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Reducing excess readmissions: promising effect of hospital readmissions reduction program in US hospitals

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Abstract

Objective: To evaluate the financial penalty effect of the Hospital Readmissions Reduction Program (HRRP) on 30-day inpatient readmissions for pneumonia (PN), acute myocardial infarction (AMI) and heart failure (HF) among hospitals identified as having excess readmissions.
Setting: Short-term, acute care hospitals in the USA.
Design: Secondary data analysis of publicly available HRRP Supplemental Data to examine the effect of HRRP on reducing excess hospital readmissions by utilizing repeated-measures analysis of variance models.
Participants: A total of 3395 nonfederal, short-term acute care hospitals under the Inpatient Prospective Payment System that are subject to the HRRP program and that reported discharges data for PN, AMI and HF for the calculation of readmission ratios for the fiscal years 2013, 2014 and 2015.
Intervention: Implementation of the HRRP in October 2012 by the Centers for Medicare and Medicaid Services (CMS) to reduce Medicare payments to hospitals with excess readmissions.
Main Outcome Measures: Thirty-day hospital readmission ratios for PN, AMI and HF.
Results: There was a significant decrease in excess readmissions for PN, AMI and HF between FY 2013 and FY 2015. The reduction in excess readmission ratios was 0.035 for PN ($P < 0.001$), 0.082 for AMI ($P < 0.001$) and 0.034 for HF ($P < 0.001$). The effect of HRRP on excess readmissions was greater for small hospitals, public hospitals and hospitals located in rural areas.
Conclusions: HRRP to reduce payments to hospitals with excess readmissions had a significant effect on the inpatient readmissions for PN, AMI and HF in US Hospitals.

Key words: hospital readmissions reduction program (HRRP), excess readmissions, quality of care, pneumonia, acute myocardial infarction, heart failure

Introduction

Pay for performance programs have been a widely used strategy to improve healthcare quality and patient outcomes [1–5]. The intention of these programs is to encourage behavioral changes of healthcare providers by financially rewarding excellent performance and improved patient outcomes [2, 6]. Despite their intentions, the effect of these programs with their reliance on financial compensation is inconsistent with some studies suggesting modest quality improvement and others showing little or no evidence of significant gains [5–8].

On 1 October 2012, mandated by Section 3025 of the Affordable Care Act to establish the Medicare Hospital Readmissions Reduction Program (HRRP), the Centers for Medicare and Medicaid Services

(CMS) implemented a strategy of linking quality to payment that relies on financial penalties to improve inpatient care quality and reduce cost. Hospitals subject to the HRRP program receive reduced Medicare payment if their hospital readmissions are deemed excessive. For Fiscal Year (FY) 2013, a hospital with excess readmissions received up to 1% reduction of Medicare base payment. The amount of the reduction is up to 2% of Medicare base payment for FY 2014, up to 3% for FY 2015 and each year thereafter [9].

High readmission rates to a hospital are considered an important indicator of inadequate quality of care and account for billions of dollars in annual Medicare spending [10–11]. There are many factors contributing to hospital readmissions, including complications from the inpatient treatment during the hospital stay, inadequate quality of care or care coordination, lack of follow-up care after the discharge from the hospital and patients' unexpected worsening conditions of the disease after discharge from the hospital [11]. Not all hospital readmissions are preventable, but studies have shown that quality improvement efforts to improve inpatient care and the coordination of transitional care can prevent many unnecessary hospital readmissions [10–12]. The intention of the HRRP is to urge hospitals to improve their performance and reduce preventable readmissions. All short-term acute care hospitals paid under the Medicare Inpatient Prospective Payment System (IPPS) are subject to the HRRP program [9, 13]. Starting FY 2013, the HRRP policy applied to conditions of acute myocardial infarction (AMI), heart failure (HF) and pneumonia (PN). Starting FY 2015, the applicable conditions targeted by the HRRP are expanded to include patients admitted for an acute exacerbation of chronic obstructive pulmonary disease (COPD), elective total hip arthroplasty (THA) and total knee arthroplasty (TKA) [9].

