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Reimbursement Penalties and 30-Day Readmissions Following Total Joint Arthroplasty

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Background: The U.S. Patient Protection and Affordable Care Act created the Hospital Readmissions Reduction Program (HRRP) and the Hospital-Acquired Condition Reduction Program (HACRP). Under these programs, hospitals face reimbursement reductions for having high rates of readmission and hospital-acquired conditions. This study investigated whether readmission following total joint arthroplasty (TJA) under the HRRP was associated with reimbursement penalties under the HACRP.

Methods: Hospital-level data on hospital-acquired conditions, readmissions, and financial penalties were obtained from Definitive Healthcare. Outcomes included receipt of an HACRP penalty and the associated losses in revenue in 2018. Logistic regression and linear regression models were used to determine whether the all-cause, 30-day readmission rate following TJA was associated with the receipt or magnitude of an HACRP penalty.

Results: Among 2,135 private, acute care hospitals, 477 (22.3%) received an HACRP penalty. After controlling for other patient and hospital characteristics, hospitals with a 30-day readmission rate of >3% after TJA had over twice the odds of receiving an HACRP penalty (odds ratio, 2.20; p = 0.043). In addition, hospitals with a readmission rate of >3% after TJA incurred $77,519 more in revenue losses due to HACRP penalties (p = 0.011). These effects were magnified in higher-volume hospitals.

Conclusions: Acute care hospitals in the United States with higher 30-day readmission rates following TJA are more likely to be penalized and to have greater revenue losses under the HACRP than hospitals with lower readmission rates after TJA. This strengthens the incentive to invest in the prevention of readmissions after TJA, for example, through greater efforts to reduce surgical site infections and other modifiable risk factors.

This study explores whether readmission rates following total joint arthroplasty (TJA) are associated with penalties under the Hospital-Acquired Condition Reduction Program (HACRP). The U.S. Patient Protection and Affordable Care Act (ACA) of 2010 created 2 important value-based purchasing programs: the Hospital Readmissions Reduction Program (HRRP) and the HACRP[1-3]. Under the HRRP, the U.S. Centers for Medicaid & Medicare Services (CMS) can reduce reimbursements, currently by up to 3% of total Medicare revenue, to hospitals with relatively high readmission rates[4]. The ACA also created the HACRP, which allows the CMS to reduce Medicare payments to hospitals with high hospital-acquired condition rates[3,5-7]. Under the HACRP, hospitals are rated on the basis of 6 quality measures: a patient safety indicator, and healthcare-acquired infections (indicators for central line-associated bloodstream infections, catheter-associated urinary tract infections, surgical site infections, methicillin-resistant *Staphylococcus aureus* [MRSA] bacteremia, and *Clostridium difficile* infections). Hospitals with hospital-acquired conditions in the poorest performing quartile are subject to a reduction in total Medicare revenue, currently by up to 1%.

The HRRP began targeting readmission for only 3 conditions: acute myocardial infarction, congestive heart failure, and pneumonia. Later, additional target conditions were added. Unplanned readmissions following chronic obstructive pulmonary disease, total hip arthroplasty (THA), and total knee arthroplasty (TKA) became targets in 2015, and unplanned coronary artery bypass graft surgery readmissions became a target starting in 2017. The HACRP targets preventable hospital-acquired conditions, including many that may occur after TJA: a fall resulting in hip fracture, hemorrhage, pulmonary embolism or deep vein thrombosis, sepsis, and wound dehiscence. It also targets infections, including central line-associated bloodstream infections, catheter-associated urinary

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TABLE I Characteristics of Private, Acute Care Hospitals, Stratified by HACRP Penalty, FY2018

