

Recent National Trends in Readmission Rates After Heart Failure Hospitalization

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Background—In July 2009, Medicare began publicly reporting hospitals' risk-standardized 30-day all-cause readmission rates (RSRRs) among fee-for-service beneficiaries discharged after hospitalization for heart failure from all the US acute care nonfederal hospitals. No recent national trends in RSRRs have been reported, and it is not known whether hospital-specific performance is improving or variation in performance is decreasing.

Methods and Results—We used 2004–2006 Medicare administrative data to identify all fee-for-service beneficiaries admitted to a US acute care hospital for heart failure and discharged alive. We estimated mean annual RSRRs, a National Quality Forum–endorsed metric for quality, using 2-level hierarchical models that accounted for age, sex, and multiple comorbidities; variation in quality was estimated by the SD of the RSRRs. There were 570 996 distinct hospitalizations for heart failure in which the patient was discharged alive in 4728 hospitals in 2004, 544 550 in 4694 hospitals in 2005, and 501 234 in 4674 hospitals in 2006. Unadjusted 30-day all-cause readmission rates were virtually identical over this period: 23.0% in 2004, 23.3% in 2005, and 22.9% in 2006. The mean and SD of RSRRs were also similar: mean (SD) of 23.7% (1.3) in 2004, 23.9% (1.4) in 2005, and 23.8% (1.4) in 2006, suggesting similar hospital variation throughout the study period.

Conclusions—National mean and RSRR distributions among Medicare beneficiaries discharged after hospitalization for heart failure have not changed in recent years, indicating that there was neither improvement in hospital readmission rates nor in hospital variations in rates over this time period. (*Circ Heart Fail.* 2010;3:97-103.)

Key Words: heart failure ■ health policy ■ hospitalizations/rehospitalizations ■ epidemiology ■ congestive ■ Centers for Medicare and Medicaid Services (US) ■ patient readmission ■ United States/epidemiology

As a measure of performance quality, the Center of Medicare and Medicaid Services (CMS) began publicly reporting hospitals' risk-standardized 30-day all-cause readmission rates (RSRRs), among fee-for-service beneficiaries discharged after hospitalization for heart failure (HF) from all the US acute care nonfederal hospitals, in July 2009. This focus on readmission is part of a larger CMS effort to promote health care, quality, and efficiency¹ and was supported by reports from both the Institute of Medicine and the Medicare Payment Advisory Commission that identified hospital readmissions as potential indicators of poor care or

missed opportunities to better coordinate care.^{2,3} The RSRR was endorsed by the National Quality Forum as a measure of hospital performance⁴ and is aligned with the American Heart Association's and American College of Cardiology's published standards for statistical models used for calculation and public reporting of health outcomes and efficiency measures.^{5,6}

Policies that target readmission after HF hospitalization through public reporting to drive improved performance have widespread potential. Readmission rates may be reduced if proven interventions are more fully instituted by hospitals

Received June 5, 2009; accepted September 28, 2009.

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Guest Editor for this article was Véronique L. Roger, MD, MPH.

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DOI: 10.1161/CIRCHEARTFAILURE.109.885210

and physicians in response to public reporting and benchmarking. HF is one of the most common principal discharge diagnoses among Medicare beneficiaries,⁷ and there is wide variation among hospitals' HF readmission rates.³ After hospitalization for HF, 15-day readmission rates have been estimated at 13%³ and 30-day readmission rates at $\approx 25\%$.^{8,9} Other studies reported rates of readmission after HF hospitalization approaching 45% at 6 months in the same population.¹⁰ In efforts to identify opportunities to improve quality of care, several interventions have been proven to lower readmission rates after HF hospitalization, including improved hospital^{11,12} and postdischarge care,^{13–17} pre-discharge planning,^{18,19} home-based follow-up,²⁰ and patient education.^{18,21,22}

