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Thirty-day Episode Payments and Heart Failure Outcomes Among Medicare Beneficiaries

Rishi K. Wadhera, MD, MPhil^{1,2}, Karen E. Joynt Maddox, MD, MPH³, Yun Wang, PhD^{2,4}, Changyu Shen, PhD², and Robert W. Yeh, MD, MSc²

¹Brigham and Women's Hospital Heart & Vascular Center, Harvard Medical School, Boston, MA

²Richard and Susan Smith Center for Outcomes Research in Cardiology, Division of Cardiology, Beth Israel Deaconess Medical and Harvard Medical School, Boston, MA

³Washington University School of Medicine, Saint Louis, MO

⁴Department of Biostatistics, Harvard T.H. Chan School of Public Health, Boston, MA

Abstract

Background—There is increased focus among policymakers on improving value for heart failure (HF) care, given its rising prevalence and associated financial burden in the United States. However, little is known about the relationship between payments and mortality for a 30-day episode of HF care.

Objectives—To examine the association of 30-day payments for an episode of HF care with patient outcomes.

Methods—Using Medicare claims data for all fee-for-service beneficiaries hospitalized for HF between July 1st, 2011 and June 30th, 2014, we examined the association between 30-day Medicare payments – beginning with a hospital admission for HF and across multiple settings following discharge –and patient 30-day mortality using mixed-effect logistic regression models.

Results—We included 1,343,792 patients hospitalized for HF across 2,948 hospitals. Mean 30-day Medicare payments per beneficiary were \$15,423 (standard deviation, \$1,523). Overall observed mortality in the cohort was 11.3%. Higher 30-day payments were associated with lower 30-day mortality after adjustment for patient characteristics (OR per \$1,000 increase in payments, 0.961; 95% CI 0.954–0.967). This relationship was slightly attenuated after accounting for hospital characteristics and HF volume, but remained significant (OR per \$1,000 increase, 0.968; 95% CI, 0.962–0.975). Additional adjustment for potential mediating factors, including cardiac service capability and post-acute service use, did not significantly affect the relationship.

Corresponding author: Robert W. Yeh, MD, MSc, Smith Center for Outcomes Research in Cardiology, Beth Israel Deaconess Medical Center, 185 Pilgrim Rd, Boston, MA 02215, ryeh@bidmc.harvard.edu.

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Conclusions—Higher 30-day episode payments were associated with lower 30-day mortality following a hospitalization for HF. This has implications for policies that incentivize reduction in payments without considering value. Further investigation is needed to understand the mechanisms that underlie this relationship.

Introduction

There is increased focus among policymakers on improving value for heart failure (HF) care, given the high and rising prevalence of HF and its associated financial burden in the United States (1). HF is the most common cause of hospitalization among Medicare beneficiaries and accounts for a large portion of total Medicare expenditures (2,3). However, mortality rates remain high, and improvements have slowed in recent years (4). To incent ongoing progress in both costs and outcomes of care, the Centers for Medicare and Medicaid Services (CMS), through the mandatory Hospital Value-based Purchasing (HVBP) program, financially rewards or penalizes hospitals based on performance on both mortality and payment measures for HF, as well as other common conditions (5).

As value-based and alternative payment models increasingly spur hospitals to both reduce costs and improve outcomes for HF, it is important to understand how payments for an episode of HF care are related to clinical outcomes. Prior studies have demonstrated significant variation in payments associated with HF hospitalizations in the US (6–8). However, little is known about whether higher payments are associated with better outcomes, which would at least potentially indicate high value, or whether higher payments are associated with worse outcomes, which would indicate poor value. The relationship is unclear, in part, because little is known about how higher payments might translate into actual care delivery. Higher payments may reflect the overuse of low-value resources or utilization of unnecessary post-acute care, which would not have a positive effect on outcomes. Alternatively, high payments may be driven by the use of resources and services that actually improve quality of care and survival. Given that for hospitals participating in HVBP, episode payment metrics together with 30-day mortality metrics account for one-half of a total score used by CMS to evaluate performance (and determine financial rewards or penalties), understanding the relationship between these measures for an episode of HF care is increasingly important and policy-relevant (5).

