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Circulation: Heart Failure

ORIGINAL RESEARCH ARTICLE

Patterns of Referral and Postdischarge Utilization of Cardiac Rehabilitation Among Patients Hospitalized With Heart Failure: An Analysis From the GWTG-HF Registry

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BACKGROUND: Coverage for cardiac rehabilitation (CR) for patients with heart failure with reduced ejection fraction was expanded in 2014, but contemporary referral and participation rates remain unknown.

METHODS: Patients hospitalized for heart failure with reduced ejection fraction (≤35%) in the American Heart Association Get With The Guidelines–Heart Failure registry from 2010 to 2020 were included, and CR referral status was described as yes, no, or not captured. Temporal trends in CR referral were assessed in the overall cohort. Patient and hospital-level predictors of CR referral were assessed using multivariable-adjusted logistic regression models. Additionally, CR referral and proportional utilization of CR within 1-year of referral were evaluated among patients aged >65 years with available Medicare administrative claims data who were clinically stable for 6-weeks postdischarge. Finally, the association of CR referral with the risk of 1-year death and readmission was evaluated using multivariable-adjusted Cox models.

RESULTS: Of 69,441 patients with heart failure with reduced ejection fraction who were eligible for CR (median age 67 years; 33% women; 30% Black), 17,076 (24.6%) were referred to CR, and referral rates increased from 8.1% in 2010 to 24.1% in 2020 (P_{trend}<0.001). Of 8310 patients with Medicare who remained clinically stable 6-weeks after discharge, the CR referral rate was 25.8%, and utilization of CR among referred patients was 4.1% (mean sessions attended: 6.7). Patients not referred were more likely to be older, of Black race, and with a higher burden of comorbidities. In adjusted analysis, eligible patients with heart failure with reduced ejection fraction who were referred to CR (versus not referred) had a lower risk of 1-year death (hazard ratio, 0.84 [95% CI, 0.70–1.00]; P=0.049) without significant differences in 1-year readmission.

CONCLUSIONS: CR referral rates have increased from 2010 to 2020. However, only 1 in 4 patients are referred to CR. Among eligible patients who received CR referral, participation was low, with <1 of 20 participating in CR.

Key Words: cardiac rehabilitation ■ health care quality, access, and evaluation ■ heart failure ■ Medicare

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Heart failure with reduced ejection fraction (HFrEF) remains a major cause of morbidity and death in the United States.[1] Continued efforts are needed toward developing and incorporating evidence-based therapeutic strategies to improve clinical outcomes and quality of life among patients with HFrEF. Cardiac rehabilitation (CR) is one such nonpharmacologic therapeutic strategy that is associated with improvement in quality of life, exercise

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This manuscript was sent to Dr Ileana L. Piña, MD MPH, Guest Editor, for review by expert referees, editorial decision, and final disposition.
Supplemental Material is available at https://www.ahajournals.org/doi/suppl/10.1161/CIRCHEARTFAILURE.122.010144.
For Sources of Funding and Disclosures, see page 681.
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Circulation: Heart Failure is available at www.ahajournals.org/journal/circheartfailure

What Is New?

- After the 2014 Centers for Medicaid and Medicare Services coverage determination for cardiac rehabilitation for patients with chronic heart failure with reduced ejection fraction, cardiac rehabilitation referral has significantly increased. However, the overall referral remains low at ≈25%.
- Overall, cardiac rehabilitation participation is very low at <5% among referred patients.

What Are the Clinical Implications?

- The present study highlights a substantial implementation gap in the referral and utilization of cardiac rehabilitation among patients with heart failure with reduced ejection fraction.
- Provider- and system-level interventions to improve patient referral and participation are needed to improve the quality of life and clinical outcomes.

Nonstandard Abbreviations and Acronyms

ARNi	angiotensin receptor neprilysin inhibitor
CMS	Centers for Medicaid and Medicare Services
CR	cardiac rehabilitation
GWTG-HF	Get With The Guidelines–Heart Failure
HF	heart failure
HFrEF	heart failure with reduced ejection fraction

capacity, and clinical outcomes among patients with chronic HFrEF (<35%) who have been clinically stable and receiving optimal medical therapy for at least 6 weeks.[2] Specifically, the seminal HF-ACTION trial (Heart Failure: A Controlled Trial Investigating Outcomes of Exercise Training) showed that among clinically stable outpatients with HFrEF, a supervised exercise program was significantly associated with improvements in quality of life, a modest but statistically significant improvement in peak exercise capacity, and a lower risk of all-cause death or hospitalization after prespecified adjustment.[2] Based on this evidence, CR is recommended for patients with Stage C HF in the 2022 American Heart Association (AHA)/American College of Cardiology (ACC)/ Heart Failure Society of America HF guidelines.[3–5] Furthermore, the Centers for Medicare and Medicaid Services (CMS) expanded coverage for CR in 2014 among patients with chronic, stable HFrEF who remain out of the hospital for 6 weeks.

Despite the evidence and multisociety guidelines recommending CR in patients with HFrEF, prior studies have reported low rates of CR referral and utilization both before and early after the 2014 CMS coverage determination.[6,7] However, it is unclear whether the lack of utilization is related to poor referral rates or lack of uptake among referred patients. Moreover, little is known about recent trends and predictors of CR referral and utilization patterns among patients with HFrEF who would qualify for CR under the expanded coverage. Furthermore, it is not known whether referral for CR is associated with improved clinical outcomes in routine clinical practice. Accordingly, we evaluated the contemporary patterns of CR referral and its utilization among patients with HFrEF hospitalized at Get With The Guidelines–Heart Failure (GWTG-HF) participating centers who were eligible for CR from January 2010 to July 2020. We also evaluated the association between CR referral and risk of death or HF hospitalization within 1-year postdischarge.

