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Association of 30-Day Readmission Metric for Heart Failure Under the Hospital Readmissions Reduction Program With Quality of Care and Outcomes

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ABSTRACT

OBJECTIVES The study sought to determine whether processes of care and long-term clinical outcomes for heart failure (HF) admissions across Get With The Guidelines-Heart Failure (GWTG-HF) program participating centers differ according to HF-specific risk-adjusted 30-day readmission rates (excess readmission ratio [ERR]) as determined by the Hospital Readmission Reduction Program (HRRP).

BACKGROUND HRRP penalizes hospitals with higher than expected risk-adjusted 30-day readmission rates (ERR >1) for common conditions including HF. However, it is unclear whether the differences in this metric of hospital performance used by HRRP and related penalties are associated with measured quality of care and long-term outcomes.

METHODS We analyzed data from the GWTG-HF registry linked to Medicare claims from July 2008 to June 2011. Using publically available data on HF-ERR in 2013, we stratified the participating centers into groups with low (HF-ERR ≤1) versus high (HF-ERR >1) risk-adjusted readmission rates. We compared the care quality, in-hospital, and 1-year clinical outcomes across the 2 groups in unadjusted and multivariable adjusted analysis.

RESULTS The analysis included 171 centers with 43,143 participants; 49% of centers had high risk-adjusted 30-day readmission rates (HF-ERR >1). There were no differences between the low and high risk-adjusted 30-day readmission groups in median adherence rate to all performance measures (95.7% vs. 96.5%; p = 0.37) or median percentage of defect-free care (90.0% vs. 91.1%; p = 0.47). The composite 1-year outcome of death or all-cause readmission rates was also not different between the 2 groups (median 62.9% vs. 65.3%; p = 0.10). The high HF-ERR group had higher 1-year all-cause readmission rates (median 59.1% vs. 54.7%; p = 0.01). However, the 1-year mortality rates were lower among high versus low HF-ERR group with a trend toward statistical significance (median 28.2% vs. 31.7%; p = 0.07).

CONCLUSIONS Quality of care and clinical outcomes were comparable among hospitals with high versus low risk-adjusted 30-day HF readmission rates. These findings raise questions about the validity of the HRRP performance metric in identifying and penalizing low-performance centers. (J Am Coll Cardiol HF 2016;■:■–■) © 2016 by the American College of Cardiology Foundation.

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ABBREVIATIONS AND ACRONYMS

CMS = Center for Medicare and Medicaid Services

ERR = excess readmission ratio

GWTG-HF = Get With the Guidelines-Heart Failure

HF = heart failure

HFrEF = heart failure with reduced ejection fraction

HRRP = Hospital Readmissions Reduction Program

ICD = implantable cardioverter-defibrillator

IQR = interquartile range

Heart failure (HF) is a significant public health problem impacting an estimated 5.7 million Americans >20 years of age (1). It is the most common cause of hospitalization in the elderly with a total annual cost for care estimated to be in excess of $30 billion (1,2). A major factor contributing to this heavy economic burden is the high rate of unplanned readmissions associated with HF (3). As a result, reducing hospital readmissions in HF patients has been a top priority of health policy agencies to improve quality of care and lower health care costs (4-6).

The Centers for Medicare and Medicaid Services (CMS) implemented the Federal Hospital Readmissions Reduction Program (HRRP) on October 1, 2012, to provide financial incentives for hospitals to reduce readmissions (7,8). Under this program, CMS used claims data from July 2008 to June 2011 to determine whether the readmission rates for HF, acute myocardial infarction, and pneumonia at each eligible U.S. hospital were higher than would be predicted by CMS models on the basis of the baseline clinical risk and case mix of the patient population. Hospitals with excess readmission rates were penalized up to 1% of their total Medicare reimbursement for fiscal year 2013. The penalty amount was determined by calculating the risk-adjusted 30-day readmission rate for each applicable condition.

Recently, concerns have been raised regarding use of risk-adjusted 30-day readmission rates as a metric of hospital quality and target to improve patient care (6,9-13). Previous studies have demonstrated poor to no correlation between 30-day readmission rates and care quality among hospitalized HF patients (14-16). Emerging evidence suggests that readmission rates and associated penalties, despite being risk standardized, are largely driven by the severity of underlying condition and the socioeconomic background of the patients (17,18). Thus, academic centers and safety-net hospitals that disproportionately take care of high-acuity patients from lower socioeconomic strata are at the highest risk of receiving penalties (19,20). Furthermore, it is unclear whether differences in the risk-adjusted 30-day readmissions and related CMS penalties are associated with long-term clinical outcomes. In this study, we compared quality of care as well as in-hospital and 1-year clinical outcomes among Get With The Guidelines-HF program (GWTG-HF) hospitals with high versus low CMS-determined risk-adjusted 30-day HF readmission rates over the first cycle of HRRP (fiscal year 2013). We hypothesized that risk-adjusted excess 30-day HF readmission rates, as defined by the CMS under HRRP, would not be associated with in-hospital care quality or 1-year clinical outcomes in patients admitted with primary diagnosis of HF.