The HRRP defines a readmission as a patient being readmitted to a hospital within 30 days of discharge. CMS chose to measure readmissions within 30 days instead of over longer time periods, because readmissions over longer periods may be impacted by factors outside the hospitals' control, such as other complicating illnesses, patients' own behaviors and care provided to patients after discharge [9]. To determine whether a hospital's readmission is excessive, the HRRP calculated the readmission ratios for each eligible US hospital using a hospital's readmission rates divided by the national average readmission rates for each of the CMS targeted conditions. A ratio >1 indicates excess readmissions [9]. To make the comparisons fair, a hospital's readmission ratios are risk adjusted for clinically relevant factors that may make a readmission more likely, such as patient demographic characteristics, patient frailty and comorbidities that patients had when they arrived at the hospital. Data used in the calculation of readmission ratios came from discharge data of an applicable period of 3 years [9].

To examine the effect of HRRP on reducing excess hospital readmissions, we used the publicly available HRRP Supplemental Data [14] to answer the following two primary questions: (i) Did the HRRP result in a downward trend in hospital readmissions for PN, AMI and HF and (ii) did the effect of HRRP differ according to hospital characteristics? For example, did the HRRP have a greater effect on readmissions for hospitals that might be more motivated to prevent readmissions, such as hospitals with a higher proportion of Medicare patients, or safety-net hospitals that are more vulnerable to the CMS payment cuts?

Methods

Sources of data

The readmission ratios data used in this study came from the publicly available HRRP Supplemental Data Files for the fiscal years 2013, 2014 and 2015. The data files contain readmission ratios for each applicable condition, measures of a hospital's readmission performance for that condition. CMS determined for each eligible hospital the readmission ratios for PN, AMI and HF using discharges that occurred from July 2008 through June 2011 for FY 2013, July 2009 to June 2012 for FY 2014 and July 2010 to June 2013 for FY 2015 [9].

We linked readmission ratios data to the 2009 American Hospital Association (AHA) annual survey to obtain information on hospital characteristics. This included hospital size measured by the number of hospital beds (small hospitals with <200 beds, medium-sized hospitals with 200–399 beds and large hospitals with ≥400 beds); teaching status (teaching hospitals with a membership in the Council of Teaching Hospitals or non-teaching hospitals); type of ownership of a hospital (public, for-profit or not-for-profit); location (metropolitan: core urban area of population ≥50 000, micropolitan: core urban area of population ≥10 000 to <50 000 population or rural, based on OMB's CBSA classifications [15]); percentage of patients with Medicaid admitted and percentage of patients with Medicare admitted. We also used the disproportionate share hospital index that CMS utilizes to quantify hospital care provided to low-income and medically vulnerable populations to identify a hospital as a safety-net hospital or not [16]. Hospitals in the highest quartile of the disproportionate share hospital index are categorized as safety-net hospitals in our study.

Study population

We included a total of 3395 IPPS nonfederal, short-term, acute care hospitals that are subject to the HRRP program and that reported discharge data to the HRRP for PN, AMI and HF for the calculations of readmission ratios for the fiscal years 2013, 2014 and 2015. Hospitals located in Puerto Rico were excluded from our study.

Statistical analysis

We first conducted univariate analyses to provide a profile of the hospitals used in our study and examined whether excess hospital readmissions differed by hospital characteristics. We then performed a series of repeated-measures analysis of variance models to examine the effect of HRRP on hospital readmissions for PN, AMI and HF. The primary goal of our analyses was to determine whether the HRRP had an effect on reducing inpatient readmissions for PN, AMI and HF between FY 2013 (before the execution of up to 1% reduction in Medicare base payment) and FY 2014 (after the execution of up to 1% reduction in Medicare payment), and FY 2015 (after the execution of up to 2% reduction in Medicare payment). We focused our analyses on hospitals with excess readmissions (readmissions ratios >1) to determine the effect of HRRP on excess readmissions for each of the applicable conditions. To do so, we restricted our sample to hospitals identified as having excess readmissions in FY 2013 ($n = 1457$). Lastly, we assessed whether the HRRP effect on excess readmissions differed according to hospital characteristics. To address these research questions, we hypothesized:

(i) The HRRP had an effect on reducing excess readmissions for PN, AMI and HF.
(ii) The effect of HRRP on reducing excess readmissions differed according to hospital characteristics. We hypothesized that the HRRP program had a greater effect on hospitals with a higher proportion of Medicare and Medicaid patients, and on safety-net hospitals.