METHODS

Study data are confidential and cannot be shared according to the terms of the contracts signed between GWTG-HF participating hospitals and the AHA, as well as the terms governing the use of Medicare claims data. Therefore, the data, analytic methods, and study materials will not be made available to other researchers for the purposes of reproducing the results or replicating the procedure.

Data Source and Study Population

This study used the AHA's GWTG-HF registry, and descriptions of the registry have been published previously.[8] GWTG-HF is a clinical quality improvement-based registry composed of patients hospitalized for acute heart failure at voluntary participating healthcare centers across the United States. Trained study personnel at each participating center collect patient-level data, including patient demographics, admission vital signs, laboratory data, medical history, and HF treatment and hospital-level demographic data. Participating hospitals use a point-of-care, interactive, internet-based patient management tool to record clinical information and submit it to the registry. Deidentified data are centrally aggregated and monitored for quality, and IQVIA (Parsippany, NJ) serves as the data collection and coordination center. The institutional review board at each participating center approved the GWTG-HF protocol and granted a waiver for informed consent. The Duke Clinical Research Institute serves as the data analysis center and is approved to analyze data for research purposes. Patients, aged >65 years, from the GWTG-HF registry with fee-for-service Medicare coverage were linked to CMS Medicare Part A inpatient claims files using the date of admission and discharge, hospital name, date of birth, and sex.[9]

The study population included 898 540 patients across 636 US hospitals from January 1, 2010 to March 31, 2020 (Figure S1). Patients were included if they were deemed eligible for CR referral based on the CMS guidance. Accordingly, patients were excluded if they did not have chronic HF with an ejection fraction ≤35%, were discharged without optimal HF medical therapy without evidence-based beta-blocker or angiotensin-converting enzyme inhibitors/angiotensin receptor blocker/angiotensin receptor neprilysin inhibitor (ARNi) therapy or without documented contraindication, discharged to hospice care or against medical advice, were transferred, or died during the index hospitalization. Additionally, patients with unknown or undocumented cardiac referral status were excluded. Our

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primary study population included 69 411 patients from 501 sites who met the CR referral criteria at discharge.

A subset of participants (N=231 698 patients from 556 sites) from the GWTG-HF registry were >65 years old and had linked fee-for-service Medicare Part A administrative claims data available. After excluding patients who did not meet eligibility for CR referral (same as primary cohort derivation criteria) and additionally those who died or had an HF hospitalization within 6 weeks postdischarge who would not be eligible for CR coverage based on the CMS guidance, the referral, utilization, and prognostic implications of CR were evaluated in the subset 8310 patients with chronic, stable HFrEF from 268 sites (Figure S2).

Ascertainment of CR Referral, Utilization, and 1-Year Outcomes

Referral to CR was ascertained from the GWTG-HF case report form (reported as yes, no, not documented, or not applicable). CR utilization among eligible patients postdischarge was defined as at least 1 Medicare claim with a Current Procedure Terminology code of 93797 or 93798 or Healthcare Common Procedure Coding System codes G0422 or G0423 within 1 year of discharge from the index hospitalization. Clinical outcomes of 1-year death, 1-year HF readmission, and 1-year all-cause readmission were assessed using linked Medicare claims data as reported previously.[9]

Statistical Analysis

Baseline characteristics of the entire cohort (eligible for CR referral) and among patients >65 years old with linked Medicare data who were eligible for CR coverage postdischarge per CMS guidance (alive without HF hospitalization up to 6 weeks postdischarge) with and without CR referral at discharge were reported and compared. Categorical variables were shown as proportions and continuous variables were reported as median (25th and 75th). Differences between groups were tested using a χ^2 test for categorical variables and Wilcoxon rank sum tests for continuous variables. Absolute standardized differences were reported for reference, and a difference >10 indicated a meaningful difference between groups. Absolute standardized differences were calculated using means and SDs, and a rank-based approach was used for skewed variables. *P* values were reported for baseline characteristics and the primary outcomes.

Temporal trends in referral for CR in the overall study cohort were reported on a quarterly basis across the study period using the Cochran-Armitage test. Trends in CR referral before and after approval of the expanded CMS coverage for CR were compared using a discontinuous/segmented regression on a continuous scale. The hospital-level variability in the proportion of eligible patients with CR referral since the expansion of CMS CR coverage was assessed with hierarchical logistic regression models with hospital-specific random intercepts. This analysis was limited to patients admitted from February 19, 2014, as CMS coverage was expanded on February 18, 2014.

Multivariable-adjusted logistic regression analysis was performed to identify patient-level and hospital-level factors significantly associated with referral for CR in the post-CMS coverage expansion era (N=54 915 patients with known referral status admitted on or after February 19, 2014 with nonmissing hospital characteristics). Covariates investigated included demographics (age, sex, and race), medical history (anemia, ischemic history, cerebrovascular accident/transient ischemic attack, diabetes, hyperlipidemia, hypertension, chronic obstructive pulmonary disease or asthma, peripheral vascular disease, renal insufficiency, and smoking), other patient characteristics (discharge systolic blood pressure, heart rate, sodium, and blood urea nitrogen), and hospital characteristics (region, teaching status, bed number, and rural location). To account for within and across-site variability, a logistic random effects model with hospital-specific random intercepts was created, with backward selection to identify factors significantly associated with CR referral. A *P* value of 0.2 was used for a covariate to remain in the model.