METHODS

DATA SOURCE. We used data from the American Heart Association's GWTG-HF registry and fee-for-service Medicare claims files for this study. GWTG-HF is a voluntary, observational, ongoing quality improvement program initiated in 2005 that includes patients admitted with HF as the primary diagnosis or patients who developed significant HF symptoms during the hospitalization. The details of the design and objectives of GWTG-HF registry have been reported previously (21,22). The registry is representative of hospitals from all regions and

Medscape Cardiology, and Regado Biosciences; served on the board of directors of the Boston VA Research Institute, Society of Cardiovascular Patient Care; served as chair of the American Heart Association Quality Oversight Committee; served on the data monitoring committees of the Duke Clinical Research Institute, Harvard Clinical Research Institute, Mayo Clinic, Population Health Research Institute; received honoraria from American College of Cardiology (senior associate editor, *Clinical Trials and News*, ACC.org), Belvoir Publications (Editor-in-Chief, *Harvard Heart Letter*), Duke Clinical Research Institute (clinical trial steering committees), Harvard Clinical Research Institute (clinical trial steering committee), HMP Communications (Editor-in-Chief, *Journal of Invasive Cardiology*), *Journal of the American College of Cardiology* (Guest Editor; Associate Editor), Population Health Research Institute (clinical trial steering committee), Slack Publications (Chief Medical Editor, *Cardiology Today's Intervention*), Society of Cardiovascular Patient Care (secretary/treasurer), and WebMD (CME steering committees); served as the deputy editor of Clinical Cardiology, Vice-Chair of the NCDR-ACTION Registry Steering Committee, and Chair of the VA CART Research and Publications Committee; received research funding from Amarin, AstraZeneca, Bristol-Myers Squibb, Eisai, Ethicon, Forest Laboratories, Ischemix, Medtronic, Pfizer, Roche, Sanofi, The Medicines Company; received royalties from Elsevier (Editor, *Cardiovascular Intervention: A Companion to Braunwald's Heart Disease*); served as site coinvestigator for Biotronik, Boston Scientific, and St. Jude Medical; and been a trustee of the American College of Cardiology; and conducted unfunded research for FlowCo, PLx Pharma, and Takeda. Dr. Fonarow has received research support from the Agency for Healthcare Research and Quality and National Institutes of Health; and has served as a consultant for Amgen, Baxter, Bayer, Janssen, Novartis, and Medtronic. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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includes community hospitals as well as large tertiary-care hospitals. Trained personnel at the participating centers collected patient-level information on consecutive HF patients admitted to the hospital using an internet-based patient management tool. Data collected include patient demographics, socioeconomic status, medical history, medications, laboratory data, and hospital characteristics. Adherence with HF-related performance measures is determined, including use and contraindications to evidence-based medical therapies. All participating centers are required to obtain institute review board approval for the GWTG-HF protocol. As data are primarily collected for quality improvement purposes, all participating centers are granted a waiver for informed consent under the common rule. The Duke Clinical Research Institute serves as the data analysis center and has an approval to analyze the aggregate deidentified data for research purposes.

Data on in-hospital outcomes were collected via the GWTG-HF data collection tool. Post-discharge outcomes were obtained from a 100% sample of Medicare inpatient claims and the associated denominator files. The GWTG-HF registry patients were identified in the Medicare files by linking registry hospitalizations to Medicare claims files using admission and discharge dates, hospital, date of birth, and sex (23). The inpatient claims files contain information from institutional claims submitted for facility costs related to the services provided during the inpatient stay. The denominator files contain data on Medicare enrollment and mortality.

STUDY POPULATION. In the present study we included HF patients with CMS-linked data available that were hospitalized at GWTG-HF centers participating in the first cycle of HRRP. This cycle included penalties/rewards assigned in fiscal year 2013, which were on the basis of data collected between July 1, 2008, and June 30, 2011. A total of 44,460 patients from 179 centers were included. The study period corresponds to the time frame used by CMS to calculate the readmission penalty for the first cycle of HRRP. We excluded GWTG-HF centers that had <25 cases during the study period (8 centers with 301 patients). Patients transferred out from presenting hospital for further management were also excluded from the study (1,016 patients). The final study population consisted of 43,143 participants from 171 centers.

EXCESS READMISSION RATIO. The primary exposure variable was the excess readmission ratio (ERR) for HF (HF-ERR), a risk-adjusted measure of 30-day HF readmission rate, for each participating center in 2013. This was obtained from the publically available CMS-HRRP supplemental data file. For the readmission penalties in fiscal year 2013, CMS used an applicable period of 3 years (July 2008 to June 2011) and a minimum of 25 cases to calculate a hospital's ERR of each applicable condition. As previously described (24), a hospital's ERR for a specific condition (e.g., HF, acute myocardial infarction) was defined as the ratio between a hospitals' predicted and expected 30-day readmission rate for that applicable condition. The rates were risk adjusted on the basis of frailty, comorbidities, and patient case mix using the risk-adjustment methodology endorsed by the National Quality Forum (25). Risk-adjustment variables that were clinically relevant and associated with the outcome were obtained from inpatient, outpatient, and physician Medicare administrative claims data. The details about risk-adjustment variables specific for HF patients are provided on QualityNet (26). The final penalty amount was calculated on the basis of the weighted average of the ERRs for each applicable condition as detailed in the Online Appendix. If a hospital's ERR for a condition was ≤1, no penalty was assigned for that condition.

OUTCOMES OF INTEREST. The primary clinical outcome of interest was a composite of 1-year mortality or all-cause readmission. Secondary clinical outcomes included in-hospital mortality and length of stay, discharge destination, 1-year mortality, and 1-year all-cause readmission.

