (4.99%)	186 (2.03%)	52 (1.59%)	282 (4.76%)	60 (0.74%)	<0.0001	1104 (2.53%)
Nitrate	155 (1.51%)	16 (1.44%)	567 (9.96%)	207 (2.26%)	39 (1.19%)	211 (3.56%)	52 (0.64%)	<0.0001	1247 (2.86%)
Diuretic	1543 (15.01%)	78 (7.01%)	2225 (39.10%)	1163 (12.68%)	496 (15.18%)	1299 (21.92%)	278 (3.43%)	<0.0001	7082 (16.26%)
Ivabradine	6 (0.06%)	0 (0.00%)	9 (0.16%)	0 (0.00%)	2 (0.06%)	0 (0.00%)	1 (0.01%)	0.0002	18 (0.04%)
Aldosterone antagonist	1225 (11.91%)	59 (5.30%)	888 (15.61%)	751 (8.19%)	171 (5.23%)	484 (8.17%)	167 (2.06%)	<0.0001	3745 (8.60%)

ACE indicates angiotensin-converting enzyme; ARB, angiotensin receptor blocker; ARNI, angiotensin receptor–neprilysin inhibitor; BB, evidence-based specific β-blocker; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; CRT-D, cardiac-resynchronization therapy defibrillator; CVA, cerebrovascular accident; ICD, implantable cardio-defibrillator; SGLT2, sodium-glucose cotransporter 2; TIA, transient ischemic attack; and VA, ventricular arrhythmia.

second look at QMT for HFrEF but, more importantly, (2) another nudge influencing provider behavior during the index admission. Improved SGLT2i prescribing and notable improvements in the prescribing of MRA and ARNI primarily drove the improved implementation of QMT at hospital discharge. Furthermore, increased prescribing of QMT was temporally associated with improved incorporation of health-related social needs assessment at discharge and at 30-day follow-up.

When we explored the variability of performance measures at hospital discharge and 30-day follow-up, we observed no significant implementation disparities when stratified by sex or race/ethnicity. However, we did note a stepwise decrement in QMT with advancing patient age, driven by all medication classes except guideline-based BB. This trend was not associated with a reduced rate of health-related social needs assessment, and it would seem to be potentially related to clinicians' perceived safety and tolerability concerns for using ARNI, MRA, and SGLT2i in more elderly patients with increasing comorbidity and polypharmacy burden. Although we did observe significant variability in quarterly performance measures by geographic region, it is worth emphasizing that all regions demonstrated a consistent uptrend in rates of QMT implementation and health-related social needs assessment from Q1 of 2021 to Q2 of 2023.

The substantial overall improvement in defect-free QMT and other performance measures observed among health systems participating in the IMPLEMENT-HF initiative is consistent with but also vastly outperforms published reports of system-level QI interventions involving the deployment of hospital-oriented interdisciplinary teams comprised of multiple stakeholders, which include nurses and pharmacists.[7] Furthermore, early initiation of higher-intensity therapies for patients with HFrEF during acute hospitalization translates to improved overall implementation associated with more favorable outcomes after discharge.[3,15] Previous clinical trials have demonstrated successful interdisciplinary interventions using clinician or patient-activating nudges, clinician education, and patient education, along with both in-people and remote medical therapy optimization programs.[16–21]

The observed overall improvement in performance measures associated with hospitals participating in the IMPLEMENT-HF initiative is attributable to multiple interventions interacting with interdisciplinary teams. A focus group of 25 participants from IMPLEMENT-HF sites was conducted to gather perspectives on which components of the initiative drove the QI. Teams

Table 2. Baseline Site Characteristics of IMPLEMENT-HF Sites by IMPLEMENT-HF Region