Among the subset of patients aged >65 years with CMS-linked data who were clinically stable for 6 weeks postdischarge (chronic stable HFrEF) and thus eligible for CR coverage postdischarge per CMS guidance, temporal trends in referral for CR and the proportional utilization of CR among those with a referral at discharge were reported. Unadjusted cumulative incidence of 1-year death, 1-year HF-related readmission, and 1-year all-cause readmission were also compared among those with versus without CR referral at discharge. Associations between CR referral and 1-year outcomes (mortality, HF-related readmission, and 1-year all-cause readmission) were also assessed using multivariable Cox proportional hazard models with adjustment for prespecified covariates including demographics, medical history and patient clinical characteristics, hospital characteristics, and medication and device use for HF on discharge (angiotensin-converting enzyme inhibitors/angiotensin receptor blocker/ARNi, beta-blocker, mineralocorticoid-receptor antagonist, implantable cardioverter defibrillator, cardiac resynchronization therapy). ARNi was tallied only among hospitalizations in and after 2015. Separate models were constructed for each outcome with censoring at 1-year postdischarge. Cause-specific Cox models for readmission outcomes were used to account for death as a competing event. Robust sandwich variance estimators were used to account for any hospital clustering effects and Schoenfeld residuals were used to assess the proportional hazard assumption. All analyses were performed using SAS (version 9.4, SAS Studios). *P* values were reported for the primary outcomes, with $P<0.05$ set as the level of significance.

RESULTS

Among 69 441 patients with HFrEF eligible for CR referral at discharge (mean age 67 years; 33.1% women; 29.7% self-reported Black), 24.6% (N=17 076) were referred to CR. Baseline characteristics among patients referred and not referred to CR are reported in Table 1. Patients referred were more likely to be younger, of the White race, and had less burden of comorbidities such as hypertension, anemia, or chronic kidney disease. Additionally, referred patients were more likely to be prescribed ARNis and mineralocorticoid-receptor antagonists on discharge, less likely to be discharged to a postacute care facility, and less likely to be hospitalized in the northeast.

In the subset of patients with available linkage to Medicare fee-for-service claims data who were alive and without HF hospitalization 6 weeks postdischarge (chronic stable HFrEF eligible for CR coverage by CMS, N=8310), 2147 patients (25.8%) were referred to CR. The baseline

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Table 1. Baseline Demographic and Clinical Characteristics Stratified by CR Referral Status Among Eligible Patients With Heart Failure and Reduced Ejection Fraction in the Get With The Guidelines–Heart Failure Registry

	With referral (N=17 076)	Without referral (N=52 365)	Absolute std. diff, %
Demographics			
Age, y	66.0 (55.0–76.0)	67.0 (56.0–78.0)	10.7
Female sex	5436 (31.8%)	17 548 (33.5%)	3.6
Race/ethnicity			18.3
White	10 762 (63.1%)	29 744 (56.8%)	
Black	4096 (24.0%)	16 526 (31.6%)	
Hispanic (any race)	1446 (8.5%)	3566 (6.8%)	
Asian	229 (1.3%)	1006 (1.9%)	
Other (includes UTD)	535 (3.1%)	1492 (2.9%)	
Insurance			13.9
Other	5591 (33.3%)	14 134 (27.2%)	
Medicaid	2858 (17.0%)	10 134 (19.5%)	
Medicare	7089 (42.2%)	23 065 (44.4%)	
No insurance/not documented/UTD	1267 (7.5%)	4656 (9.0%)	
Medical history			
ICD only	3000 (17.6%)	10 003 (19.1%)	4.0
CRT-P or CRT-D	2407 (14.1%)	6812 (13.0%)	3.2
Hypertension	13 069 (76.6%)	43 188 (82.5%)	14.7
Dyslipidemia	3480 (63.8%)	8731 (61.4%)	4.9
Smoked cigarettes in past 12 mo	4333 (25.5%)	13 303 (25.4%)	0.2
Chronic renal insufficiency	3182 (18.6%)	12 380 (23.6%)	12.3
Peripheral vascular disease	1789 (10.5%)	6028 (11.5%)	3.3
Prior CVA/TIA	2358 (13.8%)	8486 (16.2%)	6.7
COPD or asthma	4827 (28.3%)	16 792 (32.1%)	8.3
Anemia	2645 (15.5%)	10 484 (20.0%)	11.9
Etiology of HF (ischemic vs non-ischemic)	6239 (51.8%)	18 315 (49.4%)	4.9
Ischemic etiology: Med hx of CAD, MI, prior PCI, prior CABG, prior CABG/PCI	9554 (56.0%)	29 763 (56.8%)	1.8
Chronic dialysis	351 (2.1%)	1786 (3.4%)	8.3
Pacemaker	1844 (10.8%)	5708 (10.9%)	0.3
Depression	2159 (12.6%)	7642 (14.6%)	5.7
Valvular heart disease	2849 (16.7%)	9498 (18.1%)	3.8
Admission vitals and laboratories			
BMI, kg/m²*	28.9 (24.8–34.5)	28.4 (24.3–34.1)	5.3
Ejection fraction, %*	24.0 (20.0–30.0)	24.0 (19.0–30.0)	1.3
Creatinine*	1.3 (1.0–1.7)	1.3 (1.0–1.8)	3.1
Fasting glucose, mg/dL*	113 (97–147)	112 (95–144)	3.5
Hemoglobin, g/dL*	12.6 (11.1–14.1)	12.4 (10.9–13.8)	4.4
BNP, pg/mL*	1310 (700–2460)	1227 (613–2345)	11.3
NBNP, pg/mL*	6226 (2905–12747)	7230 (3378–15 589)	14.7
BUN, mg/dL*	23 (17–34)	24 (17–36)	6.5
Troponin, ng/dL	0.05 (0.02–0.12)	0.05 (0.03–0.10)	10.2
Discharge medications			
ACE inhibitors/ARB (% prescribed)	10 487 (61.4%)	31 537 (60.2%)	3.3
ARNi (tallied only among admits in and after 2015; % prescribed)	1457 (11.1%)	3899 (10.1%)	16.0
Beta blockers (% prescribed)	15 393 (90.1%)	47 662 (91.0%)	4.0
Aldosterone antagonist (% prescribed)	7037 (41.2%)	18 151 (34.7%)	14.0
Discharge laboratories and outcomes			
BNP, pg/mL*	1174 (577–2287)	1105 (518-2156)	9.9
Serum creatinine, mg/dL*	1.2 (1.0–1.7)	1.3 (1.0-1.8)	2.8
Length of stay, d*	4.0 (3.0–7.0)	4.0 (3.0-6.0)	13.2
Discharge disposition			8.3
Home	15 231 (89.2%)	45 297 (86.5%)	
Other health care facility	1845 (10.8%)	7068 (13.5%)	
Hospital characteristics			
Region			42.1
Northeast	1849 (10.8%)	13 387 (25.6%)	
Midwest	3950 (23.1%)	11 643 (22.2%)	
South	7081 (41.5%)	19 440 (37.1%)	
West	4196 (24.6%)	7895 (15.1%)	
Academic/teaching hospital	13 244 (78.3%)	42 409 (81.8%)	8.7
No. of beds*	381.0 (259.0–532.0)	400.0 (261.0-625.0)	27.3
Rural location	275 (1.6%)	1191 (2.3%)	5.3
Physician owned	964 (5.7%)	887 (1.8%)	20.9
Public vs private	14 607 (86.7%)	45 381 (91.1%)	14.
Heart transplant hospital	2403 (20.5%)	3986 (11.4%)	25.1