Variable	Overall (N = 2,135)	HACRP Penalty (N = 477)	No HACRP Penalty (N = 1,658)	P Value*
Readmission rate after TJA†				
Mean rate	4.43%	4.47%	4.41%	0.1182
≤3%†	3.1%	1.7%	3.5%	0.0430
>3%†	96.9%	98.3%	96.5%	
Profit status†				0.2150
For profit	26.7%	24.5%	27.4%	
Not for profit	73.3%	75.5%	72.6%	
No. of discharges				
Mean no. of discharges	11,149	12,116	10,870	0.0279
<5,000 discharges†	32.8%	28.3%	34.1%	
5,000 to 11,999 discharges†	33.4%	36.7%	32.5%	
≥12,000 discharges†	33.8%	35.0%	33.4%	
Case mix index				
Mean case mix index	1.66	1.64	1.66	
Low (<1.51)†	33.3%	33.1%	33.3%	
Medium (≥1.51 to <1.74)†	34.3%	34.6%	34.3%	
High (≥1.74)†	32.4%	32.3%	32.4%	
HRRP readmission penalty† (FY2018)				0.0270
None	53.3%	48.8%	54.6%	
Penalty received	46.7%	51.2%	45.4%	
1%	34.5%	37.7%	33.6%	
2%	9.1%	10.9%	8.6%	
3%	3.1%	2.5%	3.3%	
HACRP penalty† (FY2018)				NA
None	77.7%	0.0%	100.0%	
Penalty received	22.3%	100.0%	0.0%	
1%	22.3%	100.0%	0.0%	
2%	0.0%	0.0%	0.0%	
3%	0.0%	0.0%	0.0%	
HRRP revenue losses (FY2018)				0.0021
Mean loss	$243,508	$296,212	$228,346	
Zero loss†	14.8%	9.9%	16.2%	
>$0 to <$40,000†	19.9%	19.5%	20.0%	
≥$40,000 to <$130,000†	21.8%	18.4%	22.8%	
≥$130,000 to <$350,000†	21.2%	25.6%	20.0%	
≥$350,000†	22.3%	26.6%	21.1%	
HACRP revenue losses (FY2018)				
Mean loss	$90,271	$404,041	$0	NA
Zero loss†	77.7%	0.0%	100.0%	
>$0 to <$135,000†	5.2%	23.1%	0.0%	
≥$135,000 to <$300,000†	6.4%	28.5%	0.0%	
≥$300,000 to <$500,000†	5.1%	22.9%	0.0%	
≥$500,000†	5.7%	25.6%	0.0%	

continued

TABLE I (*continued*)

Variable	Overall (N = 2,135)	HACRP Penalty (N = 477)	No HACRP Penalty (N = 1,658)	P Value*
Total penalties for HRRP and HACRP (FY2018)				
Mean loss	$333,779	$700,253	$228,346	<0.0001
Zero loss†	12.6%	0.0%	16.2%	
>$0 to <$60,000†	22.3%	6.5%	26.8%	
≥$60,000 to <$180,000†	20.7%	13.0%	23.0%	
≥$180,000 to <$500,000†	22.8%	32.3%	20.0%	
≥$500,000†	21.6%	48.2%	14.0%	
Hospital region† (grouped by CMS regions)				<0.0001
1	5.5%	5.7%	5.4%	
2	7.0%	10.7%	5.9%	
3	9.6%	10.9%	9.2%	
4	17.6%	21.4%	16.5%	
5	20.9%	15.7%	22.4%	
6	14.1%	11.7%	14.8%	
7	6.1%	3.6%	6.9%	
8	4.8%	4.8%	4.8%	
9	10.9%	13.0%	10.3%	
10	3.6%	2.5%	3.9%	

*NA = not available. †TJA includes THA and TKA. ‡The values are given as the percentage of hospitals.

tract infections, surgical site infections following abdominal surgical procedures (colon and hysterectomy), MRSA bacteremia, and *C. difficile* infection.

TJAs, including both THAs and TKAs, are among the most commonly performed surgical procedures in the United States and are relevant to both the HRRP and the HACRP[8]. In 2014, there were >371,000 discharges with THA listed as the primary or secondary procedure and >680,000 discharges with TKA listed as the primary or secondary procedure[9]. Medicare was noted as the primary payer for over half of these cases[9]. Feng et al. predicted that the number of TKAs performed in the United States will continue to rise over the next decade[8]. TJA contributes to both the HRRP, because it is a target for readmissions, and the HACRP, because surgical site infections are an important complication following TJA.