	Chicago (N=14)	East central rural North Carolina (N=3)	Kansas City (N=8)	Milwaukee (N=21)	New Jersey (N=6)	Philadelphia (N=6)	St. Louis (N=9)	Overall (N=67)
Beds								
0–74 beds	0 (0.00%)	0 (0.00%)	0 (0.00%)	7 (33.33%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	7 (10.45%)
75–199 beds	2 (14.29%)	2 (66.67%)	0 (0.00%)	3 (14.29%)	1 (16.67%)	0 (0.00%)	1 (11.11%)	9 (13.43%)
200–299 beds	4 (28.57%)	1 (33.33%)	4 (50.00%)	8 (38.10%)	2 (33.33%)	1 (16.67%)	3 (33.33%)	23 (34.33%)
300–399 beds	3 (21.43%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	1 (16.67%)	2 (33.33%)	2 (22.22%)	8 (11.94%)
400–499 beds	2 (14.29%)	0 (0.00%)	3 (37.50%)	0 (0.00%)	1 (16.67%)	0 (0.00%)	0 (0.00%)	6 (8.96%)
500+ beds	3 (21.43%)	0 (0.00%)	1 (12.50%)	3 (14.29%)	1 (16.67%)	3 (50.00%)	3 (33.33%)	14 (20.90%)
Hospital type								
Government	2 (14.29%)	2 (66.67%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	4 (5.97%)
Nonprofit	12 (85.71%)	1 (33.33%)	5 (62.50%)	19 (90.48%)	5 (83.33%)	6 (100.00%)	9 (100.00%)	57 (85.07%)
For-profit	0 (0.00%)	0 (0.00%)	3 (37.50%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	3 (4.48%)
Missing, %	0 (0.00%)	0 (0.00%)	0 (0.00%)	2 (9.52%)	1 (16.67%)	0 (0.00%)	0 (0.00%)	3 (4.48%)
Teaching hospital								
Nonteaching	5 (35.71%)	3 (100.00%)	1 (12.50%)	7 (33.33%)	1 (16.67%)	0 (0.00%)	1 (11.11%)	18 (26.87%)
Teaching	9 (64.29%)	0 (0.00%)	7 (87.50%)	14 (66.67%)	5 (83.33%)	6 (100.00%)	8 (88.89%)	49 (73.13%)
Hospital location								
Urban	14 (100.00%)	2 (66.67%)	8 (100.00%)	18 (85.71%)	6 (100.00%)	6 (100.00%)	9 (100.00%)	63 (94.03%)
Rural	0 (0.00%)	1 (33.33%)	0 (0.00%)	3 (14.29%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	4 (5.97%)

involved in IMPLEMENT-HF typically expanded efforts to perform data abstraction. They utilized GWTG-HF registry reporting features to monitor temporal trends for discharge and 30-day performance measures while comparing to systems locally and at other participating regions. Regularly reviewing and comparing performance measure trends presents an effective nudge for interdisciplinary teams motivated to develop QI initiatives.