Values are median (interquartile range) or n (%). ACE inhibitors indicates angiotensin-converting enzyme inhibitors; ARB, angiotensin receptor blocker; ARNi, angiotensin receptor blocker neprilysin inhibitor; BMI, body mass index; BNP, B-type natriuretic peptide; BUN, blood urea nitrogen; CABG, coronary artery bypass graft; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; CR, cardiac rehabilitation; CRT-D, cardiac resynchronization therapy with a defibrillator; CRT-P, cardiac resynchronization therapy with a pacemaker; CVA, cerebrovascular accident; HF, heart failure; ICD, implantable cardioverter defibrillator; Med hx, medical history; MI, myocardial infarction; NBNP, N-terminal pro-B-type natriuretic peptide; PCI, percutaneous coronary intervention; std. diff, standardized difference; TIA, transient ischemic attack; and UTD, unable to determine.

*Standardized differences calculated using rank-based means to account for skewed distributions. Standardized differences >10 indicates clinically meaningful difference.

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characteristics of those referred versus not referred in the chronic, stable HFrEF cohort are shown in Table S1. Of these with CR referrals, 4.1% had a claim for CR in the year following HF hospitalization. A total of 533 patients (24.8%) with CR referral died within 1-year postdischarge and 1527 patients (71.1%) did not attend CR. Of those patients with a claim for CR, the average number of CR sessions attended was 6.7 (median 2.0; Q1–Q3, 1.0–5.0).

Temporal Trends and Variability in CR Referral

In the overall GWTG-HF cohort, referral to CR increased (P_{trend}<0.001; Figure 1A) from 8.1% in 2010 to 21.5% in 2014 and 24.1% in 2020. CR referral increased after 2014 CMS coverage expansion (median [IQR] quarterly referral rate pre-expansion versus postexpansion: 181 [157–204] versus 403 [351–553]; *P*<0.001). The rate of referrals increased sharply starting quarter 3 of 2017. Across GWTG-HF participating centers, there was substantial variability in referral across sites with a range of 0% to 100% (Q1–Q3: 4%–49%; *P*<0.001; Figure 1B). Similar trends were noted in the subset of patients with chronic, stable HFrEF who were alive and without HF hospitalization at 6 weeks postdischarge, with an increase in CR referral increased from 8.1% in 2010 to 25.1% in 2014 to 32.3% in 2018 (Figure S3).

Factors Associated With CR Referral

Select factors associated with CR referral in the overall GWTG-HF cohort are listed in Table 2. Older age and Black race were associated with less referral to CR. Comorbid conditions, including a history of cerebrovascular accident/transient ischemic attack, hypertension, chronic obstructive pulmonary disease/asthma, peripheral vascular disease, nonischemic HF etiology, and kidney disease, were associated with fewer referrals to CR. At the hospital level, hospitalization in the geographic northeast was associated with fewer referrals to CR.

CR Referral and Clinical Outcomes

The unadjusted incidence rates for 1-year all-cause death, all-cause readmission, and HF-related readmission among patients with chronic, stable HFrEF who were alive and without HF hospitalization at 6 weeks postdischarge are shown in Table S2. Patients who were referred for CR (versus those who were not referred) had significantly lower unadjusted 1-year death (25.9% versus 30.1%; *P*<0.001) and 1-year all-cause readmission (56.2% versus 59.3%; *P*=0.029). One-year HF-related readmission was not significantly different among those with (versus without) referral for CR (Figure 2). In adjusted Cox models, patients with (versus without CR referral) had a significantly lower risk of 1-year all-cause mortality (hazard ratio, 0.84 [95% CI, 0.70–1.00]; *P*=0.049) without differences in 1-year HF readmission and 1-year all-cause readmission (Table 3).

DISCUSSION

In this analysis of GWTG-HF participating hospitals, we note several key findings. First, only 1 in 4 eligible patients were referred for CR following hospitalization for HFrEF. Second, the referral rate has increased over the study period from 2010 to 2020, significantly increasing since the 2014 CMS coverage determination for CR for patients with HFrEF. Third, substantial differences in the likelihood of CR were noted based on race and age, with older patients, patients of minority races, and those with multiple medical comorbidities less likely to be referred. Fourth, among eligible patients who received CR referrals, participation was very low (4.1%). Finally, patients with (versus without) CR referral had a lower risk of adjusted 1-year all-cause death than patients not referred to CR. Our study highlights the existing implementation gap in the contemporary utilization and referral patterns of CR among clinically indicated patients with HFrEF.