Process of care measures included proportional adherence to each GWTG-HF performance measure. These included achievement measures such as use of angiotensin-converting enzyme inhibitors/angiotensin receptor blockers in patients with HF with reduced ejection fraction (HFrEF) at discharge, and assessment of left ventricular ejection faction; quality measures such as use of mineralocorticoid receptor antagonist in HFrEF patients at discharge, anticoagulation therapy for atrial fibrillation at discharge, and hydralazine and isosorbide dinitrate combination for African American patients with HFrEF at discharge; and the reporting measures such as blood pressure control (<140/90 mm Hg) at discharge, beta-blocker use in HFrEF patients at discharge, implantable cardioverter-defibrillator (ICD) insertion or prescription at discharge among patients with severe left ventricular dysfunction (ejection fraction <30%), discharge instructions, and smoking cessation counseling. The specific definitions and eligibility criteria for each measure have been described previously (15).

Site-specific composite performance measure scores such as overall adherence rate for all performance measures and proportion of eligible patients with perfect adherence to all performance measures (defect free care percentage) were also calculated.

STATISTICAL ANALYSIS. Using HRRP's publically available data on HF-ERR in 2013, we stratified the participating centers into low (HF-ERR ≤1) versus high (HF-ERR >1) risk-adjusted 30-day readmission rate groups. Baseline hospital and patient characteristics were compared across the 2 study groups. For hospital characteristics, categorical variables are presented as count (proportions) and compared across the 2 groups using the Fisher exact test; continuous variables are presented as median (interquartile range [IQR]), and the difference between groups was tested using the Wilcoxon rank sum test. For patient characteristics and process of care measures, proportions of patients for each level of categorical variables and hospital means for continuous variables (including overall adherence rate) were calculated for each of the 171 hospitals and treated as continuous hospital variables. The hospital-level proportions and hospital means of patient characteristics and process-of-care measures were presented as median (IQR), and compared across the 2 study groups using the Wilcoxon rank sum test. Clinical outcomes were also compared across the 2 study groups using a similar approach. For length of stay, the hospital means for length of stay in days were calculated. For mortality and readmission outcomes, the percentage of patients with an incident event was calculated for each hospital. The hospital mean length of stay and percentage of patients with an outcome event were also compared across the 2 study groups using the Wilcoxon rank sum test. Unadjusted and adjusted regression models were constructed to examine the association between continuous measure of HF-ERR and clinical outcomes. Adjusted models were created separately to account for: 1) only hospital characteristics as covariates in Model 1; and 2) both hospital characteristics and hospital-level patient characteristics as covariates in Model 2. The 7 hospital characteristics included geographic location (West, Midwest, South, Northeast), hospital teaching status, rural location, number of beds, number of patients in the study population, number of HF cases, and hospital ownership (government, nonprofit, other). The 22 hospital-level patient covariates included demographic characteristics (mean age, % female patients, % white patients), % patients with medical history (anemia, ischemic etiology, cerebrovascular attack/transient ischemic attack, diabetes, hyperlipidemia, hypertension, chronic obstructive pulmonary disease or asthma, peripheral vascular disease, renal insufficiency, smoking), examination and laboratory findings at presentation (% patients by left ventricular ejection fraction groups—reduced or preserved, mean systolic blood pressure, mean heart rate, mean sodium level, mean blood urea nitrogen), and discharge destination (% patients discharged home, % inpatient rehabilitation facility/skilled nursing facility, and % hospice). Subgroup analysis were performed to compare the differences in long-term clinical outcomes among centers with high versus low HF-ERR for HF with preserved ejection fraction and HFrEF patients separately. Differences between groups were considered statistically significant if a 2-sided p value is >0.05. All analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, North Carolina).

RESULTS

Of the 171 participating centers, 84 (49.1%) had higher than expected risk-adjusted 30-day HF readmission rate (HF-ERR >1) and received a readmission penalty in 2013. There were significant geographical differences among hospitals with high versus low HF-ERR. Up to 77.4% hospitals with high HF-ERR were located in the southern or northeastern US whereas low HF-ERR centers were more evenly distributed across the country. There were no significant differences in the proportion of academic hospitals, rural hospitals, or size of the hospitals between the 2 groups (Table 1).

Hospitals with high HF-ERR had a larger proportion of female and African-American patients than those with low HF-ERR. The prevalence of prior cardiovascular disease was lower in hospitals with high versus low HF-ERR, including lower rates of prior MI and cerebrovascular disease. There were no significant differences in the clinical presentation, lab measurements, or ejection fraction among patients in the 2 groups. Among management strategies, diuretic use and cardiac rehabilitation referral were less common among centers with high versus low HF-ERR (Table 2).

Figure 1 compares the adherence to process of care measures across centers with high versus low HF-ERR. Overall adherence to most process of care measures was very high, with more than 90% of eligible HF patients receiving angiotensin-converting enzyme inhibitors/angiotensin receptor blockers, beta-blockers, and discharge instructions. Almost all eligible participants received ejection fraction assessment and smoking cessation counseling during their hospitalization. Proportional use of mineralocorticoid receptor antagonists, isosorbide-hydralazine, and ICD insertion or referral among eligible patients at discharge was low and did not differ between groups. There were no

significant differences between the high versus low HF-ERR groups for adherence to individual as well as composite process of care measures (median adherence rate to all performance measures 96.5% vs. 95.7%; p = 0.37; median defect-free care 91.1 vs. 90.0%; p = 0.47).