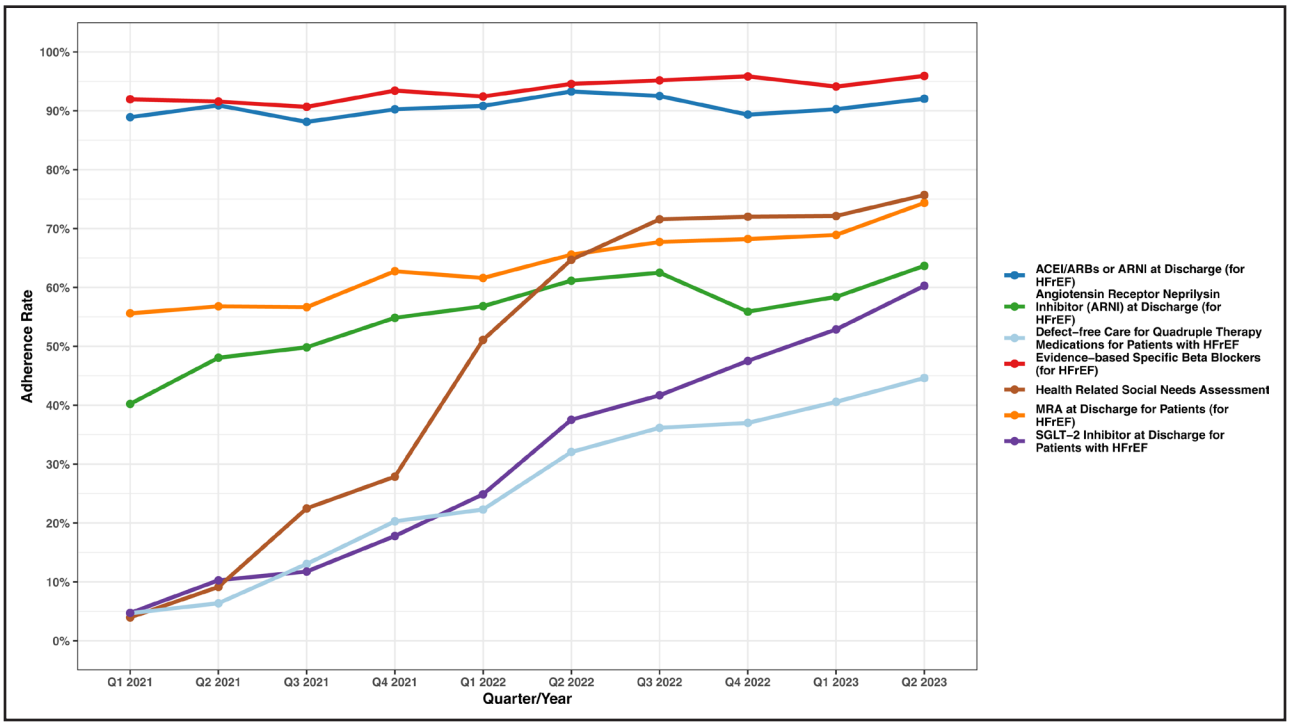

Figure 3. Inpatient measures adherence by quarter from Q1 2021 to Q3 2023.
Adherence rate at hospital discharge by quarter for associated inpatient process of care metrics during the IMPLEMENT-HF initiative. ACE indicates angiotensin-converting enzyme; ARB, angiotensin receptor blocker; ARNI, angiotensin receptor–neprilysin inhibitor; HFrEF, heart failure with reduced ejection fraction; MRA, mineralocorticoid antagonist; and SGLT2, sodium-glucose cotransporter 2.

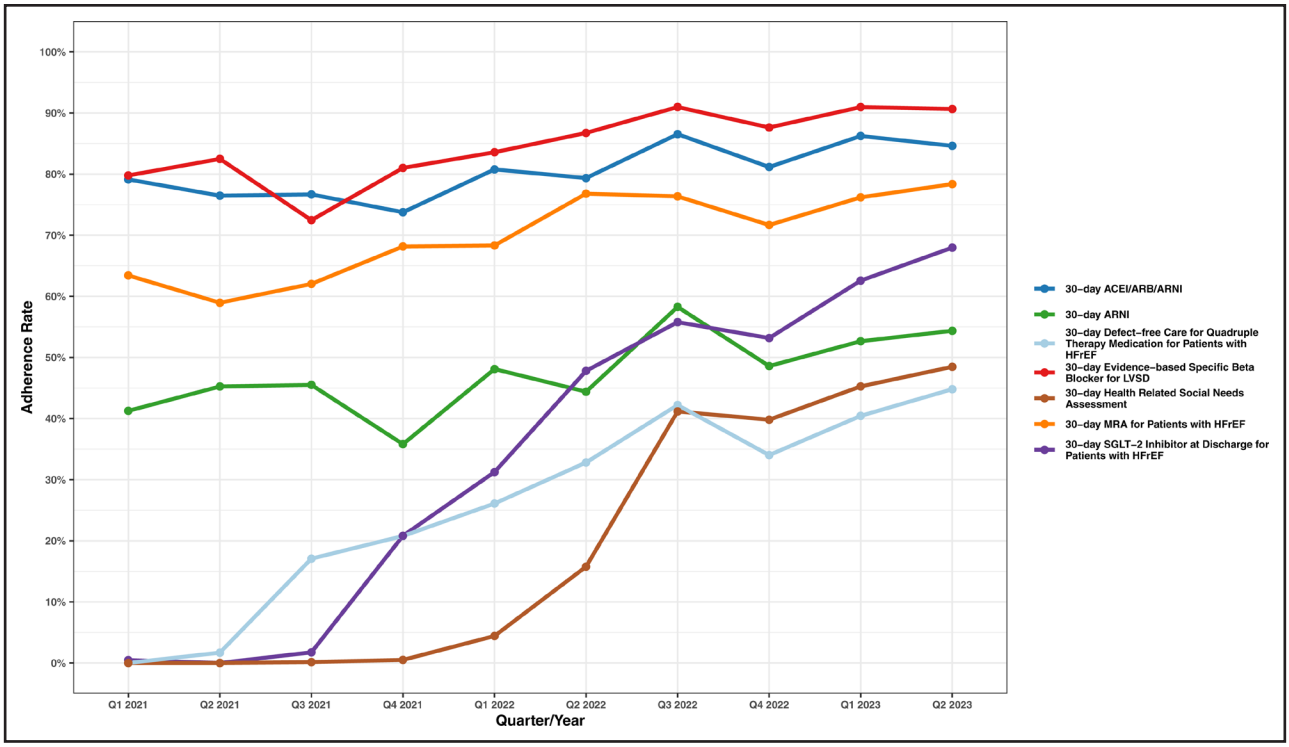

Figure 4. Thirty-day measures adherence by quarter from Q1 2021 to Q3 2023.
Adherence rate by quarter for the associated postdischarge process of care metrics during the IMPLEMENT-HF initiative. ACE indicates angiotensin-converting enzyme; ARB, angiotensin receptor blocker; ARNI, angiotensin receptor–neprilysin inhibitor; HFrEF, heart failure with reduced ejection fraction; LVSD, left ventricular systolic dysfunction; MRA, mineralocorticoid antagonist; and SGLT2, sodium-glucose cotransporter 2.