CR has been shown to improve quality of life and clinical outcomes in patients with chronic, stable HFrEF.[2,10–13] While CR referral and utilization rates are high after cardiac surgery, cardiac transplantation, or acute events such as an acute myocardial infarction, CR is markedly underutilized in patients with HF.[14,15] Before the national CMS coverage determination for CR, patients hospitalized with HF from 2005 to 2014 had a 12.2% referral rate for CR.[7] Immediately after the national CMS coverage determination, we previously reported rising rates of CR participation among patients referred after HF hospitalization or outpatient HF encounter.[6] The present study adds to existing literature describing a doubling in CR referral and persistently low CR participation over 6 years after the CMS coverage determination.

Despite the rise in CR referrals, roughly 75% of eligible patients are not referred to CR after HF hospitalization, with substantial variability across referring centers. This is particularly relevant as it has been over a decade since the first large-scale randomized-controlled trial of CR in HF, HF-ACTION, and nearly a decade since the inclusion of CR for HF in the 2013 ACC/AHA HF guidelines.[2] Several factors may underlie low referral rates. Several HF pharmacotherapies and interventions have come to market; thus, CR may not be as prioritized as a potential treatment for HF. Additionally, referral to CR may be perceived as challenging for patients with HF, as recommending rehabilitation for patients with exercise intolerance and dyspnea may seem counterintuitive. In addition, access and adherence to CR may remain a challenge for many patients, as highlighted by very low utilization rates among those referred (ie, <5%). HF is a chronic illness, and HF hospitalization may not be perceived as an inciting event for which to seek rehabilitation, as opposed to

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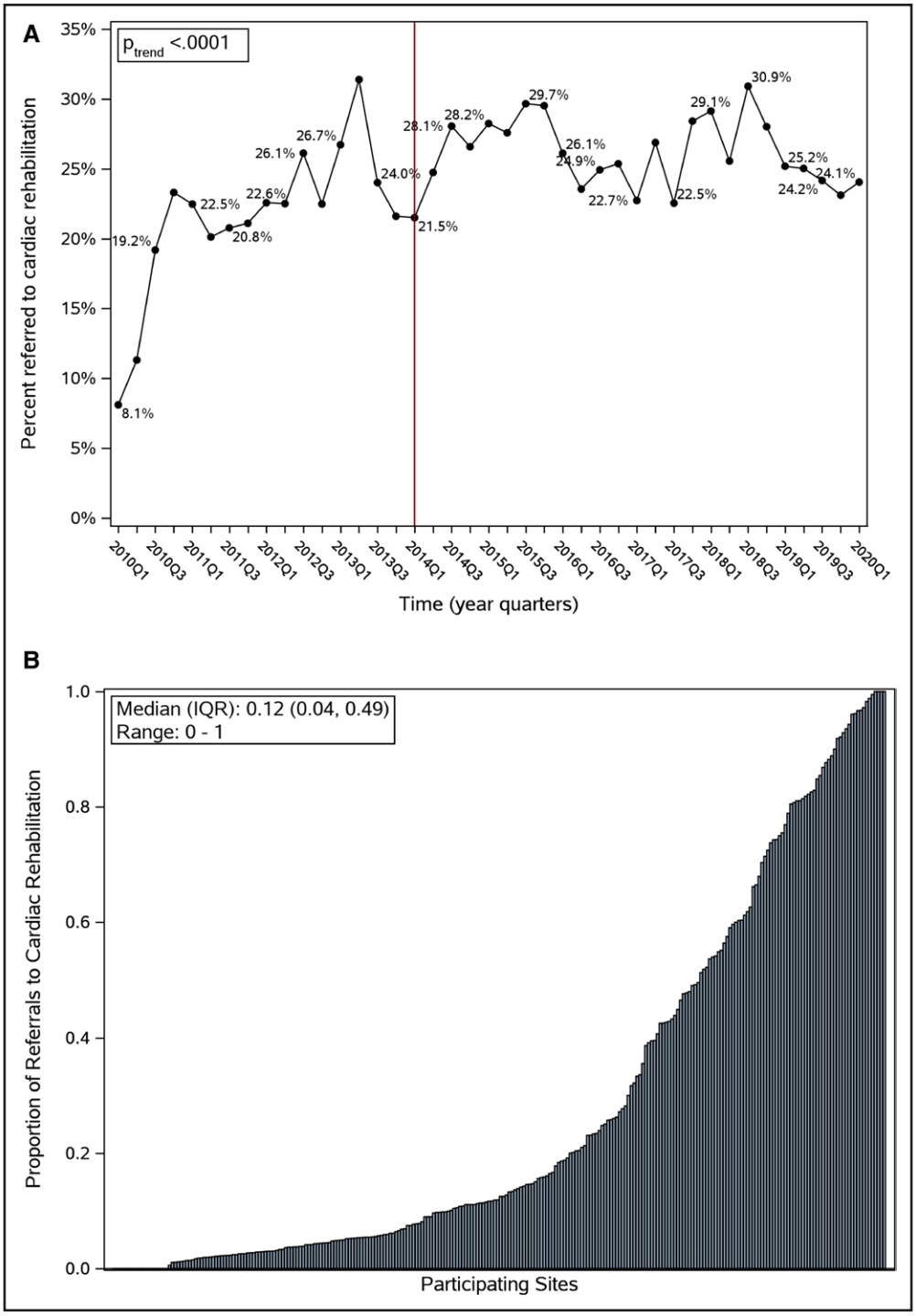

Figure 1. Cardiac rehabilitation referral rates and center-level variation in cardiac rehabilitation referral across Get With The Guidelines–Heart Failure centers.