Despite the planned public reporting of RSRRs by CMS, the most recent estimates of US readmission rates after HF hospitalization are from 2004,⁹ and it is not known whether mean hospital-specific performance has been improving, staying the same, or getting worse. Moreover, it is not known whether between-hospital variation in RSRR has changed; decreased variation would suggest that more hospitals are performing at more or less the same level, whereas increased variation would suggest that more hospitals are substantially out performing and underperforming the others. Our research objective was to describe recent national trends in 30-day all-cause readmission rates after HF hospitalization among Medicare beneficiaries to improve clinical understanding of the risk for rehospitalization after HF admission and to inform efforts of policy-makers as increased attention is focused on this new measure of hospital quality.

Methods

Study Cohort

The study population included fee-for-service Medicare patients 65 years or older discharged alive after a hospitalization with a principal discharge diagnosis of HF between January 1, 2004, and December 31, 2006. HF hospitalizations were determined using *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnostic codes, specifically the following codes: 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, and 428.x. Data were obtained from the Medicare Provider Analysis and Review files for each year (2004, 2005, and 2006) separately. We used Medicare Part A inpatient and outpatient data and Medicare Part B provider data to determine patient comorbidities, medical history, and procedure use during the 12 months before the index admission.

For each year of data, we included patients with 12 months of continuous Medicare fee-for-service enrollment before the index admission to obtain complete comorbidity information. Because our focus was on hospital readmission risk, we excluded hospitalizations during which the patient died; the proportion of excluded hospitalizations did not vary by year. Patients who were transferred from an index hospital to another acute care facility were followed as a single episode of care. These patients were attributed to the receiving hospital that was responsible for their discharge because our focus was on hospital readmission risk, as done in the previous research.⁸ Mortality was determined by linking the Medicare Provider Analysis and Review data with the Medicare Enrollment Database.

Hospital-Specific Readmission Rates

Our main outcome measure was hospital-specific all-cause readmission rates for all HF hospitalizations where patients were discharged

alive, defined using hospital rates of patient readmissions to any hospital for any reason within 30 days following discharge after an index HF hospitalization. During a calendar year, patients could have >1 HF hospitalization. However, HF hospitalizations that occurred within 30 days of discharge of an index discharge after HF hospitalization were categorized as outcome events (ie, a readmission) and not treated as new index hospitalizations.

To calculate the hospital-specific RSRR, we used measurement methods that were developed for the CMS and which have been endorsed by the National Quality Forum.⁴ These models are based on administrative data but produce estimates of RSRRs that are strongly correlated with estimates from a medical record model.⁸ This model includes patient-specific information on age and sex and uses condition categories, derived from hierarchical condition categories,²³ to additionally include information on 9 characteristics from the cardiovascular medical history and 26 other comorbid conditions (Table 1).

The hospital-specific RSRR was calculated from estimates derived from 2-level (patient and hospital) hierarchical logistic regression models. In the hierarchical regression model, the dependent variable was patient-specific 30-day all-cause readmission. The first-level covariates include patient age, sex, comorbid conditions, and cardiovascular medical history, as described earlier. The second-level covariates includes hospital-level random intercepts assumed to be normally distributed to account for the clustering (nonindependence) of patients within the same hospital.²⁴ This permitted separation of within-hospital and between-hospital variation after adjusting for patient characteristics.

Statistical Analysis

We compared patient characteristics across all 3 years using patient-level data, using a general linear model to compare the mean age of each year's cohort and χ^2 tests to compare other categorical variables across all 3 years. National trends in hospital-specific readmission rates after HF hospitalization were analyzed using hospital-level data. We calculated the mean observed readmission rates and RSRRs, along with their corresponding 95% CI, for the full 3-year pooled sample and stratified by year and Census Division in which the hospital is located. Year-stratified and Census Division-stratified estimates of the RSRR were conducted independently. To assess the effect of year and hospital Census Division on the estimated RSRRs, we fitted a hierarchical linear regression model that used the estimated RSRRs for each hospital as our dependent variable and accounted for repeated measures and imbalance because all hospitals did not have 3 years of data. All analyses were conducted using SAS Software, version 9.1.3 (SAS Institute, Inc, Cary, NC). All statistical tests were 2-tailed and used a type I error rate of 0.05.