To our knowledge, there have been very few studies on the relationship between the HRRP and the HACRP and their relation to TJA. One study examined how the acquisition of 1 of 4 hospital-acquired conditions predicted 30-day readmission following TJA, but this analysis used readmission as the outcome variable instead of the predictor variable and HACRP penalties were not included[10]. Using hospital-level data on hospital-acquired conditions, readmission, and penalties, we sought to investigate whether readmission following TJA was associated with reimbursement penalties under HACRP. We hypothesized that hospitals that had higher readmission rates after TJA would be more likely to incur an HACRP penalty, and would experience greater revenue losses as a result of HACRP penalties imposed, after adjusting for other potential risk factors. Evidence supporting this hypothesis would provide hospitals with an additional incentive to focus efforts on reducing readmissions and the complications that lead to readmissions following TJA.

Materials and Methods

This study was approved by the institutional review board at The Pennsylvania State University College of Medicine. Data were obtained from Definitive Healthcare (https://www.definitivehc.com/). Variables in the data set included geographic region of the United States, ownership status (government or private), profit status (for profit or not for profit), number of discharges per year, and mean case mix index. Only privately owned, short-term, acute care hospitals were included in the analysis; government hospitals (such as Veterans Affairs and U.S. military hospitals) were excluded, as were children's hospitals, long-term acute care facilities, rehabilitation facilities, critical access hospitals, psychiatric hospitals, and religious non-medical health-care institutions.

Two primary outcomes were studied: (1) the receipt of an HACRP penalty for fiscal year 2018 (FY2018), and (2) the associated losses in revenue experienced if an HACRP penalty

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TABLE II Risk Factors for HACRP Penalty, FY2018*

Variable	OR†	P Value
Readmission rate after TJA‡		
≤3%	Reference	
>3%	2.1989 (1.0268 to 4.7089)	0.043
Profit status		
For profit	0.8171 (0.6310 to 1.0582)	0.126
Not for profit	Reference	
No. of discharges		
<5,000	Reference	
5,000 to 11,999	1.2323 (0.9362 to 1.6221)	0.136
≥12,000	1.0575 (0.7725 to 1.4476)	0.727
Case mix index		
Low (<1.51)	0.9115 (0.6670 to 1.2457)	0.561
Medium (≥1.51 to <1.74)	0.9371 (0.7192 to 1.2209)	0.630
High (≥1.74)	Reference	
HRRP readmission penalty		
No	Reference	
Yes	1.1180 (0.8985 to 1.3911)	0.317
Hospital region (grouped by CMS regions)		
1	0.8073 (0.4913 to 1.3265)	0.398
2	1.3022 (0.8559 to 1.9813)	0.218
3	0.8956 (0.6046 to 1.3269)	0.583
4	Reference	
5	0.5260 (0.3708 to 0.7462)	<0.0001
6	0.6379 (0.4375 to 0.9302)	0.019
7	0.4022 (0.2282 to 0.7088)	0.002
8	0.8176 (0.4789 to 1.3960)	0.461
9	0.9532 (0.6536 to 1.3902)	0.803
10	0.4848 (0.2482 to 0.9470)	0.034

*The model includes private, acute care hospitals. †The values are given as the OR, with the 95% CI in parentheses. ‡TJA includes THA and TKA.

was incurred. The HACRP financial penalty represents 1% of total Medicare revenue to the hospital for the fiscal year. These revenue losses are reported as the dollar value of this withholding to the hospital. Of specific interest was how the all-cause, 30-day readmission rate following TJA was associated with the receipt of an HACRP penalty. Secondary outcomes included the receipt of an HRRP readmission penalty and the associated revenue losses.

Hospital-level data were stratified by whether or not an HACRP penalty was received in FY2018. FY2018 was chosen because of the completeness of data available for that year from our data source. Any hospital having missing demographic or outcome data for FY2018 was excluded from the analysis. Readmissions after TJA were coded in the data set as ≤3%, 4%, 5%, 6%, and ≥7%. We chose the lowest category (≤3%) as the reference group for analyses. We also controlled for case mix index, which is the mean Diagnosis-Related Group (DRG) weight for the hospital and represents the resource utilization intensity of the patient population served by the hospital.