Therefore, in this study, we aimed to answer several questions. First, how do hospitals whose HF patients incur high 30-day Medicare episode payments, reflecting both hospital-based and outpatient care in the immediate post-discharge time frame, differ from those with low episode payments? Second, are higher 30-day episode payments for HF care, beginning with a hospital admission for HF and across multiple care settings following discharge, associated with lower mortality rates? And if so, to what extent do differences in hospital characteristics, cardiac service capability, and post-acute service use explain the association?

Methods

Patient Cohort

Eligible patients were fee-for-service Medicare beneficiaries over the age of 65 hospitalized at an acute-care hospital for HF based on principal discharge diagnosis codes from the *International Classification of Diseases, Ninth Revision* from July 1st, 2011 through June 30th, 2014. Patient characteristics included age, sex, and comorbidities that were defined based on a validated administrative claims model used to profile hospital 30-day mortality measures for HF (9). We applied inclusion criteria previously used by CMS for HF mortality rate measures. For patients with more than one HF admission across the three-year period, only one randomly selected episode of care was included (7,9,10).

Thirty-Day Episode Payments for Heart Failure

Hospital-level risk-standardized payments for a 30-day episode of HF care (which from here on, will be referred to as *episode payments*) - a measure made publicly available by CMS on Hospital Compare - were used to characterize payments across a 30-day period beginning with a hospital admission for HF (7,8). Episode payments reflect variations in hospital practice patterns and resource utilization related to HF care and are calculated by summing total payments associated with a 30-day episode of HF care for each beneficiary, beginning with index admission and across multiple care settings, services, and supplies (i.e. inpatient, outpatient, skilled nursing facility, home health, physician/clinical laboratory/ambulance services, durable medical equipment). In addition to inpatient payments, post-acute payments are attributed to the hospital of index HF admission because care and discharge planning during a hospitalization influences subsequent expenditures across care settings. Geographic differences and policy adjustments (i.e. for costs of living, graduate medical education, and disproportionate share hospitals) in Medicare payment rates are accounted for. Additionally, episode payments are risk-adjusted for differences in patient characteristics and hospital case mix, and account for clustering of patients within hospitals. For patients transferred from one acute care hospital to another, total payments across 30 days are attributed to the first hospital where the patient was admitted (7). Hospitals in the Inpatient Prospective Payment System with too few HF cases (<25) were not included in the analysis. Hospital payment performance is assessed over a rolling three-year period; here, we used performance data representing July 1st, 2011 through June 30th, 2014, which were used in the HVBP program in fiscal year 2016 (7).

We used episode payments because they represent healthcare expenditures from a payer's (Medicare's) perspective, and reflect a hospital's style of practice in terms of the level of utilization of resources and services by their HF patients – for example, some hospitals may tend to discharge more HF patients to institutional post-acute care than others, or to provide more post-discharge follow-up care. We focused on a thirty-day episode of HF care because CMS payment measures through HVBP do so, making this the most policy-relevant approach to assessing value. Episode payments were assessed on a hospital rather than patient level to examine the impact of a patient population being exposed to varying styles of care rather than an individual patient being exposed to more intense care, and to diminish the likelihood of patient-level confounding (11).

Hospital Characteristics

Hospital characteristics were obtained from the 2013 American Hospital Association annual survey, and included hospital size, census region, Joint Commission certification status, location (urban or rural), ownership (for-profit, private not-for profit, and public), teaching status (large teaching versus others), nurse-to-patient ratio, and cardiac service capability (percutaneous coronary intervention and coronary artery bypass graft surgery). Additionally, using Medicare inpatient data, we calculated fee-for-service HF volume as well as the proportion of HF patients discharged to a skilled nursing facility or with homecare services for each hospital.

Outcomes

The primary outcome was patient-level 30-day mortality, defined as all-cause deaths within 30 days of the date of admission.

Statistical Analysis

We classified 30-day HF episode payments into low- (<25th percentile), average- (25th–75th percentile), and high-spending (>75th percentile) for descriptive purposes, similar to prior studies (12–16). Bivariate analyses were performed to compare patient and hospital characteristics across episode payment categories, using the Mantel-Haenszel χ^2 test for categorical variables and the Kruskal-Wallis test for continuous variables. To demonstrate geographic variability, we also mapped county-specific episode payments for HF care.