Results

After exclusions were applied, the 2004 data included 570 996 hospitalizations for HF in which the patient was discharged alive among 4728 hospitals, the 2005 data included 544 550 hospitalizations for HF in which the patient was discharged alive among 4694 hospitals, and the 2006 data included 501 234 hospitalizations for HF in which the patient was discharged alive among 4674 hospitals, for a total of 1 616 780 hospitalizations for HF in which the patient was discharged alive from 2004 to 2006. The average patient age was 80.1 years and 57.3% were women. The majority of these patients had multiple chronic diseases; 74.1% had been previously diagnosed with HF, 60.1% had been previously diagnosed with heart arrhythmias, 72.8% with chronic atherosclerosis, 49.2% with diabetes, and 28.9% with renal failure (Table 1).

Table 1. Demographic Characteristics, Cardiovascular Medical History, and Comorbid Conditions for Fee-For-Service Medicare Beneficiary Discharges After HF Hospitalization, Stratified by Year

	Overall	Year			P
		2004	2005	2006	
No. (%) of discharges	1 616 780	570 996 (35.3)	544 550 (33.7)	501 234 (31.0)	
Demographics					
Age, mean (SD)	80.1 (7.9)	79.9 (7.8)	80.0 (7.9)	80.3 (7.9)	<0.001
Female, %	57.3	57.8	57.1	56.9	<0.001
Cardiovascular medical history, %					
History of CABG surgery	12.9	13.4	13.1	12.1	<0.001
HF (CC 80)	74.1	74.0	74.4	74.0	<0.001
Acute coronary syndrome (CC 81, 82)	19.6	20.4	19.5	18.8	<0.001
Arrhythmias (CC 92, 93)	60.1	59.0	60.3	61.1	<0.001
Cardiorespiratory failure and shock (CC 79)	17.3	17.0	17.0	18.0	<0.001
Valvular and rheumatic heart disease (CC 86)	47.9	46.7	48.0	49.2	<0.001
Vascular or circulatory disease (CC 104 to 106)	42.8	42.2	42.7	43.5	<0.001
Chronic atherosclerosis (CC 83, 84)	72.8	72.9	72.9	72.4	<0.001
Other and unspecified heart disease (CC 94)	18.6	18.4	18.6	18.8	<0.001
Comorbid condition, %					
Stroke (CC 95, 96)	8.5	8.7	8.5	8.3	<0.001
End-stage renal disease or dialysis (CC 129, 130)	3.2	2.9	3.2	3.5	<0.001
Renal failure (CC 131)	28.9	25.5	27.6	34.2	<0.001
Nephritis (CC 132)	3.4	3.7	3.5	3.0	<0.001
Other urinary tract disorders (CC 136)	36.0	37.6	37.8	32.2	<0.001
COPD (CC 108)	44.8	44.7	44.8	45.0	0.001
Asthma (CC 110)	7.7	7.7	7.7	7.7	0.98
Pneumonia (CC 111 to 113)	31.1	29.8	30.8	33.0	<0.001
Fibrosis of lung and other chronic lung disorders (CC 109)	6.8	6.6	6.8	7.0	<0.001
Diabetes and diabetes mellitus complications (CC 15 to 20, 119, 120)	49.2	48.9	49.3	49.5	<0.001
Liver and biliary disease (CC 25 to 30)	6.0	6.0	6.1	6.1	0.01
Peptic ulcer, hemorrhage, other specified GI disorders (CC 34)	15.0	15.2	15.0	14.7	<0.001
Other GI disorders (CC 36)	48.7	48.3	48.5	49.3	<0.001
Dementia and senility (CC 49, 50)	15.8	15.3	15.8	16.5	<0.001
Depression (CC 58)	12.5	12.6	12.4	12.5	<0.001
Major psychiatric disorders (CC 54 to 56)	7.7	7.7	7.6	7.7	0.003
Other psychiatric disorders (CC 60)	9.1	9.0	9.0	9.3	<0.001
Drug/alcohol abuse/dependence/psychosis (CC 51 to 53)	8.7	8.6	8.9	8.8	<0.001
Metastatic cancer and acute leukemia (CC 7)	1.9	1.9	1.9	1.9	0.06
Cancer (nonmetastatic) (CC 8 to 12)	18.9	18.6	18.8	19.2	<0.001
Severe hematologic disorders (CC 44)	3.4	3.2	3.4	3.5	<0.001
Iron deficiency and other/unspecified anemias and blood disease (CC 47)	44.9	44.2	44.8	45.8	<0.001
Hemiplegia, paraplegia, paralysis, functional disability (CC 67 to 69, 100 to 102, 177, 178)	5.9	6.1	5.9	5.8	<0.001
Decubitus ulcer or chronic skin ulcer (CC 148, 149)	12.0	11.7	12.0	12.2	<0.001
Protein-calorie malnutrition (CC 21)	4.7	4.5	4.7	5.1	<0.001
Disorders of fluid/electrolyte/acid-base (CC 22 to 23)	36.5	35.4	36.5	37.7	<0.001

