The Journal of Arthroplasty 28 Suppl. 1 (2013) 7–10

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Winner of the Dorr Award

Risk Factors, Causes, and the Economic Implications of Unplanned Readmissions Following Total Hip Arthroplasty

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ARTICLE INFO

Article history:
Received 18 August 2012
Accepted 28 April 2013

Keywords:
total hip arthroplasty
unplanned readmission
risk factors
economic analysis

ABSTRACT

In order to identify risk factors for readmissions following total hip arthroplasty (THA) and the causes and financial implications of such readmissions, we analyzed clinical and administrative data on 1583 consecutive primary THAs performed at a single institution. The 30-day readmission rate was 6.51%. Increased age, length of stay, and body mass index were associated with significantly higher readmission rates. The most common re-admitting diagnoses were deep infection, pain, and hematoma. Average profit was lower for episodes of care with readmissions ($1548 vs. $2872, $P = 0.028$). If Medicare stops reimbursing for THA readmissions, the institution under review would sustain an average net loss of $11,494 for episodes of care with readmissions and would need to maintain readmission rates below 23.6% in order to remain profitable.

The 30-day readmission rate has become a pervasive quality indicator for hospital care. The Medicare Payment Advisory Commission (MedPAC) estimated that, in 2005, 17.6% of patients were readmitted to the hospital within 30 days of discharge. This resulted in $15 billion in annual spending, 80% of which was related to potentially preventable readmissions [1]. With growing national attention on cost containment, payors and providers alike are focused on readmissions as a target for cost cutting and quality improvement.

Section 3025 of the Patient Protection and Affordable Care Act of 2010 grants the Centers for Medicare & Medicaid Services (CMS) the authority to penalize hospitals with excessive 30-day readmission rates [2]. In October 2012, CMS began recouping hundreds of millions of dollars from hospitals with high rates of readmission following hospitalization for heart failure, acute myocardial infarction, and pneumonia [3]; the government may extend this policy in the coming years to include a broader range of conditions [1,4].

Over 300,000 total hip arthroplasty (THA) operations are performed in the United States annually, with Medicare paying for the majority of cases [5]. By one recent estimate, 8.5% of primary and 14.1% of revision THA patients are readmitted within 30 days of discharge [6]. Furthermore, annual THA volume has been predicted to expand to 570,000 by the year 2030, partially as a result of an aging population and the growing prevalence of obesity [7]. National spending on THAs is thus likely to continue increasing into the future and may soon be a focus of regulatory scrutiny.

In this changing healthcare environment, with increasing pressures for cost-containment and quality improvement, it is critical that hospitals identify the risk factors and quantify the costs of unplanned readmissions; thus allowing healthcare institutions to prevent these episodes and remain financially viable. The purpose of this study is to identify risk factors for readmissions following THA and the causes and financial implications of such readmissions should CMS revoke reimbursements for them.

Methods

This is a retrospective cohort study examining 1583 consecutive primary THA procedures performed between July 1, 2009, and June 30, 2011, at an urban tertiary academic hospital network serving over 70,000 inpatients annually. The investigation received approval from the health system's institutional review board. Subjects were identified for inclusion from the pool of all inpatient admissions on the basis of the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) procedures code indicating primary THA (81.51); revision procedures were not included. The outcome of interest was unplanned readmissions within 30 days of discharge from the inpatient stay when THA was performed. Readmissions were

The Conflict of Interest statement associated with this article can be found at http://dx.doi.org/10.1016/j.arth.2013.04.055.

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0883-5403/2808-0003$36.00/0 – see front matter © 2013 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.arth.2013.04.055

included only if occurring for unforeseen causes; planned readmissions for inpatient rehabilitation or skilled nursing care were excluded from the analysis. In accordance with CMS policies, returns to the emergency department were not considered readmissions without subsequent admission to a hospital floor or intensive care bed.