The outcome variables used in examining the effect of HRRP are excess readmission ratios for PN, AMI and HF. Independent variables included three periods of fiscal years and hospital characteristics of size, type of ownership, location, safety-net hospitals, teaching status and percentage of patients with Medicare admitted and percentage of patients with Medicaid admitted. We included two-way interaction terms in the repeated-measures analysis of variance models to examine whether the HRRP had a differential effect on hospitals according to their characteristics. Hospitals with fewer than 25 readmission cases for a given condition were excluded from the analysis for that condition due to the fact that a readmission ratio would not be reliable and thus was not calculated by the HRRP. Statistical significance was set at $P < 0.05$ (two-tailed). All analyses were performed using the SAS software version 9.3 (SAS Institute, Cary, NC, USA).

Results

Characteristics of hospitals

Among eligible hospitals included in our study, 25.4% were located in the rural areas, 59.1% were small hospitals with the number of beds fewer than 200 and 25.1% were safety-net hospitals (Table 1). Majority of the hospitals (91.6%) were a member of Council of Teaching Hospital of the Association of American Medical Colleges. For FY 2013, the percentage of hospitals that were identified as having excess readmissions by CMS was 47.5% for PN, 50.2% for AMI and 48.4% for HF. These percentages did not change significantly for the next two fiscal years of 2014 and 2015 (Table 2). Due to the underlying structure of HRRP, the percentage of hospitals that were identified as having excess readmissions will remain about 50% and face a financial penalty even as hospitals overall improve over years.

Table 1 Distribution of characteristics of IPPS hospitals subject to HRRP

Characteristics	Distribution, *n* (%)
Region	
Midwest	764 (22.9)
Northeast	516 (15.4)
South	1433 (42.9)
West	627 (18.8)
Location	
Metropolitan	1369 (40.9)
Micropolitan	1124 (33.7)
Rural	847 (25.4)
Size of hospital	
Small (<200 beds)	1916 (59.1)
Medium (200–399 beds)	877 (27.0)
Large (≥400 beds)	450 (13.9)
Type of hospital	
Public	532 (16.4)
For-profit	2007 (61.9)
Not-for-profit	704 (21.7)
Teaching status	
Yes	2970 (91.6)
No	273 (8.4)
Safety-net hospital	
Yes	838 (25.1)
No	2502 (74.9)
% Medicare admissions[a]	45 (40–52)
% Medicaid admissions[a]	18 (12–22)
Excess readmissions[b]	
Pneumonia	1450 (47.5)
Acute myocardial infarction	1120 (50.2)
Heart failure	1475 (48.4)

[a]Median percentage and interquartile range were reported.
[b]Percentage of hospitals with excess readmissions in FY 2013.

As shown in Table 2, hospitals with excess readmissions for the applicable conditions differed significantly from hospitals without excess readmissions by characteristics. Hospitals with excess readmissions tended to be large, located in metropolitan areas, not-for-profit, safety-net and hospitals with larger percentages of Medicaid patients.