Table 3 compares clinical outcomes across the 2 study groups. In-hospital mortality was not significantly different between high versus low HF-ERR groups (site-level median 3.1% [IQR: 0.5% to 4.6%] vs. 3.5% [IQR: 1.2% to 4.8%]; p = 0.48). Length of stay was slightly longer in the high HF-ERR group with a trend toward significance (site-level median 5.5 [IQR: 5.0 to 6.2] days vs. 5.3 [IQR: 4.7 to 6.0] days; p = 0.07).

There was no significant difference in the composite of 1-year mortality or all-cause readmission between high versus low HF-ERR groups (site-level median 65.3% [IQR: 52.9% to 73.7%] vs. 62.9% [IQR: 57.1% to 66.7%]; p = 0.10). When the individual endpoints were assessed separately, high HF-ERR group had higher 1-year all-cause readmission (site-level median 59.1% [IQR: 48.9% to 64.9%] vs. 54.7% [IQR: 48.3% to 60.0%]; p = 0.01). However, the 1-year mortality rate was lower among centers with high versus low HF-ERR, with a trend toward statistical significance (site-level median 28.2% [IQR: 21.4% to 34.4%] vs. 31.7% [IQR: 25.4% to 34.8%]; p = 0.07). Similarly, in unadjusted time-to-event analysis, centers with HF-ERR ≤1 had lower risk for all-cause readmission and modestly higher risk for all-cause mortality compared with centers with HF-ERR >1 (Figure 2). Furthermore, the majority of readmission events on follow-up occurred early after discharge from the index hospitalization (Figure 2).

Similar findings were also observed in adjusted regression analysis treating HF-ERR as a continuous variable. Higher HF-ERR was not significantly associated with defect-free care (adjusted estimate per 0.1 unit higher ERR: -0.7; 95% confidence interval: -2.8 to 1.5), 1-year composite of mortality or all-cause readmission (adjusted estimate per 0.1-U higher ERR: 1.5; 95% confidence interval: -1.8 to 4.7), or the individual components of the composite outcome (Table 4).

In subgroup analysis by HF subtype, compared with low HF-ERR group, centers with high HF-ERR had higher 1-year readmission for both HF with preserved ejection fraction and HFrEF patients with no differences in 1-year mortality (Online Table 1).

TABLE 1 Baseline Hospital, Demographic Characteristics and Medical History Across the Study Groups

	HF-ERR ≤1 (n = 87)	HF-ERR >1 (n = 84)	p Value
Hospital characteristics			
Geographic region			0.031
West	19 (21.8)	8 (9.5)	
South	31 (35.6)	32 (38.1)	
Midwest	17 (19.5)	11 (13.1)	
Northeast	20 (23.0)	33 (39.3)	
Teaching status, % yes	48 (55.2)	41 (48.8)	0.446
Rural location, % yes	9 (10.3)	6 (7.1)	0.591
Hospital size	296 (184–428)	277 (176–470)	0.834
Hospital ownership			0.890
Government	11 (12.6)	10 (11.9)	
Nonprofit	61 (70.1)	57 (67.9)	
Other	15 (17.2)	17 (20.2)	
No. of heart failure cases	521 (284–736)	434 (241–635)	0.247
Patient characteristics			
Mean age, yrs	80.2 (79.0–81.8)	80.5 (78.4–82.8)	0.491
% Female	53.5 (48.5–59.5)	55.7 (51.6–64.3)	0.013
Race, %			
White	90.3 (77.8–96.5)	81.8 (53.6–93.1)	0.004
Black	3.1 (0–9.5)	8.1 (1.2–23.8)	0.006
Hispanic	0.7 (0–3.2)	0.5 (0–3.7)	0.767
Medical history, % yes			
Atrial flutter/fibrillation	43.8 (36.4–50.5)	40.6 (34.0–50.0)	0.174
Diabetes	41.8 (35.3–46.0)	43.3 (36.8–49.7)	0.137
Myocardial infarction	21.1 (16.0–26.8)	16.8 (11.2–26.6)	0.038
Cerebrovascular events	17.1 (13.5–20.9)	15.0 (8.3–19.3)	0.020
Heart failure	66.8 (56.3–76.0)	68.2 (57.5–82.1)	0.312
Dialysis (chronic)	1.9 (0–3.8)	2.7 (0–4.9)	0.272
Renal insufficiency (SCr >2.0)	20.1 (12.3–29.0)	21.7 (12.9–29.9)	0.424
Depression	8.5 (4.8–13.7)	8.0 (1.5–13.0)	0.655
CRT-D (with ICD)	3.0 (0–7.0)	1.0 (0–4.6)	0.010
Ischemic etiology	59.5 (52.9–66.7)	60.5 (50.0–66.1)	0.621
Smoking	8.3 (5.7–11.3)	7.0 (4.2–11.1)	0.255

Values are n (%) or median (interquartile range). For patient characteristics, hospital-level proportions for categorical variables and hospital means for continuous variables were calculated. The median (interquartile range) for hospital-level proportions and means is presented.