To evaluate the association between 30-day episode payments and 30-day patient-level mortality, we fit a mixed model with a logit link function and random hospital intercepts to model mortality as a function of 30-day HF episode payments (\$1,000). We fit the model in the following sequence: 1) unadjusted 2) risk-adjusted for patient characteristics and comorbidities used by CMS to profile hospital 30-day mortality measures for HF (9), and 3) additionally adjusted for key hospital characteristics (ownership, major teaching hospital, urban vs. rural hospital, region, and nurse staffing) as well as HF volume. This allowed us to control for individual risk factors and institutional characteristics and make inferences at the patient level regarding the association of being exposed to different levels of 30-day payments for HF care and outcomes. Next, we explored potential mediating variables related to hospital payment including cardiac service capability and mean proportion of HF patients discharged to skilled nursing facility (SNF) or with homecare services.

We performed several additional analyses. First, we examined the relationship between CMS *inpatient* payments and patient mortality, to determine if this relationship paralleled our primary analysis. Second, we performed quantile regression to assess the nature of the relationship between episode payments and outcomes (17). This allowed us to understand whether the association between episode payments and patient risk of mortality differed across quantiles of mortality. Third, we conducted an iterative non-parametric bootstrapping analysis with a replacement that randomly selected hospitals from the CMS episode payment dataset with a sample size equal to total hospitals in the dataset. We then re-fit the mixed models described above. We repeated this process 1,000 times to obtain the distribution of odds ratios for the association between payments and outcomes. Finally, we

also evaluated the relationship between 30-day episode payments and one year mortality following the index hospitalization.

Statistical tests were 2-sided at a significance level of 0.05. Analyses were performed using SAS version 9.4 64-bit (SAS Institute Inc., Cary, North Carolina).

Results

Study Population

Our study sample included 1,343,792 HF patients hospitalized from July 1st, 2011 through June 30th, 2014 across 2,948 hospitals with 25 eligible HF cases and episode payment information. Patient demographics were generally similar across low, average, and high episode payment hospital groups (eTable 1). Comorbidities, including the proportion of patients with a history of HF, coronary artery disease, prior myocardial infarction, stroke, and hypertension, were also similar across groups.

Thirty-day Payments

Thirty-day episode payments for HF care varied nearly two-fold across hospitals (10). Mean 30-day episode payments were \$15,423, with a standard deviation of \$1,523 (eFigure 1). Median 30-day episode payments per beneficiary were \$13,732 in the low-payment group, \$15,308 in the average-payment group, and \$17,207 in the high-payment group (Table 1). There was evidence of geographic variation in 30-day episode payments for HF care across the United States (Figure 1)

Hospital Structural Characteristics

Hospitals in the high 30-day episode payment group were larger, tended to be teaching hospitals, were more frequently Joint Commission accredited, were less likely to be public hospitals, and had lower nurse-staffing ratios, compared with hospitals in the average- and low-payment groups (Table 1). High episode payment hospitals also had greater median Medicare fee-for-service HF volume and were more likely to provide cardiac services including cardiac surgery and percutaneous coronary intervention (PCI).

Hospital Resource Use and Discharge Patterns

Procedure and resource use during and immediately following hospitalization varied across episode payment groups (Table 2). Hospitals in the high 30-day episode payment group were more likely to perform cardiac catheterizations and coronary angiograms during initial hospitalization. Overall rates of revascularization were low, but high episode payment hospitals were also more likely to perform PCI and coronary artery bypass grafting surgery during initial inpatient stay. Patients cared for in high episode payment hospitals had longer mean lengths of stay and were less likely to be transferred to another institution. They were more likely to be discharged to a SNF or with homecare services. In addition, observed 30-day readmission rates were highest at average-payment institutions compared with low and high-payment institutions.