Second, each region would participate in model sharing through a variety of venues, as previously described. Third, as each participating hospital contributed to the all-teach, all-learn culture by engaging in over 40 hours of dedicated collaboration cohort meetings and 83 QI strategy-sharing activities, opportunities for system interventions such as inpatient formulary upgrades, standardized discharge order sets, and electronic medical record standardized checklists (to name just a few examples) would gain momentum as successful strategies were shared across participating regions. Finally, the steadily increasing concerted effort to engage patients with the consistent administering of health-related social needs assessment allowed for the optimization of connecting patients with resources and education to improve access to care while reducing implementation disparities.

Our findings should be interpreted in the context of potential limitations. First, the larger GWTG-HF denominator compared with our study population raises the concern for selection bias. The voluntary nature of the participating clinicians and health systems, including the willingness to participate in a QI initiative and the lack of randomized concurrent control, may have introduced confounding. As such, improvements in QMT seen in IMPLEMENT-HF may represent secular trends spurred forward by the strong endorsement of QMT by the 2022 Clinical Practice Guidelines. However, we have seen no reports suggesting comparably improved trends in QMT utilization in other contemporary cohorts.[22,23] We also acknowledge total medication burden may have negatively impacted QMT prescribing behavior, although patients with higher total medication burden are also most likely to experience comorbidity and derive the most benefit from guideline-directed medical therapy optimization.[24] Although the enhanced QI initiatives driven by IMPLEMENT-HF leadership almost assuredly drove improved adherence to measures, results may not be replicable in hospitals lacking dedicated QI team support. In addition, GWTG-HF participating hospitals were focused on improving each of these individual measures, with extensive QI efforts and national performance achievement awards. Although similar improvements were seen at GWTG-HF hospitals, we acknowledge that these findings may not be generalized to hospitals that are not participating in GWTG-HF/IMPLEMENT-HF. Furthermore, social determinants of health is a relatively recent performance measure incorporated into the IMPLEMENT-HF initiative, so the marked improvement observed across regions could be an epiphenomenon. In addition, data included in this analysis are dependent on the accuracy and abstraction of documentation in the medical record. Some patients may have had contraindications/intolerance present but not documented. Finally, medication

use is based on medical records. Patients may or may not have adhered to the prescribed regimen.

In summary, the IMPLEMENT-HF initiative, using data abstraction to create dashboards and model sharing in a learning collaborative to improve systems and enhance patient and team education and resources, was associated with a substantial and equitable improvement in QMT, along with an improved assessment of health-related social needs. Although significant improvements in QMT were observed in each region, there were variations in the magnitude of improvements. Future studies should explore the relationship between enhanced performance measures such as QMT utilization in multidisciplinary team-oriented initiatives such as IMPLEMENT-HF and clinical outcomes.

ARTICLE INFORMATION

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Affiliations

Saint Luke's Mid-America Heart Institute, Kansas City, MO (A.J.S., J.S.). American Heart Association, Dallas, TX (C.B., S.C., L.M.-S., K.T., M.J., M.C., R.K.). SSM Health, Lake St. Louis, MO (G.C.). Hackensack University Medical Center, NJ (K.P.M.). ProHealth Care, Waukesha, WI (M.T.S.). University of Pennsylvania, Philadelphia (L.R.G., J.W.). Vanderbilt University Medical Center, Nashville, TN (J.L.). Washington University School of Medicine in St. Louis, MO (N.S.). University of Mississippi Medical School, Baylor Scott & White Research Institute, Jackson (J.B.). Smidt Heart Institute, Cedars-Sinai Medical Center, Los Angeles, CA (M.M.K.). Thomas Jefferson University, Philadelphia, PA (I.P.). Catawba Valley Cardiology, Conover, NC (S.P.). Stanford University, CA (E.F.L.). University of Colorado School of Medicine, Aurora, CO (L.A.A.). Northwestern University, Feinberg School of Medicine, Chicago, IL (C.Y.). UCLA Health, Los Angeles, CA (G.C.F.).

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Supplemental Material

Tables S1 and S2
Figures S1–S5

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