CC indicates condition category; CABG, coronary artery bypass graft; COPD, chronic obstructive pulmonary disease; GI, gastrointestinal.

Table 2. Observed and Risk-Standardized Hospital-Specific 30-Day All-Cause Readmission Rates for Fee-For-Service Medicare Beneficiary Discharges After HF Hospitalization, Stratified by Year

	Overall	Year			<i>P</i>
		2004	2005	2006	
Observed readmission rate					
Mean (SD), %	23.1 (10.2)	23.0 (9.9)	23.3 (10.2)	22.9 (10.4)	0.04
Median (50th percentile), %	23.1	23.1	23.3	22.9	
25th, 75th percentiles, %	18.6, 27.5	18.7, 27.3	18.8, 27.8	18.2, 27.3	
Risk-standardized readmission rate					
Mean (SD), %	23.8 (1.3)	23.7 (1.3)	23.9 (1.4)	23.8 (1.4)	<0.001
Median (50th percentile), %	23.7	23.6	23.8	23.7	
25th, 75th percentiles, %	23.0, 24.5	23.0, 24.4	23.1, 24.7	23.0, 24.5	

Among 1 616 780 hospitalizations for HF in which the patient was discharged alive from 2004 to 2006, 384 397 (23.8%) were readmitted to a hospital for any reason within 30 days of discharge. Unadjusted hospital-specific 30-day all-cause readmission rates were virtually identical in each year over this period, although statistically different: mean (SD) of 23.0% (9.9) in 2004, 23.3% (10.2) in 2005, and 22.9% (10.4) in 2006 ($P=0.04$; Table 2).

Annual estimates of between-hospital variation in patient risk of readmission were similar: 0.021 (SE=0.001) for 2004, 0.024 (SE=0.002) for 2005, and 0.025 (SE=0.002) for 2006. This implies that the odds of readmission for a patient discharged from a hospital 1SD above the national mean is 1.4 times that for a patient discharged from a hospital 1SD below the national mean. In 2004, 2005, and 2006, the mean RSRR was 23.7% (SD=1.3; interquartile range [IQR]=23.0% to 24.4%), 23.9% (SD=1.4; IQR=23.1% to 24.7%), and 23.8% (SD=1.4; IQR=23.0% to 24.5%); $P<0.001$, respectively, and there was similar heterogeneity in hospital-specific RSRRs across all 3 years (Figure 1). Again, although there were statistically significant differences in mean RSRRs by year, this finding was not clinically significant. Pooling all 3 years of data, the mean hospital-specific

30-day RSRR after HF hospitalization from 2004 to 2006 was 23.8% (SD=1.3; IQR=23.0% to 24.5%).