Thirty-Day Payments and Patient Mortality

Observed mortality in the overall population was 11.3%. Greater 30-day episode payments were associated with lower 30-day mortality (unadjusted OR 0.975 for every \$1,000 increase; 95% CI 0.969–0.982, $p < 0.001$, Figure 2). This relationship became more pronounced following adjustment for patient characteristics (Table 3 and eTable 2: OR 0.961 per \$1,000 increase; 95% CI 0.954–0.967, $p < 0.001$). When both patient characteristics, hospital characteristics, and HF volume were accounted for, higher hospital episode payments remained associated with lower 30-day patient mortality (OR 0.968 per \$1,000 increase, 95% CI 0.962–0.975, $p < 0.001$). Addition of variables that could potentially mediate the relationship between episode payments and outcomes, including cardiac service capability and discharge to SNF or homecare use, did not alter our findings (Table 3).

Additional Analyses

We found that the association between CMS *inpatient* payments and patient mortality was similar to our main analysis (eTable 3). We also examined whether the observed relationship between 30-day episode payments and mortality was consistent across all quantile levels of patient 30-day mortality. We found a predominately linear relationship across the distribution, though the association between episode payments and mortality was larger at higher quantiles of mortality (eFigure 2). Our iterative bootstrapping simulation demonstrated that the distribution of the odds ratios of the association between payments and outcomes remained significant (eFigure 3). Finally, we found that higher 30-day episode payments following a HF hospitalization were also associated with lower one year mortality (eTable 4).

Discussion

In this study of Medicare payments and mortality rates among beneficiaries hospitalized for HF, we found that higher Medicare payments for a 30-day episode of HF care, which included both inpatient and post-acute care payments across multiple settings, were associated with lower 30-day mortality even after accounting for patient case-mix. Overall, patients admitted for HF to hospitals with 30-day payments one standard deviation (\$1523) above the mean, compared with hospitals one standard deviation below the mean, had an associated $\approx 1.3\%$ lower mortality. This association was attenuated, but remained significant, after adjusting for key hospital characteristics and HF volume. Variation in hospital cardiac service capability and post-acute care use did not mediate the association between spending and outcomes. Collectively, our findings should not necessarily be interpreted as causal in nature, but rather, shed light on *value* and provide insight regarding HF care in the context of CMS episode-based payment models, particularly given the continued evolution of HVBP and ongoing uncertainty around cardiac bundled payment models (18).

There has been a broad interest among policymakers in improving the value of HF care, given the high and rising prevalence of HF and its associated financial burden. This interest is reflected in the addition of HF-specific spending measures, determined by Medicare payments made to hospitals, to the HVBP, as well as through alternate payment models (1,19). However, hospital characteristics associated with higher longitudinal payments are

not accounted for in CMS payment models, leaving certain institutions susceptible to penalties, even if they provide high-quality care. In fact, early evidence from the HVBP demonstrates that some hospital types that tend to have better outcomes, including major teaching hospitals (20,21), often have high payments, as in our study, and consequently are more likely to be penalized (22). Conversely, some low-payment institutions that also provide low-quality care receive financial rewards (22). Whether or not the HVBP program truly incentivizes value, then, is unclear.

As hospitals are held financially accountable for both longitudinal spending and outcomes following a hospitalization for HF, it will be important to understand what resources and services actually improve quality of care. It is possible that hospitals receiving higher payments use diagnostic testing, invasive procedures, specialist care, and intensive care units more frequently, to the benefit of outcomes (23). Alternatively, factors not captured in our study, such as use of education and counseling services, interdisciplinary collaborative ambulatory care, and home monitoring services may result in higher payments, but better care quality (24–26). In addition, early and frequent outpatient follow-up and the type of outpatient care received following discharge (i.e. primary care provider vs. cardiologist vs. HF clinic), may have also mediated the observed relationship (24). Understanding these mechanisms will be essential to ensure that hospitals do not respond to payment programs, such as the HVBP, by reducing expenditures in a manner that is ultimately detrimental to patient care - a potential unintended consequence. Additionally, identifying low-value procedures, resources and services that are of little benefit to patient care will also be of equal importance as hospitals navigate where to reduce expenditures (27).