CRT-D = Cardiac resynchronization therapy device; HF-ERR = heart failure excess readmission ratio; ICD = implantable cardioverter-defibrillator; SCr = serum creatinine.

DISCUSSION

We observed 2 important findings in the present study. First, adherence to HF process of care measures was comparable at GWTG-HF participating centers with high versus low risk-adjusted 30-day HF readmission rates. Second, overall short- and long-term clinical outcomes were not different between the 2 groups. Hospitals with low risk-adjusted 30-day HF readmission rates had significantly lower 1-year all-cause readmission rates but a trend toward paradoxically higher 1-year morality rates. Taken together, these findings suggest that the 30-day readmission metric currently used by CMS to determine readmission penalties are not associated with quality of care or overall clinical outcomes as indexed by the composite rates of 1-year mortality or all-cause readmission among GWTG-HF participating centers.

TABLE 2 Clinical Presentation, In-Hospital Management, and Discharge Medications Among Hospitalized Heart Failure Patients Across the Study Groups

	HF-ERR ≤1 (n = 87)	HF-ERR >1 (n = 84)	p Value
Presentation characteristics			
Body mass index, kg/m^2	27.9 (26.8-28.7)	28.0 (27.1-29.2)	0.30
Heart rate, beats/min	82.6 (80.5-84.6)	83.4 (81.5-86.1)	0.15
Systolic blood pressure, mm Hg	140.5 (136.7-144.1)	141.0 (136.3-145.6)	0.50
Respiratory rate, beats/min	21.3 (20.1-22.0)	21.1 (20.3-22.3)	0.73
Serum creatinine, mg/dl	1.7 (1.5-1.9)	1.7 (1.5-1.9)	0.51
Blood urea nitrogen, mg/dl	32.1 (30.3-34.1)	31.4 (29.3-34.6)	0.55
BNP, pg/ml	1,317.1 (1,123.6-1,620.7)	1,265.4 (1,019.9-1,698.8)	0.63
Troponin, ng/dl	0.2 (0.1-0.3)	0.1 (0.1-0.3)	0.21
EF	43.6 (40.5-45.6)	42.9 (40.5-46.0)	0.62
EF category, %			
Preserved EF	45.8 (40.6-52.2)	46.7 (38.2-50.9)	0.86
Borderline reduced EF	14.0 (10.9-16.7)	14.0 (10.9-18.1)	0.54
Reduced EF	39.3 (33.3-44.6)	37.6 (31.9-46.6)	0.71
In-hospital procedure, % yes			
Cardiac cath/coronary angiography	5.4 (0.2-8.9)	3.2 (0-7.8)	0.12
Coronary bypass surgery	0 (0-0.4)	0 (0-0.3)	0.64
ICD only	0.2 (0-1.4)	0 (0-1.3)	0.38
CRT-D (with ICD)	0.3 (0-3.0)	0 (0-1.1)	0.16
Discharge medication, % yes			
ACEi/ARB	57.1 (51.1-64.4)	59.6 (50.0-66.9)	0.35
Beta blocker	71.4 (63.7-76.8)	73.0 (66.0-79.7)	0.23
Aldosterone antagonist	14.5 (9.5-20.9)	13.4 (8.6-20.2)	0.49
Digoxin	14.3 (7.8-18.1)	12.8 (1.7-17.9)	0.34
Diuretic	73.2 (52.5-80.7)	69.2 (29.2-77.0)	0.04
Anticoagulation for atrial fibrillation	32.7 (27.2-38.6)	31.9 (25.0-36.6)	0.24
Heart failure rehab, % yes			
Referred to outpatient cardiac rehab	15.2 (0.8-50.0)	3.1 (0-30.2)	0.05
Referral data missing	35.6 (6.4-97.5)	90.2 (23.3-100)	0.002

Values are median (interquartile range). Proportions of patients for each level of categorical variables and hospital means for continuous variables were calculated. The hospital-level proportions and hospital means are presented as median (interquartile range) for the 2 study groups.

ACEi/ARB = angiotensin-converting enzyme inhibitor/angiotensin receptor blocker; BNP = B-type natriuretic peptide; EF = ejection fraction; other abbreviations as in Table 1.

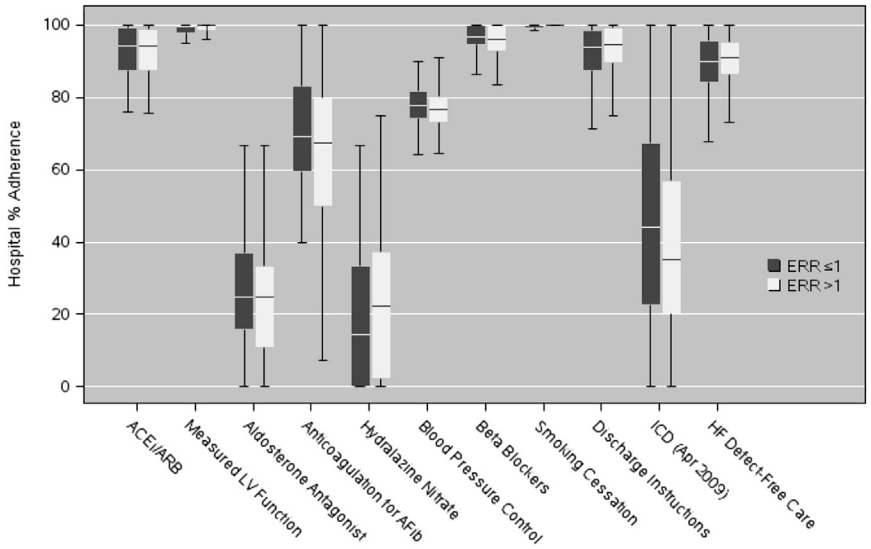
Thirty-day readmission has become a benchmark of hospital performance and CMS penalizes centers with higher than expected risk-adjusted readmission rates with up to 3% penalty in reimbursement. Findings from the present study suggest that the current 30-day readmission metric used by CMS to penalize hospitals with high readmission rates may not identify hospitals with poor quality of care. The quality of care appears to be comparable among centers with high versus low risk-adjusted 30-day readmission rates, suggesting that the higher 30-day readmission does not necessarily reflect poor quality of care but may be related to other factors. This observation is consistent with findings from previous studies have demonstrated a lack of association between in-hospital quality of care and 30-day readmission rates (14-16).