There were small statistical differences in the mean hospital-specific 30-day unadjusted and RSRRs across Census Divisions of the United States from 2004 to 2006 ($P<0.001$), but these differences were not clinically significant, and there was also similar heterogeneity in hospital-specific 30-day RSRRs among all 3 years across Census Divisions (Figure 2). Hospitals in the Mountain Division were found to have the lowest mean hospital-specific RSRR (23.5%, SD=1.0; IQR=23.0% to 24.0%), whereas hospitals in the Mid-Atlantic Division were found to have the highest mean hospital-specific RSRR (24.2%, SD=1.4; IQR=23.2% to 25.2%).

Discussion

Among fee-for-service Medicare beneficiaries discharged alive after hospitalization for HF, we found that recent risk-standardized hospital-specific 30-day readmission rates approached 25% across the United States in each of 3 years we studied, consistent with previous estimates,⁹ and that there were no clinically important changes in

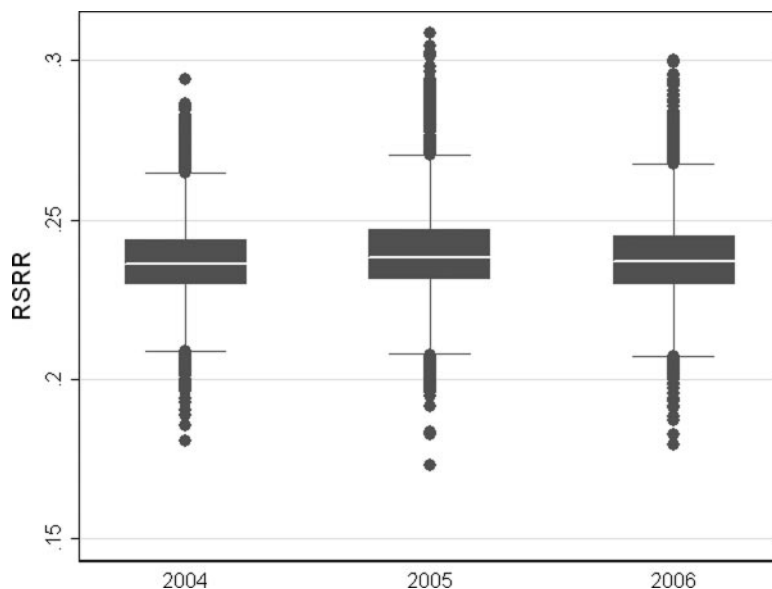


Figure 1. Frequency distribution of RSRRs for fee-for-service Medicare beneficiaries discharged after heart failure hospitalization, 2004–2006. The upper boundaries of the boxes represent the 75th percentile, the lines bisecting the boxes represent the median or 50th percentile, and the lower boundaries of the boxes represent the 25th percentile. The upper and lower boundaries of the whiskers are set at $1.5 \times \text{IQR}$ above the 75th percentile and at $1.5 \times \text{IQR}$ below the 25th percentile, respectively, with dots representing hospitals beyond these percentiles at the extreme.