Readmitted and non-readmitted patients were compared based on demographic, clinical and financial parameters. Demographic and clinical data, including patient age, gender, race, length of stay (LOS), height, weight, procedure codes, and readmitting diagnoses (if applicable) were collected from the institution's data warehouse. Height and weight were used to calculate body mass index (BMI). Financial data, including actual costs and calculated reimbursements, were obtained from a cost accounting database maintained by the institution's Finance Department. Reimbursement calculations were performed using Medicare reimbursement rates for all patients regardless of the actual insurer in order to enhance the study's generalizability as private reimbursement rates vary widely based on geography and bargaining power in local markets. These calculations were carried out in accordance with CMS policy as a function of the Medicare Severity Diagnosis Related Group (MS-DRG) associated with the admission. Profit (or loss) was calculated for each patient by subtracting total cost from reimbursement revenue. Financial analysis was also performed to model the hypothetical scenario in which unplanned readmissions following THA are no longer reimbursed. Breakeven analysis was preformed to assess the impact of potential reimbursement changes on the THA program's profitability.

For all calculations, statistical significance was defined by P values of less than 0.05. Continuous variables were tested for normality. Parametric variables were compared using the Student's t-test and are represented as mean and standard deviation. Non-parametric variables were compared using the Mann–Whitney U-test and are represented as median and interquartile range (IQR). Categorical variables were analyzed as proportions using chi-squared testing and are represented as percents. Odds ratio (OR), 95% confidence interval (CI), and P value were calculated using bivariate and multivariate logistic regression.

Results

The average age and standard deviation of the 1583 THA patients enrolled in our study were 60.7 ± 13.3 years (Table 1). Fifty-three percent were female, and average BMI was 30.3 ± 7.0. Sixty-nine percent of patients were white, 27% black, 0.6% Asian, 0.1% Native American, and 3.3% classified racially or ethnically as "other" or "unknown." Ninety-seven patients (6.13%) were readmitted to the hospital comprising 103 readmissions (6.51% readmission rate).

Table 1
Patient Characteristics.

	All Patients (N = 1583)		Readmitted (N = 97)		Not Readmitted (N = 1486)		
	N or Mean	% or SD	N or Mean	% or SD	N or Mean	% or SD	*P* Value
Age (y)	60.7	13.3	64.5	14.7	60.5	13.1	0.004
Gender							0.368
Female	844	53.3%	56	57.7%	788	53.0%	
Male	739	46.7%	41	42.3%	698	47.0%	
Race							
White	1093	69.0%	65	67.0%	1028	69.2%	0.654
Black	426	26.9%	30	30.9%	396	26.6%	0.357
Native American	2	0.1%	0	0.0%	2	0.1%	0.718
Asian	10	0.6%	0	0.0%	10	0.7%	0.418
Other	30	1.9%	1	1.0%	29	2.0%	0.519
Unkown	22	1.4%	1	1.0%	21	1.4%	0.755
BMI	30.3	7.0	32.7	7.9	30.1	6.9	<0.001
LOS (d)	4.0	2.5	4.9	3.4	4.0	2.4	<0.001

Table 2
Bivariate Logistic Regression (Readmitted vs Non-Readmitted Patients).

	OR	95% CI	*P* Value
Age	1.02	1.01–1.04	0.004
≤55	1.00	–	–
56–65	0.90	0.50–1.62	0.74
66–75	1.51	0.87–2.61	0.14
≥76	2.02	1.14–3.60	0.017
Gender			
Female	1.00	–	–
Male	0.83	0.55–1.25	0.37
Race			
White	1.00	–	–
Black	1.20	0.77– 1.88	0.43
Other	0.39	0.05–2.85	0.35
LOS	1.09	1.03–1.16	0.003
BMI	1.05	1.02–1.07	0.001
<25	1.00	–	–
25–<30	0.66	0.33–1.31	0.23
30–<35	1.42	0.77–2.62	0.27
≥ 35	2.28	1.27–4.09	0.006

Increased age ($P = 0.004$), LOS ($P < 0.001$), and BMI ($P < 0.001$) were correlated with readmissions. The rate of readmission was not found to be correlated with gender ($P = 0.368$) or race ($P = 0.357$–0.755).