Several factors may explain the lack of association between HF process-of-care measures and risk adjusted 30-day readmission rates. The time period of 30 days may not be long enough to notice significant impacts of implementation of evidence-based therapies, which have been evaluated and validated for long-term clinical outcomes. Second, the in-hospital process of care assessment are limited in precision with no information on use of optimal doses of evidence based therapies and adherence to medications post-discharge. Third, previous studies have demonstrated that the major drivers of 30-day readmission for HF are not related to the quality of care and include hospital-level factors such as the proportion of vulnerable patients served, socioeconomic status of the hospital community, and patient-level factors such as history of mental illness, social and home support, and baseline disease severity (17-20). Along these lines, we observed significant differences in patient demographics with a greater proportion of women and African American patients at centers with high risk-adjusted 30-day readmission rates. Taken together, findings from the present study provide further evidence challenging the utility of 30-day readmission rates as a tool to identify hospitals with high versus low quality of care.

Interestingly, we observed that diuretic use and cardiac rehabilitation referral were significantly lower at centers with higher risk-adjusted 30-day readmission rates. Although use of diuretics and cardiac rehabilitation are not associated with improved survival among HF patients in the long term and thus are not traditionally considered HF quality-of-care measures, they may contribute to lower short-term readmission by improving the symptom burden among HF patients (27-29). Future studies are needed to better characterize the utility of diuretic use and cardiac rehabilitation as quality metrics to improve short-term outcomes such as 30-day readmission rates among HF patients.

We compared 1-year clinical outcomes among centers with high versus low risk-adjusted 30-day readmission rates to further assess the usefulness of this CMS metric as a measure of hospital quality. The composite end-point of 1-year mortality or all-cause readmission was not significantly different between the 2 groups. However, interesting between-group differences were noted for the individual components of the composite end-point. Centers with low 30-day risk-adjusted readmission rates had lower 1-year all-cause readmission rates. Several factors may underlie the observed association between short- and long-term readmission rates. First, as discussed previously, major determinants of HF

FIGURE 1 Adherence to Get With The Guidelines-Heart Failure Performance Measures Across the Study Groups



For individual process-of-care measures and the defect-free care measure, the proportion of patients meet each of these criteria were calculated for each hospital, and the median (interquartile range) for the hospital-level proportions are presented. ACEi/ARB = angiotensin-converting enzyme inhibitor/angiotensin receptor blocker; ERR = excess readmission ratio; HF = heart failure; ICD = implantable cardioverter-defibrillator (data available from April 2009 onwards); LV = left ventricular.

readmissions such as the composition of the patient population served at the hospital, disease severity, and socioeconomic status are nonmodifiable (17,18). Thus, higher short-term readmission rates would be expected to translate into higher long-term readmission rates. It is noteworthy that the association between HF-ERR and 1-year all-cause readmission in our study population was not significant after adjustment for these hospital and patient characteristics measures. Second, higher use of observation services at centers with low 30-day readmission rates may also have contributed to the lower 1-year readmission rates. In a recent study, Zuckerman et al. (30) demonstrated a significant increase in utilization of observation stays over the past few years since and before the implementation of HRRP. Although no significant association was observed between changes in 30-day readmission rates and changes in observation stays, the study did not evaluate the association between long-term (1-year) readmission rates and observation stays. Future studies are needed to evaluate if differences in long-term readmission outcomes between centers with high versus low ERR are related to differences in observation stay rates.

In contrast to the 1-year readmission outcomes, a trend toward higher 1-year mortality rate was observed among centers with low 30-day risk adjusted HF readmission rate. This discordance between the readmission and mortality outcomes is consistent with the findings from previous studies that demonstrated higher 30-day mortality among