Effect of HRRP on excess readmisisons

To examine the effect of HRRP on excess readmissions, we focused our further analyses on hospitals with excess readmissions by restricting our sample to hospitals that had readmission ratios >1 in FY 2013. We found that the excess readmissions ratios reduced significantly after FY 2013 for PN, AMI and HF (Table 3). Specifically, the results showed a significant downward trend in readmission ratios for PN from FY 2013 to 2014 (ratio reduction 0.016, 95% CI: 0.013–0.018, $P < 0.001$), from FY 2014 to 2015 (ratio reduction 0.019, 95% CI: 0.015–0.023, $P < 0.001$) and with the greatest reduction from FY 2013 to 2015 (ratio reduction 0.035, 95% CI: 0.030–0.039, $P < 0.0001$). For AMI, the readmission ratios were reduced 0.053 (95% CI: 0.043–0.064) from FY 2013 to 2014 ($P < 0.001$), 0.028 (95%CI: 0.018–0.039) from FY 2014 to 2015 ($P < 0.001$) and 0.082 (95% CI: 0.069–0.094) from FY 2013 to 2015 ($P < 0.001$). For the same period, the readmission ratios reduction for HF was 0.013 (95% CI: 0.009–0.018, $P < 0.001$), 0.021 (95% CI: 0.016–0.026, $P < 0.0001$) and 0.034 (95% CI: 0.028–0.04, $P < 0.001$), respectively. These reductions in readmission ratios signified significant decreases in excess readmissions of 3.3% for pneumonia, 7.6% for acute myocardial infarction and 3.2% for heart failure after 3 years of implementing the HRRP.

Effect of HRRP on excessive readmissions according to hospital characteristics

To examine whether the effect of HRRP on reducing excess readmissions differed according to hospital characteristics, we included the two-way interaction terms in repeated-measures analysis of variance models. We categorized the proportions of Medicare and Medicaid patients into quartiles with the 1st quartile being the lowest and 4th being the highest proportion of percentage of Medicare and Medicaid patients admitted to a hospital. We had hypothesized that the HRRP might have a greater effect on safety-net hospitals or on hospitals with a higher proportion of Medicare or Medicaid patients. The results of our analyses demonstrated a stronger response of safety-net hospitals to the effect of HRRP on excess readmissions for AMI ($P < 0.05$, Fig. 1). However, the effect of HRRP on excess readmissions for PN and HF did not differ according to whether a hospital was safety-net hospital or not. In addition, we found no evidence that the effect of HRRP was associated with the proportion of Medicare or Medicaid patients admitted to a hospital for any of the three conditions under study ($P > 0.05$).

As for other related hospital characteristics, the results of our analyses indicated that the hospital size, location and the type of ownership were associated with a differential response to the effect of HRRP on readmissions for AMI (Table 4). Specifically, small hospitals (<200 beds), public hospitals and hospitals located in rural areas had a stronger response to the effect of HRRP than their counterpart hospitals. For heart failure, we found the effect of HRRP only differed by the

Table 2 Hospitals with and without excess readmissions by hospital characteristics[a]