A, This shows referral rates for cardiac rehabilitation from 2010 to 2020 across Get With The Guidelines–Heart Failure centers. Referral rates have risen through the study period, with an interrupted time series analysis demonstrating a significantly increased trend after the Centers for Medicare and Medicaid Services coverage expansion for cardiac rehabilitation in 2014, as represented by a vertical line in the graph. **B**, This highlights the variability in cardiac rehabilitation referrals across centers participating in the Get With The Guidelines–Heart Failure registry. The vertical line represents the time of Centers for Medicare and Medicaid Services coverage expansion. The P_{trend} is assessed using the Cochran-Armitage test. IQR indicates interquartile range; and Q, quarter.

a postsurgical or procedural CR referral. Lack of patient confidence in potential improvements or participation eligibility may also lead to lessened CR utilization.[16] This may manifest as incomplete education about the benefits of CR, leading to a lack of understanding and a lesser willingness to attend sessions.

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Table 2. Factors Associated With CR Referral in the Post-CMS Coverage Expansion Era (After February 2014) Among Eligible Patients With Heart Failure and Reduced Ejection Fraction in the Overall Get With The Guidelines–Heart Failure Registry Cohort

Effect	Adjusted OR (95% CI) (N=54 320)	*P* value
Age (per 10 y increase)	0.93 (0.91–0.95)	<0.001
Race (vs White race)		
Black	0.90 (0.83–0.97)	0.032
Hispanic	0.93 (0.82–1.05)	
Other	0.92 (0.80–1.06)	
Medical history		
Anemia	0.90 (0.84–0.98)	0.009
Ischemic history	1.08 (1.02–1.15)	0.008
CVA/TIA	0.90 (0.83–0.97)	0.007
Diabetes	1.08 (1.02–1.15)	0.006
Hypertension	0.87 (0.81–0.94)	<0.001
COPD/asthma	0.88 (0.82–0.93)	<0.001
PVD	0.88 (0.81–0.96)	0.005
Renal insufficiency	0.84 (0.78–0.91)	<0.001
Smoked cigarettes in the last 12 mo	0.95 (0.89–1.02)	0.15
SBP (per 10 mm Hg increase)	0.97 (0.95–0.99)	<0.001
Sodium (per 5 bpm increase)	1.04 (1.00–1.08)	0.07
BUN (per 10 mg/dL increase)	0.99 (0.97–1.01)	0.26
Hospital characteristics		
Region (vs Northeast)		
Midwest	2.52 (1.38–4.64)	0.009
South	2.52 (1.39–4.55)	
West	1.89 (0.95–3.75)	
Teaching hospital	1.47 (0.91–2.37)	0.12
Rural location	0.45 (0.18–1.11)	0.08

Logistic random effects model was fit with the following adjustments. Demographics: age, sex, and race; medical history: anemia, ischemic history, CVA/TIA, diabetes, hyperlipidemia, hypertension, COPD or asthma, PVD, renal insufficiency, smoking; laboratory or vital signs: discharge values of SBP, heart rate, sodium, BUN; hospital characteristics: region, hospital type (teaching vs nonteaching), number of beds, rural location. BUN indicates blood urea nitrogen; CMS, Centers for Medicare and Medicaid Services; COPD, chronic obstructive pulmonary disease; CR, cardiac rehabilitation; CVA, cerebrovascular accident; OR, odds ratio; PVD, peripheral vascular disease; SBP, systolic blood pressure; and TIA, transient ischemic attack.

Consistent with prior literature, we observed that patients of self-reported Black race and those living in rural areas were less likely to be referred for CR.[6,17,18] Among Black patients with HFrEF, referring providers' perception of socioeconomic challenges to CR participation and other race-based conscious and subconscious biases may contribute to lower referral rates.[19,20] Similarly, high travel time and limited availability of CR in rural areas may also limit CR participation among patients living in rural regions leading to lower referral rates.[21,22] This is particularly relevant as prior studies have identified geographic proximity to a CR facility as an important predictor of CR utilization.[23,24] Among other factors, older age and a higher burden of comorbidities was associated with lower odds of CR referral. Specifically, comorbidities such as chronic kidney disease, cerebrovascular accident/transient ischemic attack, and chronic lung disease are all associated with lower referral rates. Patients with HF are older and have a higher frailty burden than those who undergo surgical or percutaneous invasive procedures. Thus, patients with HF may be perceived as less suitable candidates for CR than those undergoing invasive cardiac procedures.[25]

Another important observation in the present study was the lower 1-year all-cause death among eligible HFrEF patients with (versus without) CR referral. This difference likely reflects differences in patient selection for referral to CR that are not captured by covariate adjustment as the actual CR participation rates were very low. Patients referred for CR are likely less sick and have better social support, possibly contributing to a lower 1-year mortality risk of death. Importantly, this referral paradigm is in contrast to recent findings from HF-ACTION and other rehabilitation intervention studies that have demonstrated greater clinical benefit from CR participation in higher-risk and more frail patients.[26,27] This highlights the mismatch between patients currently referred to CR versus those most likely to benefit from the same.

It is important to note that CR is currently approved for utilization among chronic, stable patients with HFrEF. This is based on the study population of the HF-ACTION trial, which included patients with chronic HFrEF who were stable and free of HF hospitalization for at least 6 weeks.[2] Accordingly, we have assessed the utilization patterns and prognostic implications of CR referral among patients with HFrEF hospitalized at GWTG-HF participating centers who were alive and without HF hospitalization for 6 weeks postdischarge and, thus, would be eligible for CR. While the acute hospitalization episode provides a window for initiation of guideline-recommended medical therapies, including CR referral, patients should be evaluated for disease stability per the HF-ACTION trial criteria and CMS guidance, and the CR initiation should be delayed by at least 6 weeks postdischarge. The safety and efficacy of CR initiation among hospitalized HFrEF patients during the in-hospital stay or immediately postdischarge is not established based on the existing evidence. The recently published REHAB-HF trial (Physical Rehabilitation for Older Patients Hospitalized for Heart Failure) demonstrated numerically higher death rates among hospitalized HFrEF patients who received the multidomain rehabilitation intervention.[10] However, the study was not powered to evaluate the effects of the physical function intervention on clinical outcomes among patients with HFrEF. Future adequately powered trials are needed to evaluate the safety and efficacy of early initiation of CR among HFrEF patients in the peridischarge period.