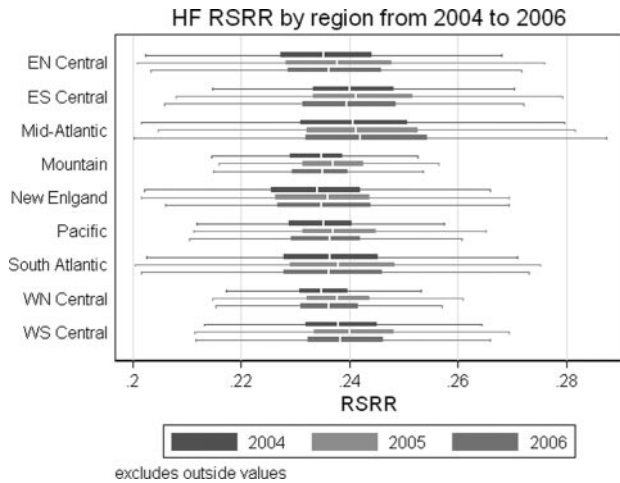


Figure 2. Frequency distribution of RSRRs for fee-for-service Medicare beneficiaries discharged after heart failure hospitalization by Census Division, 2004–2006. The left-most boundaries of the narrow boxes represent the 75th percentile, the lines bisecting the narrow boxes represent the median or 50th percentile, and the right-most lower boundaries of the boxes represent the 25th percentile. The left-most and right-most boundaries of the whiskers are set at $1.5 \times \text{IQR}$ below the 25th percentile and $1.5 \times \text{IQR}$ above the 75th percentile respectively. Hospitals beyond these percentiles at the extreme were excluded from this figure.

readmission rates over this time period. Our findings demonstrate that there has been no aggregate improvement, across the nation or in any geographic region, in readmission rates after HF hospitalization. Readmitting approximately a quarter of patients after HF hospitalization within 30 days is not likely to represent optimal care for patients and suggests that there is substantial room and a clear opportunity for improvement that might be achieved through enhancing the quality of inpatient care or through improved transitions from the inpatient to the outpatient environments. Paying greater attention to hospital readmission rates through surveillance efforts such as public reporting may be an important first step toward this goal.

We found similar heterogeneity among hospital performance in all 3 years. Half of the US hospitals were found to have RSRRs within 1.5% of one another, suggesting that there is little variability in the effectiveness of hospitals' approach to managing transitions of care among patients discharged after HF hospitalization and that all the US hospitals appear to be facing similar challenges in preventing readmissions. Although the lack of practice variation prohibits our exclusion of the possibility that all hospitals are functioning at peak efficiency and are providing transition care of the highest quality, several clinical interventions have been shown to lower readmission rates below usual care. We cannot determine whether all the patients discharged after HF hospitalization were consistently provided with necessary services and medications or they were taught how to manage their health and monitor their symptoms, or they had an appointment scheduled with their primary care physician, who had received necessary and critical information about the patient's

hospitalization, to ease the transition from the hospital to home. However, each of these actions represents a previously identified strategy to minimize hospital readmissions after HF hospitalization that ideally would be widely used and are likely to lower readmission rates within 30 days below 25%.^{13,14,18,19,21,22} Despite randomized, controlled trials of postdischarge HF disease management repeatedly demonstrating patient benefits and reduced costs,^{14–16,22} practices proven to be effective in the US studies have generally not been continued or expanded, mostly because of financial constraints, whereas similar practices proven to be effective in other countries have often become permanent.²⁵

We hypothesize that the hospital performance we have observed is likely to be a function of the current fee-for-service payment system and further research is needed to examine readmission rates in health systems that do not use a fee-for-service payment system, such as the Veterans Health Administration. Rather than rewarding better outcomes, current CMS hospital and physician payment policy rewards greater volume. Piecemeal payment is an economic incentive for healthcare providers, both hospitals and physicians, to increase patient volume and service intensity during hospitalizations to increase revenue. In contrast, CMS payments are low or do not exist for the services that have been proven to lower hospitalization rates, such as disease management strategies. Appropriate delivery of these services may potentially reduce hospitalization revenue substantially without creating reciprocal revenue elsewhere, even if hospitals offer extensive ambulatory care services, which would in turn impede hospitals and physician groups from adopting such strategies.²⁵ Fortunately, Medicare Payment Advisory Commission recently recommended that CMS alter its payment policy and realign financial incentives, driving collaborations and clinical integration between hospitals, physicians, nurses, and other outpatient services by bundling payments around a hospitalization.³ Action needs to be taken to ensure that these reforms are enacted and financial incentives are established to improve transition care quality, thereby lowering readmission rates.