The statistical analysis of the data evaluated the association between readmission rates after TJA and the risk and magnitude of HACRP penalties. In univariate analyses, comparisons were made between hospitals that had an HACRP penalty and those that did not using t tests for continuous variables and chi-square tests for binary and categorical variables. In the multivariable analyses, logistic regression was used to model the risk of receiving an HACRP penalty in FY2018, and linear regression was used to model HACRP revenue losses after controlling for potential confounders. Finally, a sensitivity analysis was performed to account for how hospital volume (defined as mean number of discharges per year) may have driven the estimated associations. The effect of hospital volume on outcomes following TJA has been suggested in several other

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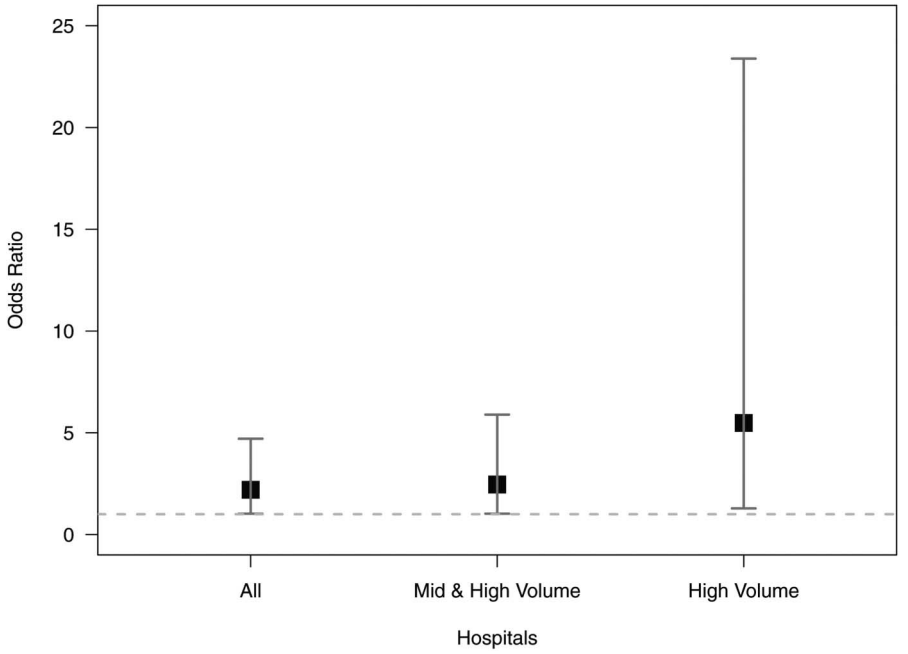

Fig. 1

Sensitivity analysis for hospital volume and odds of receiving an HACRP penalty in FY2018. The error bars represent 95% CIs.

studies[11-14]. To test for this effect in this study, a series of regressions were performed that sequentially excluded low and medium-volume hospitals.

Significance was set at $p < 0.05$, and all statistical analyses were performed using Stata MP, version 15.1 (StataCorp).

Results

A total of 2,135 private, acute care hospitals are included. Among these, 477 hospitals (22.3%) received an HACRP penalty and 1,658 hospitals (77.7%) did not (Table I). The distributions of for-profit or not-for-profit hospitals, as well as the mean case mix index, were similar between the 2 cohorts.

Across the hospital cohort, the great majority of hospitals had a 30-day readmission rate following TJA that was ≤3%, with the HACRP penalty group having a significantly higher proportion with >3% at 98.3% compared with the non-HACRP penalty group at 96.5% ($p = 0.043$). In addition, hospitals who received an HACRP penalty had a higher mean number of discharges (12,116 discharges per year) compared with hospitals not penalized (10,870 discharges per year) ($p = 0.0279$). The HACRP penalty group had a significantly higher proportion that received an HRRP readmission penalty in addition to their HACRP penalty (51.2% compared with 45.4%; $p = 0.027$). The HACRP penalty group also had higher mean revenue losses secondary to HRRP penalties ($296,212 compared with $228,346; $p = 0.0021$), as well as higher revenue losses due to combined HRRP and HACRP penalties ($700,253 compared with $228,346; $p < 0.0001$).