Our study found significant differences in institutional characteristics across low, average, and high episode payment groups. While controlling for these characteristics in our analysis only somewhat attenuated our findings, and do not necessarily account for heterogeneity in care delivered within hospitals, these patterns may shed light on potential underlying mechanisms. For example, high-payment hospitals were more likely to be large, teaching institutions. Prior studies have shown that admission for HF to major teaching hospitals, compared with nonteaching hospitals, is associated with lower 30-day mortality (20,21). Similarly, a greater proportion of high-payments hospitals were Joint Commission accredited, which has been linked to better performance on HF quality measures (28). HF volume and cardiac service capabilities also varied across hospital payment groups, which may reflect differences in institutional experience and expertise in caring for HF patients. Collectively, these patterns suggest that greater capacity and expertise may result in better outcomes for HF patients, albeit at higher costs.

We also found that beneficiaries at high-payment institutions had longer average lengths of stay, which may have resulted in patients being more clinically optimized at time of discharge. This kind of reasoning may also be supported by the Hospital Readmission Reduction Program - with its incentives to reduce readmission rates (29), the program may have helped counteract pressures for hospitals to discharge patients ever more quickly and encouraged greater care coordination. Notably, observed 30-day readmission rates were slightly higher in average-episode payment institutions compared to low and high payment groups. In addition, patients at high-payment institutions were more likely to be discharged

to SNFs and/or with home health services. Though SNF utilization has been linked at the patient level with a higher risk of death, likely because it reflects greater severity of illness (30), the use of home health services as a supplemental support mechanism has been associated with lower mortality after HF hospitalization (31,32). We found that the use of these post-acute care services did not explain the relationship between higher payments and better outcomes, thus it is not clear whether such patterns necessarily reflect high-value HF care. This is consistent with prior work that has shown that greater high-intensity post-acute care use in higher-spending regions of the US is not associated with better quality care (33). As institutions have a greater financial stake in post-acute care for HF through shared-savings programs and episode-based payment models, they will be incentivized to ensure appropriate use of post-acute care services (34).

Prior investigations have focused on the association of inpatient spending with HF outcomes, though findings have been mixed. For example, a study of Medicare beneficiaries hospitalized in 2006 found that higher inpatient costs of care for HF were associated with lower mortality, while another found no relationship between risk-adjusted costs and HF outcomes (12,13). Two subsequent analyses in Medicare showed that higher hospital spending intensity was associated with better in-hospital HF outcomes. Both studies used an end-of-life expenditure index -spending on hospital and physician services provided in patients' last year(s) of life – to assess spending intensity. This measure is informative for care intensity in general, but may not necessarily reflect condition-specific treatment decisions for patients not at the end of life (14,16,35,36). Our study is novel in that it examined payments over a longitudinal episode that included both inpatient and post-discharge care across multiple settings, which has greater relevance given the movement toward episode-based reimbursement. In addition, we evaluated HF-specific payments, rather than hospital costs, thus reflecting utilization beyond hospitals' internal cost structure.

There are limitations of this study. Due to its observational nature, we are unable to make inferences about causation. We only examined Medicare patients over 65 years of age, and our findings may not generalize to other populations. Patients may have varied in ways that were not captured by the comorbidities coded in claims data; however, such unmeasured severity would have most likely biased our results towards the null. In addition, claims data does not capture clinical information (i.e. vitals signs, ejection fraction, biomarkers, cardiac medications) that is of relevance to a heart failure population. We did not account for socioeconomic determinants of health, because payment programs such as HVBP do not, though these factors do play an important role in HF outcomes (37). Thirty-day episode payments reflected aggregate data at the hospital level, which may be subject to ecological fallacy, though our outcome was evaluated at the patient level. We also lacked detailed clinical data and a decomposition of episode payment data with which to identify specific mechanisms by which higher payments improved outcomes -this represents an important area for future study. Though we defined *value* as the relationship between payments and outcomes, we were unable to characterize quality of life, which is an important consideration when evaluating value of care. Because our sample size was large, our interpretation of this analysis focused on the estimated effect sizes for the relationship between episode payments and outcomes, rather than the extent to which P values were significant.