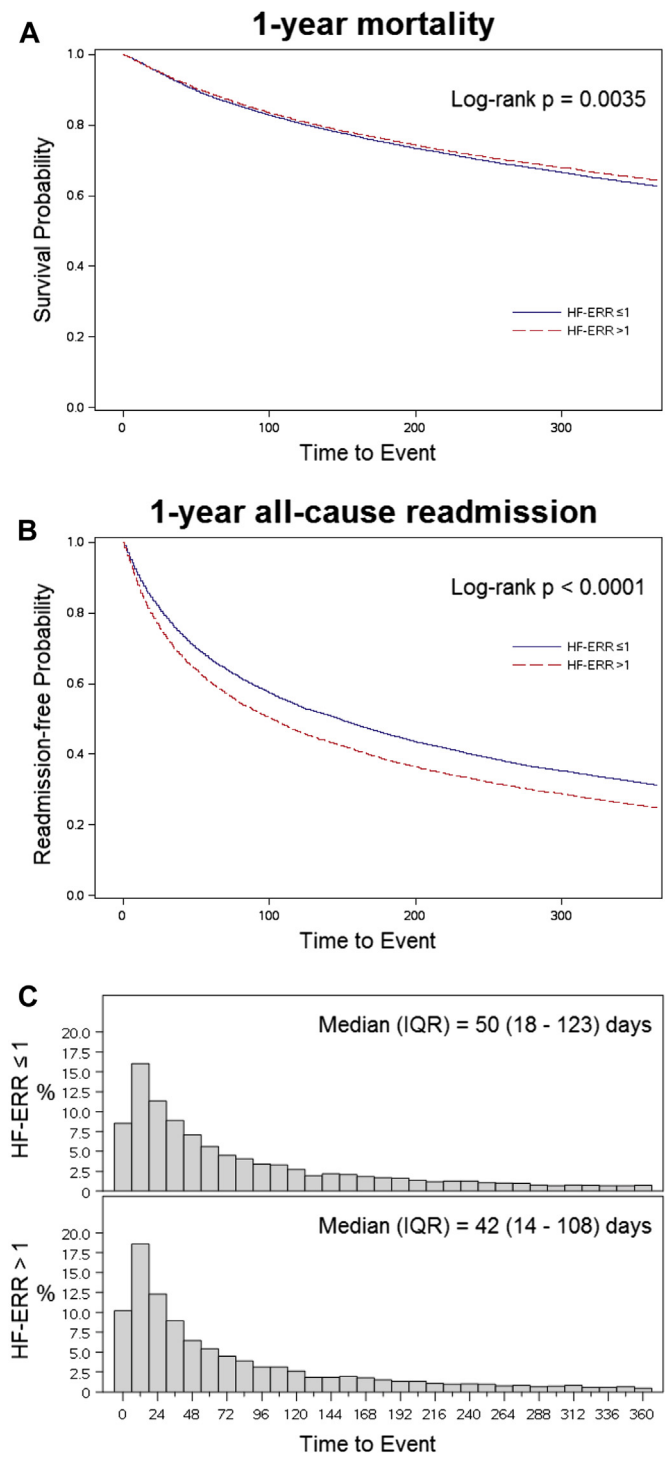
TABLE 3 In-Hospital and 1-Year Clinical Outcomes Among Heart Failure Patients Across the Study Groups

	HF-ERR ≤1 (n = 87)	HF-ERR >1 (n = 84)	p Value
In-hospital outcomes			
Inpatient mortality, % yes	3.5 (1.2–4.8)	3.1 (0.5–4.6)	0.48
Length of stay, days	5.3 (4.7–6.0)	5.5 (5.0–6.2)	0.06
Discharge destination, %			
Home	68.3 (62.2–75.0)	67.3 (60.3–74.0)	0.37
Skilled nursing facility	16.5 (11.6–22.5)	17.1 (11.0–25.1)	0.44
Hospice, home	1.9 (1.2–3.8)	1.3 (0–2.4)	<0.001
Hospice, health care facility	1.3 (0.5–2.6)	0.9 (0–2.5)	0.08
Inpatient rehabilitation facility	0.4 (0–2.5)	0.4 (0–1.9)	0.92
Intermediate-care facility	0.6 (0–2.4)	0.3 (0–3.0)	0.89
Long-term-care hospital	0 (0–0.5)	0 (0–0.4)	0.92
1-year follow-up outcomes, % yes			
Composite of mortality or all-cause readmission	62.9 (57.1–66.7)	65.3 (52.9–73.7)	0.10
Mortality	31.7 (25.4–34.8)	28.2 (21.4–34.4)	0.07
All-cause readmission	54.7 (48.3–60.0)	59.1 (48.9–64.9)	0.01

Values are median (interquartile range). For readmission, mortality, and discharge location outcomes, the proportion of patients with the outcome of interest were calculated for each hospital, and the median (interquartile range) for the hospital-level proportions is presented. For length of stay, hospital means were calculated and are presented as median (interquartile range) for the 2 study groups.

HF-ERR = heart failure excess readmission ratio.

FIGURE 2 Comparison of 1-Year Clinical Outcomes Across the Study Groups



Kaplan-Meier plot showing **(A)** mortality- and **(B)** readmission-free survival among patients across centers with heart failure excess readmission ratio (HF-ERR) ≤1 and HF-ERR >1. **(C)** Histograms for time to readmission event on follow-up among patients across centers with HF-ERR ≤1 and HF-ERR >1. IQR = interquartile range.

centers with low 30-day readmission rates (10,31). Similarly, in a recent study, Nuti et al. (32) reported higher risk-adjusted readmission rates but lower mortality rates at 30 days for HF and acute myocardial infarction among Veterans Affairs hospitals as compared with non-Veterans Affairs hospitals. Our study findings add significantly to the existing literature and demonstrate that the inverse relationship between readmission and mortality risk is maintained on long-term follow-up. Several factors may explain this paradoxical association. Higher readmission in the short term may be reflective of better care coordination and follow-up care after discharge. It is noteworthy that certain planned readmissions for procedures, surgeries, and other in-patient evaluations, which are not included in the CMS pre-specified list of planned procedures (33), may be appropriate in improving long-term survival but are counted against the hospital and contribute to the readmission penalty calculation. Furthermore, 30-day readmission rates may be lowered spuriously by higher competing risk of mortality.