Public reporting of hospital readmission rates offers an important opportunity to provide a visible incentive for healthcare quality improvement by promoting informed patient choices, fostering hospital concern for protecting or enhancing its public image, and providing objective feedback that fuels professional desires to improve care.^{26–28} At the very least, ongoing public reporting efforts by CMS can be used to inform practice and policy, rather than being isolated from them as in the past.²⁵ Similarly, reporting can identify high-quality hospitals that can be subsequently examined in an effort to determine which structures and processes of care enable and sustain the provision of high-quality care or low-quality hospitals whose performance can be subsequently addressed.

Our study is among the first to describe national estimates of hospital-specific 30-day all-cause readmission rates after HF hospitalization, using a risk-standardization model to determine hospital performance that was en-

dorsed by the National Quality Forum and validated using chart-abstracted data. However, there are considerations in interpreting our results. First, we examined readmission outcomes only for patients who had been discharged after hospitalization for HF, so that our results may not be generalized to other conditions. However, HF is among the most common hospital discharge diagnoses and readmission after HF hospitalization has been shown to be modifiable through controlled interventions, justifying our focus on the condition. Second, we only examined readmission outcomes for HF patients and did not address other important dimensions of quality, such as mortality, processes of care, health status outcomes, or other patient care experiences, such as treatment satisfaction. Third, although our study provides insights for understanding healthcare delivery in the United States, it was limited to fee-for-service Medicare beneficiaries, and the hospital readmission rates we estimated using this population may not be representative of the readmission rates of other populations. Finally, because of Medicare data availability, we only report on readmission trends through 2006. We are unable to determine whether other recent efforts outside of CMS to lower hospital readmission rates, such as the focus on readmission rates by the Institute for Healthcare Improvement, have had an impact during the past 2 years.

In conclusion, there has been no recent national or regional improvement in hospital readmission care among Medicare beneficiaries discharged alive after HF hospitalization. Recent national hospital-specific risk-standardized readmission rates approached 25% for the most common discharge diagnosis among Medicare beneficiaries and the distribution in hospital performance has not changed. Given the need to lower readmission rates, it is hoped that the upcoming efforts by CMS to publicly report HF RSRRs for all hospitals can offer an important opportunity to drive healthcare quality improvement.

Sources of Funding

The analyses upon which this publication is based were performed under contract HHSM-500-2005-CO001C, entitled "Utilization and Quality Control Quality Improvement Organization for the State (Commonwealth) of Colorado," funded by the Centers for Medicare & Medicaid Services, an agency of the US Department of Health and Human Services. Dr Ross is currently supported by the National Institute on Aging (K08 AG032886) and by the American Federation of Aging Research through the Paul B. Beeson Career Development Award Program. Dr Bueno was supported by grant BA08/90010 from the Fondo de Investigaciones Sanitarias, Instituto de Salud Carlos III, Madrid, Spain. Dr Vidán was supported by grant BA08/90012 from the Fondo de Investigaciones Sanitarias, Instituto de Salud Carlos III, Madrid, Spain.

Disclosures

Dr Ross had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Drs Chen, Lin, Curtis, Normand, Wang, Wang, and Krumholz and Mr Schreiner report that they developed RSRRs for heart failure under contract with the Colorado Foundation for Medical Care. Dr Krumholz reports that he chairs a scientific advisory board for UnitedHealthcare. The content of this publication

does not necessarily reflect the views or policies of the Department of Health and Human Services, nor does mention of trade names, commercial products, or organizations imply endorsement by the US Government. The authors assume full responsibility for the accuracy and completeness of the ideas presented.

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Circ Heart Fail. 2010;3:97-103; originally published online November 10, 2009;
doi: 10.1161/CIRCHEARTFAILURE.109.885210

Circulation: Heart Failure is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

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Print ISSN: 1941-3289. Online ISSN: 1941-3297

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