Hospital characteristics	PN ($n = 3053$)		AMI ($n = 2233$)		HF ($n = 3045$)	
	Yes *n* (%)	No *n* (%)	Yes *n* (%)	No *n* (%)	Yes *n* (%)	No *n* (%)
Region						
Midwest	322 (22.2)	386 (24.1)	239 (21.3)	295 (26.5)	290 (19.7)	417 (26.6)
Northeast	286 (19.7)	206 (12.8)	283 (25.3)	145 (13.0)	306 (20.7)	186 (11.9)
South	657 (45.3)	641 (40.0)	449 (40.1)	420 (37.7)	670 (45.4)	626 (39.9)
West	185 (12.8)	370 (23.1)	149 (13.3)	253 (22.73)	209 (14.2)	341 (21.8)
P-value	<0.001		<0.001		<0.001	
Location						
Metropolitan	705 (48.6)	528 (32.9)	603 (53.8)	420 (37.7)	694 (47.0)	547 (34.8)
Micropolitan	414 (28.6)	600 (37.4)	345 (30.8)	485 (43.6)	392 (26.6)	617 (39.3)
Rural	331 (22.8)	475 (29.6)	172 (15.4)	208 (18.7)	389 (26.4)	406 (25.9)
P-value	<0.001		<0.001		<0.001	
Size of hospital						
Small (<200 beds)	766 (53.3)	957 (60.5)	474 (42.6)	507 (45.9)	809 (55.5)	902 (58.0)
Medium (200–399 beds)	412 (28.7)	439 (27.7)	396 (35.6)	406 (36.7)	422 (29.0)	435 (27.9)
Large (≥400 beds)	258 (17.8)	187 (11.8)	243 (21.8)	192 (17.4)	226 (15.5)	219 (14.1)
P-value	<0.001		<0.05		0.35	
Type of hospital						
Public	227 (15.8)	277 (17.5)	131 (11.2)	139 (12.6)	244 (16.8)	254 (16.3)
For-profit	891 (62.1)	1052 (66.5)	786 (70.6)	767 (69.4)	899 (61.7)	1045 (67.2)
Not-for-profit	318 (22.1)	254 (16.0)	196 (17.6)	199 (18.0)	314 (21.5)	257 (16.5)
P-value	<0.001		0.79		<0.001	
Safety-net hospital						
Yes	437 (30.1)	351 (21.9)	334 (29.8)	203 (18.2)	463 (36.4)	326 (20.8)
No	1013 (69.9)	1252 (78.1)	786 (70.2)	910 (81.8)	1012 (68.6)	1244 (79.2)
P-value	<0.001		<0.001		<0.001	
Teaching status						
Yes	1262 (87.9)	1492 (94.2)	963 (86.5)	1001 (90.6)	1288 (88.4)	1456 (93.6)
No	174 (12.1)	91 (5.8)	150 (13.5)	104 (9.41)	169 (11.6)	100 (6.4)
P-value	<0.001		<0.01		<0.001	
% Medicare admissions[b]	0.45 (0.11)	0.46 (0.11)	0.45 (0.10)	0.45 (0.10)	0.46 (0.11)	0.46 (0.10)
P-value	0.03		0.14		0.53	
% Medicaid admissions[b]	0.20 (0.11)	0.18 (0.09)	0.20 (0.08)	0.18 (0.10)	0.20 (0.11)	0.18 (0.10)
P-value	<0.001		<0.001		<0.001	
FY						
2013	1450 (33.0)	1603 (33.3)	1120 (33.5)	1113 (33.2)	1475 (32.9)	1570 (33.8)
2014	1482 (33.8)	1595 (33.1)	1113 (33.3)	1115 (33.2)	1515 (33.8)	1538 (33.1)
2015	1456 (33.2)	1621 (33.6)	1106 (33.12	1127 (33.6)	1498 (33.4)	1542 (33.1)
P-value	0.78		0.91		0.64	

[a]Sample size varied due to the exclusion of hospitals with readmission cases fewer than 25 and missing values.
[b]Mean and standard deviation were reported.

hospital ownership with a stronger HRRP effect on public hospitals (Table 4). For pneumonia, no differential effect of the HRRP on excess readmissions was found associated with any hospital characteristics under study.

Discussion

Although the HRRP has been implemented for only a few years, we have found its effect to be promising in reducing the excess 30-day hospital readmissions for PN, AMI, and HF. Hospitals that were identified by the CMS as having excess readmissions and faced reduced Medicare payments in FY 2013 showed a significant downward trend of readmissions for all three targeted conditions from FY 2013 to FY 2015. We also found the HRRP had a stronger effect on readmissions for rural hospitals, small hospitals, safety-net hospitals and public hospitals than that for their counterpart hospitals. There might be an explanation for this differential effect of the HRRP on hospitals. Due to their remote geographic locations and small sizes, rural hospitals often have low-patient volumes and subsequently have the financial challenge to manage the high costs associated with operating a hospital. Thus, they are particularly vulnerable to Medicare and Medicaid payment cuts. Public hospitals and safety-net hospitals also rely heavily on Medicare and Medicaid payments. These hospitals therefore might be more motivated by the HRRP program to avert readmissions and reduce excess readmissions.

As policymakers anticipated, the HRRP has changed the traditional Medicare hospital payment practice of not motivating hospitals to preventing or reducing readmissions. Under Medicare Inpatient Prospective Payment System, hospitals received a fixed average amount per admission based on patient diagnosis regardless of if an admission was a 30-day readmission. There was no financial deterrence for hospitals to avert unnecessary readmissions, unless they were at full capacity. The implementation of the HRRP has discouraged hospitals from using inpatient readmissions as a hospital revenue scheme.