A logistic regression model for receipt of an HACRP penalty in FY2018 is presented in Table II. After controlling for covariates, hospitals with a 30-day readmission rate after TJA of >3% had over twice the odds of receiving an HACRP penalty compared with hospitals with lower readmission rates after TJA of ≤3% (odds ratio [OR], 2.20; $p = 0.043$).

Figure 1 presents the results of a sensitivity analysis of hospital volume. When the lowest-volume hospitals were excluded from the model, the odds increased to 2.46 (95% confidence interval [CI], 1.03 to 5.9) and remained significant ($p = 0.044$). When both the lowest and medium-volume hospitals were excluded (leaving only the highest volume included), the odds increased to 5.48 (95% CI, 1.3 to 23.4; $p = 0.021$).

Table III provides the results of a linear regression model for the magnitude of HACRP revenue losses incurred. After controlling for other covariates, hospitals with a readmission rate after TJA of >3% incurred $77,519 more in revenue losses due to HACRP penalties compared with hospitals with a ≤3% readmission rate, and the effect was significant ($p = 0.01$). In addition, higher hospital volume significantly increased HACRP losses (5,000 to 11,999 admissions, $p = 0.004$; ≥12,000 admissions, $p < 0.0001$), and lower case mix index was significantly associated ($p < 0.0001$) with lower revenue losses. This is consistent with expectations because more resource-intense populations should generate more revenue and, therefore, incur higher penalties as a proportion of revenue.

Figure 2 presents the results of a sensitivity analysis for the association between hospital volume and revenue losses after TJA in the linear regression model. When the lowest-volume hospitals were excluded from the model, HACRP penalties associated with a higher readmission rate after TJA increased to $94,070 (95% CI, $13,547 to $174,594) and

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TABLE III Linear Regression for HACRP Revenue Losses, FY2018

Variable	Coefficient*	P Value
Readmission rate after TJA†		
≤3%	Reference	
>3%	$77,519 ($17,636 to $137,402)	0.011
Profit status		
For profit	−$14,049 (−$39,279 to $11,180)	0.275
Not for profit	Reference	
No. of discharges		
<5,000	Reference	
5,000 to 11,999	$39,556 ($12,715 to $66,397)	0.004
≥12,000	$113,546 ($83,241 to $143,851)	<0.0001
Case mix index		
Low (<1.51)	−$76,534 (−$107,078 to −$45,990)	<0.0001
Medium (≥1.51 to <1.74)	−$70,462 (−$96,540 to −$44,383)	<0.0001
High (≥1.74)	Reference	
HRRP readmission penalty (FY2018)		
None	Reference	
Penalty received	$16,271 (−$5,319 to $37,860)	0.140
Hospital region (grouped by CMS regions)		
1	$836 (−$49,611 to $51,283)	0.974
2	$83,746 ($37,364 to $130,128)	<0.0001
3	−$8,373 (−$49,480 to $32,733)	0.690
4	Reference	
5	−$47,373 (−$81,492 to −$13,255)	0.007
6	−$51,090 (−$88,165 to −$14,014)	0.007
7	−$66,153 (−$114,593 to −$17,712)	0.007
8	−$61,587 (−$115,442 to −$7,731)	0.025
9	−$8,132 (−$47,946 to $31,681)	0.689
10	−$91,664 (−$151,658 to −$31,670)	0.003
Intercept	$32,576 (−$35,992 to $101,144)	0.352

*The values are given as the coefficient, with the 95% CI in parentheses. †TJA includes THA and TKA.

remained significant (p = 0.022). When both the lowest and medium-volume hospitals were excluded (leaving only the highest volume included), the marginal impact increased to $137,401 (95% CI, $8,616 to $266,186; p = 0.037).

Discussion

This study, the first of its kind, to our knowledge, examining the association between the components of the ACA's value-based purchasing programs, revealed that hospitals that had higher all-cause, 30-day readmission rates following TJA were significantly more likely to be penalized under the HACRP and experience revenue losses. The findings of this study may be informative to hospital decision-makers in their efforts to identify how CMS penalties may affect revenues in the near future and to optimally design performance improvement initiatives. They may also inform policymakers in their efforts to understand how the CMS reimbursement policy may impact hospitals, particularly how smaller, potentially more vulnerable hospitals may be impacted by these programs.