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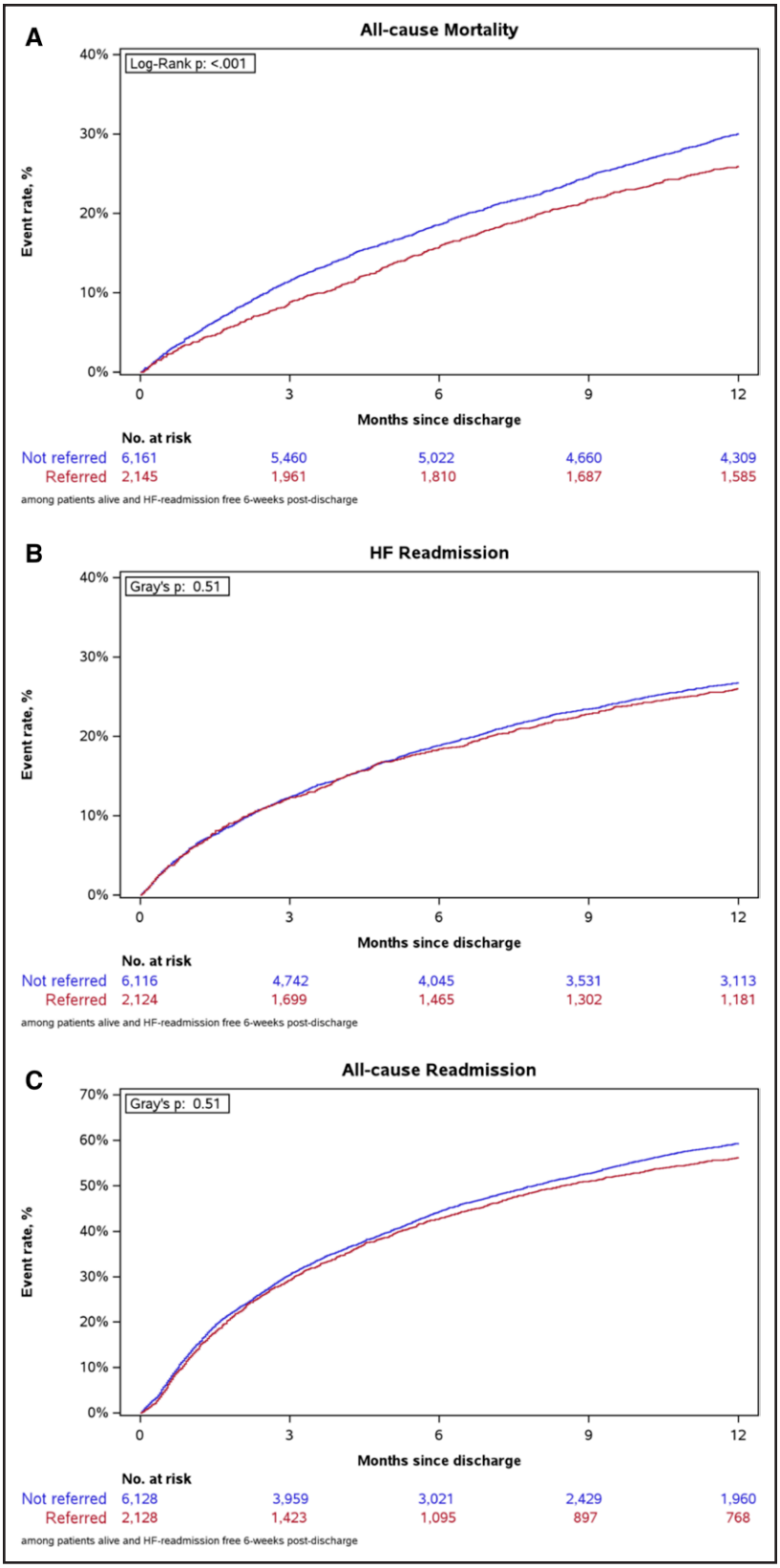

Figure 2. Kaplan-Meier incidence curves for 1-year outcomes among clinically stable patients with Medicare who survived without interim heart failure hospitalization in the 6-week postdischarge period among participants referred vs not referred to cardiac rehabilitation.
A, This demonstrates an increased rate of 1-year all-cause death among patients not referred vs patients referred to cardiac rehabilitation. **B**, This demonstrates no significant difference in 1-year heart failure readmission rates between patients not referred and patients referred to cardiac rehabilitation. **C**, This demonstrates no significant difference in 1-year all-cause readmission rates between patients not referred and patients referred to cardiac rehabilitation.

Future Steps

Despite the CMS coverage determination for CR for clinically stable patients with HFrEF in 2014, referral rates remain low, and participation rates are <5% among those referred to CR. Substantial improvements in both referral and CR participation are necessary to improve patient quality of life and clinical outcomes. First, the significant

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Table 3. Hazard Ratios for Unadjusted and Adjusted Clinical Outcomes Stratified by Cardiac Rehabilitation Referral Status Among Patients With Heart Failure and Reduced Ejection Fraction and Fee-for-Service Medicare Who Were Stable for 6 Weeks Postdischarge

	Unadjusted hazard ratio (95% CI; N=10 289)	*P* value	Adjusted hazard ratio (95% CI; N=4005)	*P* value
1-y all-cause death				
Referred vs not referred	0.84 (0.75–0.93)	<0.001	0.84 (0.70–1.00)	0.049
1-y HF readmission				
Referred vs not referred	0.94 (0.85–1.04)	0.24	0.92 (0.80–1.05)	0.20
1-y all-cause readmission				
Referred vs not referred	0.92 (0.85–0.98)	0.017	0.95 (0.85–1.05)	0.27