In summary, we found that in a cohort of Medicare beneficiaries hospitalized for HF across a three-year period, higher 30-day episode payments for HF care was associated with lower mortality. Emerging payment models seek to incentivize high value HF care, but our findings illustrate the challenges institutions may face in balancing expenditures and clinical outcomes as these models hold practitioners and hospitals financially accountable for both these elements of care. Further research is needed to identify interventions that improve outcomes, both during and following hospitalization, to ensure that hospitals continue to invest in procedures, services, and resources that improve survival, while cutting wasteful utilization.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

HF	Heart Failure
CMS	Centers for Medicare and Medicaid Services
HVBP	Hospital Value-Based Purchasing Program
SNF	Skilled Nursing Facility
PCI	Percutaneous Coronary Intervention

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Perspectives

Competency in Systems-Based Practice

Higher 30-day payments following an admission for heart failure are associated with a lower likelihood of mortality at 30-days.

Translational Outlook

Our findings highlight the challenges institutions may face as they are increasingly held financially responsible for both payments and outcomes associated with an episode of HF care through value-based and alternative payment programs. Further research is needed to understand the mechanisms that mediate the relationship between higher payments and better outcomes.

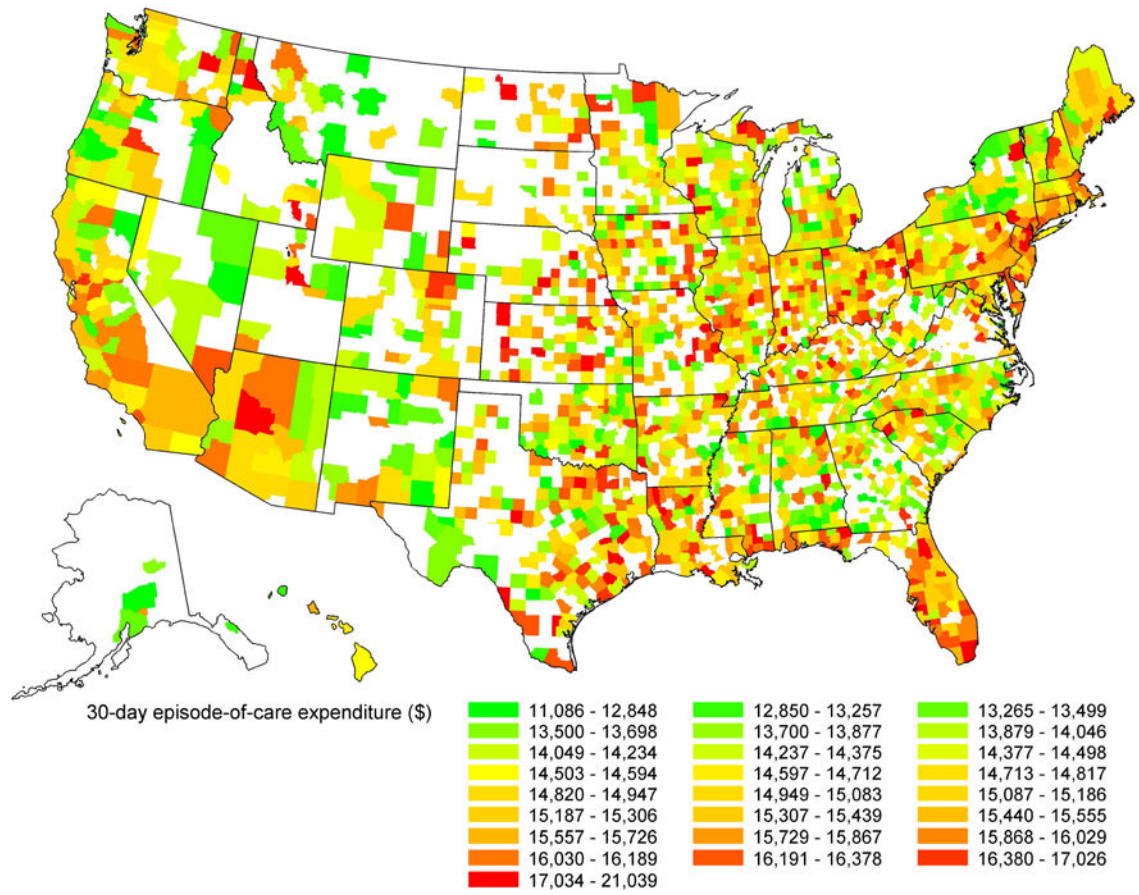


Figure 1.