In our sample, readmission rates for TJA of >3% were associated with over twice the odds of incurring an HACRP penalty. Raines et al. found that acquiring 1 of 4 specific hospital-acquired conditions (venous thromboembolism, urinary tract infection, surgical site infection, and pneumonia), either during the index admission or as noted on subsequent admissions, was associated with >7 times the odds of being readmitted; the OR was 7.71 (95% CI, 6.49 to 9.27) for TKA and 7.11 (95% CI, 5.75 to 8.78) for THA[10]. Many other studies have connected certain conditions to early, unplanned readmission following TJA, but, to our knowledge, none have yet established an association with the likelihood of receiving a CMS penalty at the hospital level.

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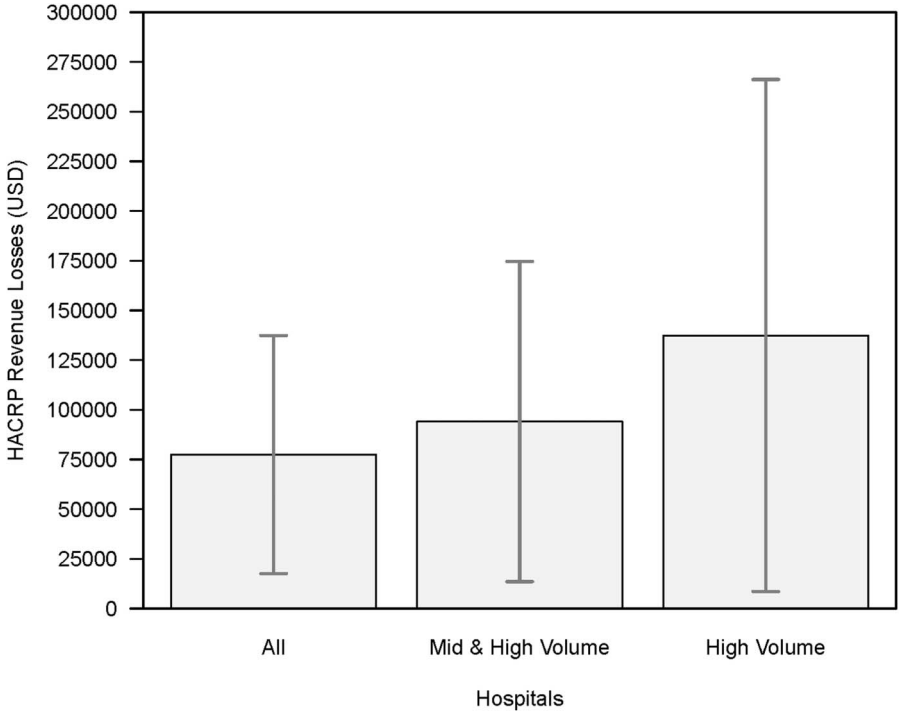

Fig. 2

Results of a sensitivity analysis for hospital volume and HACRP revenue losses incurred in FY2018. The error bars represent 95% CIs. HAC = hospital-acquired condition.

The primary risk factors for unplanned readmission following TJA have been well reported in the literature and include surgical site infection, deep vein thrombosis, and pulmonary embolism[10,11,15-32], all of which currently factor into the HACRP algorithm. Surgical site infection is one of the most frequently encountered hospital-acquired conditions following TJA. For example, Mednick et al. found that surgical site infection following THA was associated with nearly 30 times higher odds of readmission (adjusted OR, 29.7; $p < 0.001$)[31]. Raines et al. reported that a surgical site infection was associated with 34.1 (95% CI, 22.4 to 51.9) times higher odds of being readmitted following THA and 18.9 (95% CI, 14.0 to 25.8) times higher odds following TKA[10]. Minhas et al. suggested that surgical site infection was the cause of readmission following TJA in nearly one-third of their cohort (31.8% of readmissions following THA and 34.2% of readmissions following TKA)[22]. There is ample evidence documenting the impact of surgical site infection on readmission rates following TJA. Our results also hint that, in the current value-based purchasing reimbursement environment, readmissions after TJA may have indirect as well as indirect effects, as they may also contribute to penalties and revenue losses in other areas.