Table 3 Changes in readmissions ratios from FY 2013 to FY 2015 among hospitals with excess readmissions ($n = 1457$)[a]

Condition	Mean difference in readmissions ratios (95% CI)	*P*-value
Pneumonia		
FY 2013–FY 2014	0.016 (0.013–0.018)	<0.001
FY 2014–FY 2015	0.019 (0.015–0.023)	<0.001
FY 2013–FY 2015	0.035 (0.030–0.039)	<0.001
Acute myocardial infarction		
FY 2013–FY 2014	0.053 (0.043–0.064)	<0.001
FY 2014–FY 2015	0.028 (0.018–0.039)	<0.001
FY 2013–FY 2015	0.082 (0.069–0.094)	<0.001
Heart failure		
FY 2013–FY 2014	0.013 (0.009–0.018)	<0.001
FY 2014–FY 2015	0.021 (0.016–0.026)	<0.001
FY 2013–FY 2015	0.034 (0.028–0.040)	<0.001

[a]Hospitals with readmission ratios >1 in FY 2013.

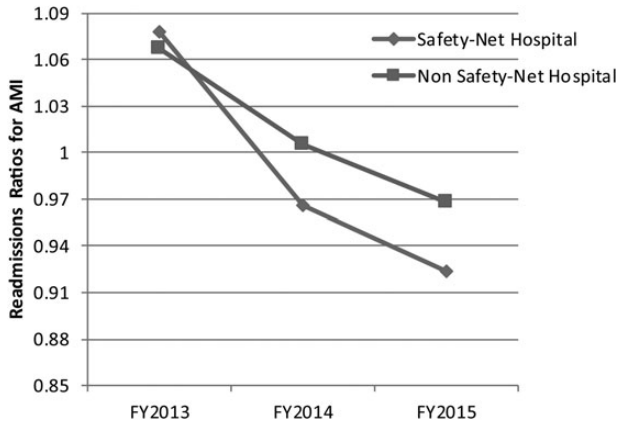

Figure 1 Differential effect of HRRP by safety-net hospitals for AMI.

Although not all readmissions can be prevented, the financial penalty policy of the HRRP has motivated hospitals to reduce the excessive readmissions.

Our study has several limitations. First, the study did not control for the effect of other policies or programs that may have contributed to the reduction in excess readmissions. For example, in 2009, CMS began public reporting of hospital readmission rates on the Hospital Compare website to provide a reputational incentive for hospitals to reduce readmissions [17]. CMS intended it to increase the transparency of hospital care, help consumers choose a care venue and provide a benchmark for hospitals in their efforts to improve their performance. We were unable to demonstrate whether any of the effect of the HRRP on reducing excess readmissions found in our study might be associated with the effect of the public reporting of readmission rates. Research findings about the effect of public reporting on the quality of care are mixed with some studies suggesting a beneficial effect and others reporting a marginal or no effect on inpatient care quality [18–21]. A recent study has showed a positive effect of public reporting on reducing healthcare-associated infections, such as central catheter-associated bloodstream infections, catheter-associated urinary tract infections and ventilator-associated pneumonia [22]. Another study suggested that the public reporting on hospital process measures had been associated with the improved patient outcomes [23]. Depending on what measures are publically reported, their effects may or may not be evident on improving the quality of care. As to the effect of public reporting on preventing unnecessary hospital readmissions, studies suggested a weak or none-existing relationship [24].

Second, our definition of safety-net hospitals is based on the quartile of the disproportionate share hospital index that qualifies care provided to the low-income and medically vulnerable populations by CMS. There are other definitions or methods to determine whether a hospital is a safety-net hospital. Different definitions might have resulted in a different conclusion as to the effect of safety-net hospitals on the HRRP effect of reducing excess readmissions. Nonetheless, our definition to identify safety-net hospitals has been widely used [16, 24].