Geographic Variation in 30-day Episode Payments for Heart Failure Care

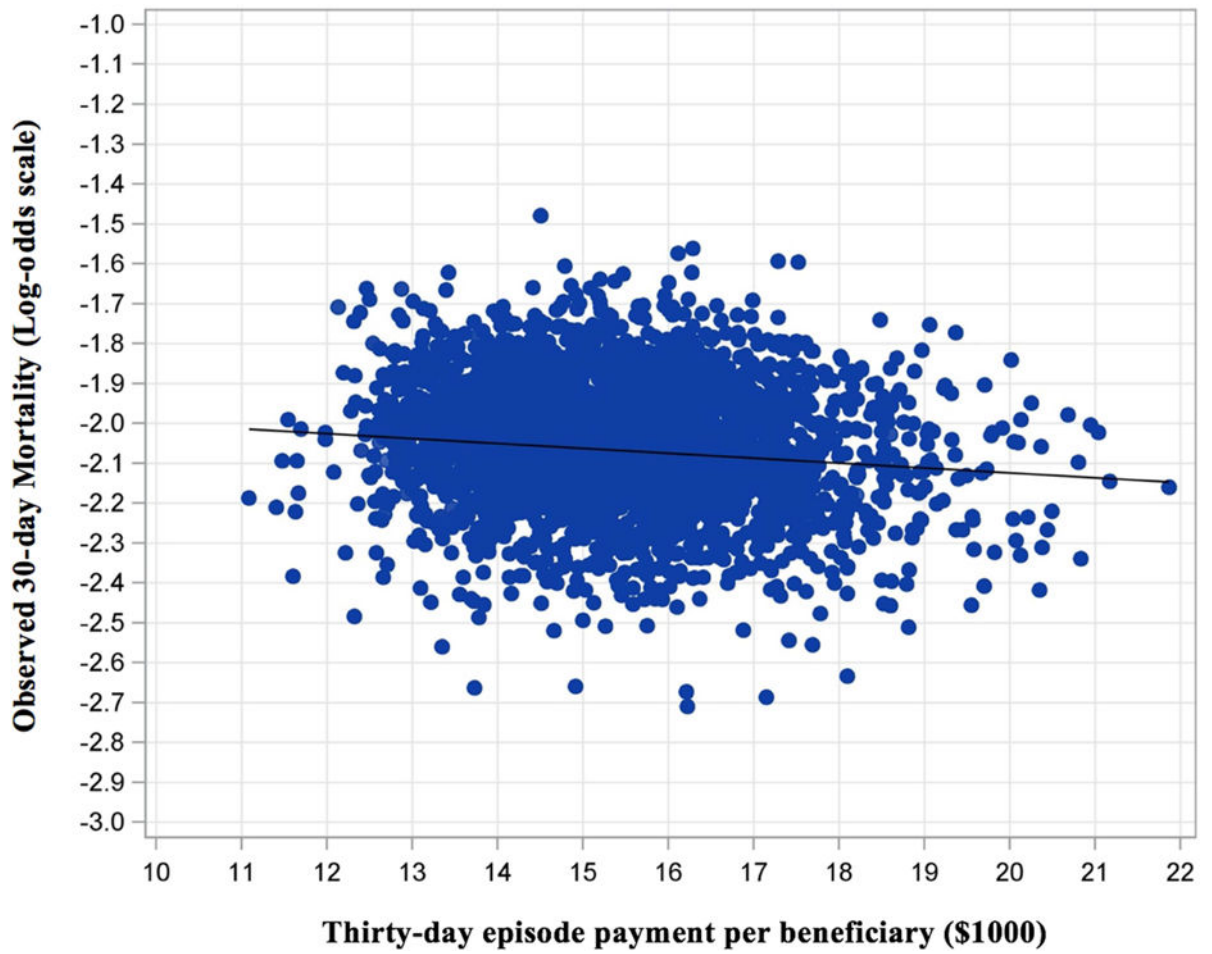


Figure 2.
30-Day Episode Payments and Patient 30-day Mortality

Table 1

Hospital Characteristics by 30-Day Episode Payment Categories

	Low (n=735)	Average (n=1476)	High (n=737)	P value
30-day HF spending, median \$ (IQR)	13,732 (13,268–14,019)	15,308 (14,841–15,809)	17,207 (16,713–17,853)	
Hospital size, median beds (IQR)	95 (50–165)	182 (99–310)	260 (165–406)	<0.001
Ownership, No. (%)^a				0.05
For profit	139 (19.0)	261 (17.8)	198 (26.9)	
Private nonprofit	409 (56.0)	1012 (68.9)	490 (66.6)	
Public	179 (24.5)	195 (13.3)	48 (6.5)	
Large teaching hospital, No. (%)	22 (3.0)	118 (8.0)	103 (14.0)	0.005
JCAHO Accredited, No. (%)	519 (70.6)	1235 (83.7)	648 (87.9)	<0.001
Region, No. (%)^b				<0.001
Northeast	86 (12.2)	240 (16.5)	145 (19.7)	
Midwest	218 (31.0)	247 (33.6)	542 (37.3)	
South	262 (37.3)	467 (32.1)	184 (25.0)	
West	137 (19.5)	205 (14.1)	137 (21.6)	
Rural hospital, No. (%)[*]	270 (36.9)	461 (31.4)	119 (16.2)	0.27
Nurses per 100 Patients, median (IQR)	4.5 (3.7–5.7)	4.3 (3.6–5.4)	4.2 (3.3–5.0)	<0.001
Medicare patients (%), median (IQR)	49.4 (43.3–54.8)	48.2 (42.4–54.0)	46.2 (40.4–52.7)	<0.001
Medicaid patients (%), median (IQR)	17.9 (13.4–24.4)	17.4 (13.0–22.4)	18.0 (12.5–22.3)	<0.001
Cardiac Services, No. (%)				
Cardiac surgery capable	72 (9.8)	581 (39.4)	434 (58.9)	<0.001
PCI capable	160 (21.8)	810 (54.9)	514 (69.7)	<0.001
HF Volume, median (IQR)	50 (31–96)	121 (64–211)	178 (101–272)	<0.001

Abbreviations: HF, heart failure; JCAHO, joint commission accreditation; IQR, interquartile range; PCI, percutaneous coronary intervention