THA and TKA are currently under the same DRG according to the CMS reimbursement schedules. However, George et al. suggested that outcomes may differ depending on the procedure[33]. They found that THA cases had significantly higher 30-day readmission and surgical site infection rates compared with TKA cases, even after adjusting for potential confounders. In their study, patients undergoing THA had 11% higher odds of being readmitted at 30 days, had 43% higher odds of experiencing a surgical site infection, and had nearly twice the odds of having a periprosthetic joint infection (all reported p values were <0.001). Based on the documented data, it appears that surgical site infection plays a critical role in causing readmission following both TKA and THA. If true, it may be helpful to pursue strategies to reduce surgical site infections and their related readmissions.

As of FY2015, both THA and TKA have become targeted conditions under the HRRP. An important implication of readmission after TJA being a significant predictor of the HACRP penalty is the potential for hospitals to experience a double penalty. This has also been observed in the study by Raines et al.[10], who found that, of all of the patients who experienced a hospital-acquired condition following TJA, over one-third (33.7%) also experienced a readmission. The 34% of patients who underwent TJA, developed a hospital-acquired condition, and were subsequently readmitted could potentially equate to penalties under both the HACRP and the HRRP. Although Raines et al. only evaluated 4 hospital-acquired conditions (venous thromboembolism, urinary tract infection, surgical site infection, and pneumonia), our study agrees with their conclusion even when a wider range of hospital-acquired conditions is taken into account.

Timing may play a role in the risk of double penalties. McNair and Luft pointed out that conditions penalized under the HACRP may not manifest themselves until a readmission occurs[34]. In the study by Raines et al., nearly half (47%) of hospital-acquired conditions were not identified until after discharge from the index admission. Over 55% of hospital-acquired conditions identified post-discharge resulted in an early, unplanned readmission (within 30 days), and only 14.8% of hospital-acquired conditions identified pre-discharge resulted in readmission[10]. These findings suggest that hospital-acquired conditions identified early enough (i.e., pre-discharge) may prevent a double penalty, but, as McNair and Luft noted, not all hospital-acquired conditions may be obvious during a short index hospitalization stay.

As the CMS reimbursement continues to shift from fee-for-service toward value-based purchasing, reducing unplanned readmissions for common procedures such as TJA will become a greater concern. Implementing measures that focus on keeping the TJA readmission rate below 3% may be one way for hospitals to reduce their risk of incurring CMS reimbursement penalties. Surgical site infections are one facet of the HACRP scoring algorithm. Other studies have noted that wound infection following TJA is a common cause for readmission[35]; thus, efforts to prevent surgical site infection following TJA may yield dividends in reductions in HACRP penalties.

There were some shortcomings to the current study. First, because this study was an aggregated, hospital-level analysis, we did not have the level of clinical detail present in patient-level analyses that allowed for controlling of all potential confounders. For example, we could not control for patient demographic characteristics and other known risk factors for surgical site infection and readmission following TJA, such as diabetes and smoking status. Second, patients who were undergoing TJA and whose primary payer is Medicare comprised only a portion of all patients undergoing this surgical procedure. Thus, the readmission rate after TJA for the purposes of HRRP and HACRP penalties was calculated from only a subset of all patients undergoing this surgical procedure at most hospitals. Third, our analysis was limited in scope to FY2018 due to the availability of complete data for that year only. Fourth, our data set included only a cross-section of private, acute care hospitals; these hospitals may not have been entirely representative of a national sample, which may have limited the generalizability of our results. Fifth, missing data were handled by casewise deletion, which is an appropriate approach but may have introduced bias and reduced generalizability. Finally, we did not have the total volume of TJA cases in the data set. Thus, we controlled for the total hospital volume rather than the total volume of TJA cases. Although these variables are likely to be correlated, total hospital volume is not a perfect projection of TJA volume.

In summary, acute care hospitals in the United States with a higher all-cause, 30-day readmission rate following TJA were significantly more likely to be penalized and to have greater revenue losses under the HACRP than hospitals with lower readmission rates after TJA. This strengthens the incentive to invest in prevention of readmissions after TJA, for example, through greater efforts to reduce surgical site infections and other modifiable risk factors for readmission. ■

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