Table 4 Differential effect of HRRP on AMI and HF readmissions by hospital characteristics[a]

Hospital characteristics	Readmissions ratios			*P*-value
	FY 2013 ratio (95% CI)	FY 2014 ratio (95% CI)	FY 2015 ratio (95% CI)	
Readmissions for AMI				
Size of hospital				<0.001
Small (<200 beds)	1.07 (1.05–1.08)	0.93 (0.89–0.97)	0.89 (0.85–0.94)	
Medium (200–399 beds)	1.07 (1.06–1.08)	1.00 (0.96–1.04)	0.96 (0.91–1.01)	
Large (≥400 beds)	1.08 (1.07–1.09)	1.02 (0.98–1.07)	0.99 (0.93–1.04)	
Location				0.01
Metropolitan	1.08 (1.07–1.09)	1.01 (0.97–1.47)	0.98 (0.94–1.03)	
Micropolitan	1.07 (1.06–1.08)	1.00 (0.96–1.04)	0.97 (0.92–1.01)	
Rural	1.07 (1.05–1.08)	0.95 (0.89–0.99)	0.89 (0.84–0.94)	
Type of hospital				0.01
Public	1.06 (1.05–1.08)	0.97 (0.92–1.03)	0.89 (0.83–0.96)	
For-profit	1.08 (1.07–1.09)	1.00 (0.97–1.04)	0.99 (0.96–1.03)	
Not-for-profit	1.08 (1.07–1.09)	0.98 (0.93–1.02)	0.95 (0.90–1.00)	
Readmissions for HF				
Type of hospital				0.003
Public	1.06 (1.05–1.07)	1.03 (1.01–1.05)	0.99 (0.97–1.02)	
For-profit	1.08 (1.07–1.08)	1.07 (1.05–1.08)	1.05 (1.03–1.06)	
Not-for-profit	1.08 (1.07–1.09)	1.07 (1.05–1.09)	1.05 (1.03–1.08)	

[a]Readmissions ratios for hospitals with excess readmissions for FY 2013.

Third, we did not examine other potentially important hospital characteristics that may have the interaction effect with the effect of HRRP on reducing excess readmissions, such as the percentage of Medicare payments of a hospital's total critical revenue, and the health insurance status of patients with readmissions. These are important details that were beyond the scope of our study. Finally, the reduction in readmissions found in our study was among hospitals identified as having excess readmissions in FY 2013. Whether or not the same reduction would realize among hospitals with excess readmissions in FY 2014 and FY 2015 was not determined in our study. For the purpose of the study, we restricted our sample to hospitals that were identified as having excess readmissions. Due to the fact that hospitals with excess readmissions are more likely to be large hospitals, safety-net hospitals and hospitals located in the metropolitan areas, our sample contained a higher proportion of these hospitals than that of a general hospital population targeted by the HRRP. For this reason, caution should be exercised when extrapolating and generalizing the study findings. In addition, whether the HRRP has a long-lasting effect remains to be seen.

In summary, our study has demonstrated the promising effect of the financial penalty on reducing preventable or excess readmissions for PN, AMI and HF. We also found the HRRP may have differential effects for different hospitals. The current penalty of up to 3% cuts in Medicare base payment may have prompted considerable financial shortfalls for hospitals operating with marginal profits (such as small hospitals, rural hospitals and safety-net hospitals) while mild financial setbacks for others. As CMS expands the HRRP to include patients admitted for an acute exacerbation of COPD, elective THA and TKA, more studies are needed to evaluate the effect of HRRP and its consequences, positive and negative, expected and unexpected. It is worth noting that even though our study demonstrated the effect of HRRP on reducing hospital readmissions, the mechanism by which the readmissions are reduced is not clear. Further studies are needed to determine whether reduced readmissions are the result of quality improvement measures motivated by the financial effect of HRRP. It is most likely that hospitals will continue to experiment with various interventions to reduce readmissions [25–26]. Studies to determine and demonstrate those that are most effective will be beneficial to policymakers, hospitals, patients and the overall quality of our health care.

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