^aVariable missing for 13 hospitals

^bVariable missing for 56 hospitals

Table 2

Resource Use, Procedure Use and Discharge Patterns by 30-Day Episode Payment Categories

	Low (n=166052)	Average (n=699251)	High (n=478489)	P Value
Observed 30-day mortality (%)	11.6	11.4	11.0	<0.001
Observed 30-day readmission rates (%)	21.6	23.9	22.6	<0.001
Length of Stay (mean days)	4.6	5.1	5.7	<0.001
Cardiac Procedures (Initial Admission)				
Cardiac catheterization (%)	2.3	4.6	6.4	<0.001
Coronary angiogram (%)	2.2	4.5	6.0	<0.001
Percutaneous coronary intervention (%)	0.3	0.7	1.2	0.002
CABG (%)	0.04	0.18	0.32	0.05
Discharge Disposition				
Transferred Out (%)	3.8	2.2	1.6	<0.001
Discharged home (%)	45.7	41.2	38.9	<0.001
Homecare on discharge (%)	20.9	23.8	24.3	<0.001
Discharged to SNF (%)	19.2	21.7	22.5	<0.001

Abbreviations: IQR, interquartile range; CABG, coronary artery bypass grafting; SNF, skilled nursing facility

Table 3

Unadjusted and Multivariate Adjusted Odds of 30-Day Mortality for Every \$1000 Increase in 30-Day Episode Payments

Model	Odds Ratio (per \$1000 increase)	95% Confidence Interval
A	0.975	0.969 – 0.982
B	0.961	0.954 – 0.967
C	0.972	0.966 – 0.979
D	0.968	0.962 – 0.975
E	0.969	0.962 – 0.977
F	0.969	0.962 – 0.976

A. Unadjusted

B. Adjusted for patient characteristics

C. Adjusted for patient and hospital characteristics

D. Adjusted for patient and hospital characteristics, and HF volume

E. Adjusted for patient/hospital characteristics, HF volume, and cardiac service capability

F. Adjusted for patient/hospital characteristics, HF volume, cardiac service capability and discharge disposition (SNF and home healthcare)

*
p<0.001 for all models