Our findings have important clinical and health policy implications. The 30-day risk-adjusted excess readmission has been portrayed as a highly reliable and actionable metric of hospital quality of care that may be targeted to improve patient care. In this context, a reliable and clinically meaningful metric of hospital care quality is expected to predict long-term clinical outcomes such that hospitals identified as high performing have better clinical outcomes on long-term follow-up. Findings from our study suggest that the current policy of using risk adjusted 30-day readmission rate to identify low quality of care hospitals may be problematic. Lower 30-day readmission rates were significantly associated with lower 1-year readmission rate, highlighting the utility of this metric as a target for cost reduction. However, the observed trend toward higher 1-year mortality among centers with low versus high 30-day readmission rates potentially argues against its validity as a measure of care quality. It is possible that certain hospitals may be penalized unfairly despite providing similar quality of care and comparable long-term outcomes, due only to their high 30-day readmission rates, which may be driven by other nonmodifiable factors.

In the first year of HRRP implementation (fiscal year 2013), CMS penalized 64% participating centers with a total of $290 million in penalties (34). This has prompted the hospitals to invest extensive resources on reducing short-term readmissions, potentially at the expense of other important quality improvement issues (35–37). Our study findings highlight the need to broaden the focus of hospital quality assessment

TABLE 4 Unadjusted and Adjusted Effects on Outcomes for per 0.1 Unit Increased HF-ERR

	Unadjusted Effect (95% CI)	p Value	Model 1 Adjusted Effect (95% CI)*	p Value	Model 2 Adjusted Effect (95% CI)†	p Value
Defect-free care, % yes‡	0.2 (-1.6 to 2.0)	0.81	-0.2 (-2.2 to 1.7)	0.81	-0.7 (-2.8 to 1.5)	0.54
1-year follow-up outcomes, % yes						
Composite of mortality or all-cause readmission	2.9 (-0.1 to 5.9)	0.06	2.6 (-0.5 to 5.8)	0.10	1.5 (-1.8 to 4.7)	0.38
Mortality	-0.2 (-2.5 to 2.1)	0.87	-0.3 (-2.7 to 2.2)	0.83	-0.8 (-3.3 to 1.6)	0.50
All-cause readmission	4.8 (2.0 to 7.7)	<0.001	4.5 (1.5 to 7.5)	0.004	2.6 (-0.4 to 5.7)	0.09

*Model 1 has only adjusted for the 7 hospital characteristics. †Model 2 has adjusted for both the 7 hospital characteristics and the 22 patient characteristics (calculated as site mean or site %). ‡Defect-free care refers to adherence to all performance measures among eligible patients.

CI = confidence interval; HF-ERR = heart failure excess readmission ratio.

and improvement programs from short-term readmission rates to more comprehensive measures of care quality and clinical outcomes (11,38). This includes targeting longitudinal adherence to evidence-based therapies, promoting better transition of care, and implementing effective interventions to address relevant social issues that may influence long-term clinical outcomes.

STUDY LIMITATIONS. Several limitations to our study must be noted. First, the study population consisted of Medicare fee-for-service beneficiaries enrolled in the GWTG-HF centers that participated in the first cycle of HRRP (fiscal year 2013). Thus, our study findings may not be generalizable to other hospitals with different patient case mix, resource availability, and care patterns. Second, we only examined the hospitals included in the first year of HRRP and interventions aimed at reducing hospital readmissions implemented as a consequence of this policy may have had a positive impact on quality of care and outcomes in later years. Third, data were collected by medical chart review and the quality of the data depends on the accuracy and completeness of the clinical documentation. Fourth, the 1-year outcomes were determined from administrative database and thus may be confounded by some degree of misclassification. Fifth, we did not account for multiple testing in our analysis and the number of significant tests may be inflated. Future studies are needed to validate our study findings. Finally, we did not assess health-related quality of life, patient satisfaction, and other outcomes that may differ across centers on the basis of 30-day readmission rates.

CONCLUSIONS

Among GWTG-HF participating centers, the quality of care and overall 1-year clinical outcomes were comparable among centers with high versus low risk-adjusted 30-day HF readmission rates. These findings question the usefulness of this CMS-HRRP performance metric in identifying and penalizing hospitals with low quality of care. Future prospective studies are needed to determine how readmission penalties levied by CMS have affected quality of care and outcomes in hospitals over time.

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PERSPECTIVES

COMPETENCY IN MEDICAL KNOWLEDGE: The quality of care and clinical outcomes were comparable among centers with high versus low risk-adjusted 30-day HF readmission rates as determined under the HRRP.

TRANSLATIONAL OUTLOOK: Future studies are needed to determine the impact of HRRP and interventions aimed at reducing hospital readmissions implemented as a consequence of this policy on quality of care and outcomes in later years.

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KEY WORDS heart failure, mortality, quality of care, readmission

APPENDIX For a supplemental methods section and a supplemental table, please see the online version of this article.