Adjusted for age, sex, race, anemia, ischemic history, CVA/TIA, diabetes, hyperlipidemia, hypertension, COPD or asthma, PVD, renal insufficiency, smoking, discharge systolic blood pressure, discharge heart rate, discharge sodium, discharge BUN, discharge ACE inhibitors/ARB, discharge ARNi, discharge beta-blocker, discharge MRA, discharge ICD, discharge CRT, hospital teaching status, hospital region, number of beds, rural location. ACE inhibitors indicates angiotensin-converting enzyme inhibitors; ARB, angiotensin receptor blocker; ARNi, angiotensin receptor blocker neprilysin inhibitor; BUN, blood urea nitrogen; COPD, chronic obstructive pulmonary disease; CRT, cardiac resynchronization therapy; CVA, cerebrovascular accident; HF, heart failure; ICD, implantable cardioverter defibrillator; MRA, mineralocorticoid receptor antagonist; PVD, peripheral vascular disease; and TIA, transient ischemic attack.

variability in hospital-level referral rates suggest the need for center-based initiatives to improve CR referral.[28] Targeted education is needed to improve clinician understanding of the role of CR in the treatment of chronic HFrEF. Additionally, given the lower rates of referral among patients of Black race, education and system-wide efforts in bias reduction and equitable care are vitally needed.[29] Mobile CR programs may help reduce costs and improve accessibility, especially among patients with inadequate transportation or who live in rural or medically underserved areas without available CR.[30,31] However, the comparative effectiveness of CR programs in HFrEF will need intense study. National policy-level changes may improve CR participation. Reducing the need for copayment with each CR session would be invaluable as the need for individual copayment per session may limit completing a comprehensive 36-session CR program. Importantly, providing financial incentives has been shown to improve CR participation among patients with low socioeconomic status, again highlighting the solid economic factors impacting participation.[32]

Limitations

This study has limitations. First, participation in the GWTG-HF registry is voluntary, and as such, our findings may not be representative of nonparticipating hospitals. However, GWTG-HF is well represented nationally among nonacademic and academic hospitals and rural and urban hospitals. Our analysis was limited to patients with documented CR referral status and patients on a beta-blocker and angiotensin-converting enzyme inhibitors/angiotensin receptor blocker/ARNi therapy. This led to a substantial loss of sample size and may have underestimated the number of eligible patients. GWTG-HF does not contain information on outpatient care, so we are unable to discuss patterns of CR referral in the outpatient setting. However, with additional linkage to CMS data, we were able to assess participation rates in adults who receive Medicare. As the participation rates were very low, we lacked statistical power to analyze the long-term clinical outcomes of patients who participated versus patients who did not participate but were referred to CR.

Conclusions

In conclusion, among GWTG-HF participating hospitals, the rate of CR referral has significantly risen over the study period but overall remains low at 25%. Patients referred to CR are more likely to be of the White race, younger, and with fewer medical comorbidities, with hospitalization at hospitals not in the geographic northeast. Finally, among patients with available Medicare claims data who were referred to CR, the overall CR participation is exceptionally low at <5% among referred patients.

ARTICLE INFORMATION

Received September 5, 2022; accepted May 10, 2023.

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Sources of Funding

Dr Keshvani is supported by the National Heart, Lung, and Blood Institute T32 postdoctoral training grant (5T32HL125247-08). Dr Subramanian is supported by the National Institutes of Health (NIH) Grant for Stimulating Access to Research in Residency (UT-STaRR) program (R38HL150214). The Get With The Guidelines–Heart Failure (GWTG-HF) program is provided by the American Heart Association. GWTG-HF is sponsored, in part, by Novartis, Boehringer Ingelheim, Novo Nordisk, AstraZeneca, Bayer, Tylenol, and Alnylam Pharmaceuticals.

Disclosures

Dr Greene has received research support from the Duke University Department of Medicine Chair's Research Award, American Heart Association ([AHA] 929502), National Heart, Lung, and Blood Institute (NHLBI), Amgen, AstraZeneca, Bristol Myers Squibb, Cytokinetics, Merck & Co Inc, Novartis, Pfizer, and Sanofi; has served on advisory boards for Amgen, AstraZeneca, Boehringer Ingelheim/Lilly, Bristol Myers Squibb, Cytokinetics, Roche Diagnostics, and Sanofi; serves as a consultant for Amgen, Bayer, Bristol Myers Squibb, Merck & Co Inc, PhamaIN, Roche Diagnostics, Sanofi, Tricog Health, Urovant Pharmaceuticals, and Vifor; and has received speaker fees from Boehringer Ingelheim. Dr DeVore reports research funding through his institution from the AHA, Biofourmis, Bodyport, Cytokinetics, American Regent Inc, the NHLBI, Novartis, and Story Health. He also provides consulting services for and/or receives honoraria from Abiomed, AstraZeneca, Cardionomic, InnaMed, LivaNova, Natera, Novartis, Procyrion, Story Health, Vifor, and Zoll. He has also received nonfinancial support from Abbott for educational and research activities. Dr Allen has received grant funding from National Institutes of Health, Patient Centered Outcomes Research Institute, Agency for Health Resource and Quality, and AHA; and

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consultant fees from ACI Clinical, Boston Scientific, Cytokinetics, and Novartis. Dr Fonarow reports consulting for Abbott, Amgen, AstraZeneca, Bayer, Cytokinetics, Edwards, Eli Lilly, Janssen, Medtronic, Merck, and Novartis. Dr Pandey has received research funding from the Texas Health Resources Clinical Scholarship, Gilead Sciences Research Scholar Program, Applied Therapeutics (investigator-initiated grant), and National Institute of Aging (GEMSSTAR grant 1R03AG067960-01); and serves on the advisory board of Roche Diagnostics. The other authors report no conflicts.

Supplemental Material

Figures S1–S3
Tables S1–S2

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