Bivariate logistic regression revealed similar correlations (Table 2). Prolonged LOS ($P = 0.003$) was associated with an OR of 1.09 for risk of readmission (95% CI: 1.03–1.16). Age ≥76 ($P = 0.017$) demonstrated an OR of 2.02 when compared with age <55 (95% CI: 1.14–3.60), and BMI ≥35 ($P = 0.006$) demonstrated an OR of 2.28 when compared with BMI <25 (95% CI: 1.27–4.09). Again, gender ($P = 0.37$) and race ($P = 0.35$–0.43) were not associated with unplanned readmissions. A multivariable logistic regression model adjusted for gender and race confirmed these correlations between unplanned thirty-day readmissions and age ($P = 0.003$), BMI ($P < 0.001$), and LOS ($P = 0.020$).

The most common ICD-9 diagnosis code associated with readmissions was 998.59 signifying "Other postoperative infection" and accounting for 19 readmissions (18.3%). This code is typically used for operative site infections other than infected seromas and cellulitis. Other common codes associated with readmission were "Infection and inflammatory reaction due to internal joint prosthesis" (996.66) accounting for 12 readmissions (11.5%), and "Hematoma complicating a procedure" (998.12) accounting for seven readmissions (6.7%). For an expanded list, see Table 3.

Table 3
Most Common Principal Diagnosis Code Descriptions for Readmission.

Rank	ICD-9 Code	Readmitting Diagnosis	Count	% of Complications
1	998.59	"Other postoperative infection"	19	18.3%
2	996.66	"Infection and inflammatory reaction due to internal joint prosthesis"	12	11.5%
3	998.12	"Hematoma complicating a procedure"	7	6.7%
4	719.45	"Pain in joint, pelvic region and thigh"	6	5.8%
5	996.42	"Dislocation of prosthetic joint"	5	4.8%
5	729.5	"Pain in limb"	5	4.8%
7	996.77	"Other complications due to internal joint prosthesis"	3	2.9%
7	729.81	"Swelling of limb"	3	2.9%
9	453.41	"Acute venous embolism and thrombosis of deep vessels of proximal lower extremity"	2	1.9%
9	780.97	"Altered mental status"	2	1.9%
9	682.9	"Cellulitis and abscess of unspecified sites"	2	1.9%
9	682.6	"Cellulitis and abscess of leg, except foot"	2	1.9%
9	786.5	"Chest pain"	2	1.9%
9	780.6	"Fever and other physiologic disturbances of temperature regulation"	2	1.9%
9	486	"Pneumonia, organism unspecified"	2	1.9%

Table 4
Economic Analysis Under Current Reimbursement Scheme.

	Avg THA Episode	Avg Episode Without Readmission	Avg Episode With Readmission(s)	Difference With & Without Readmission	*P* Value
Revenue	$21,613 ($16,257–$25,333)	$21,285 ($16,234–$25,333)	$34,481 ($24,860–$48,298)	−$13,196	<0.001
Cost	$17,636 ($15,741–$21,363)	$17,454 ($15,643–$20,505)	$31,755 ($26,099–$44,253)	−$14,301	<0.001
Profit	$2828 (−$1751–$8217)	$2872 (−$1524–$8188)	$1548 (−$9153–$8645)	$1323	0.028

Note: Profit values do not exactly equal revenue less cost because these are median observed values from the study sample, not calculated figures.

The median (IQR) hospital revenue, cost, and profit of THA in this study were $21,613 ($16,257–$25,333), $17,636 ($15,741–$21,363), and $2828 (−$1751–$8217), respectively (Table 4). Of note, the profits described are not precisely equal to revenue less cost because these figures are median values of the sample. When compared to episodes without an unplanned readmission, episodes with readmissions were $14,301 more expensive ($P < 0.001$), were reimbursed by an additional $13,196 ($P < 0.001$), and were $1323 less profitable ($P = 0.028$).

Under the hypothetical scenario in which CMS denies reimbursement for THA readmissions, the median unplanned readmission would generate a loss of $11,494 rather than the current profit of $227 ($P < 0.001$) (Table 5). As some THA episodes result in multiple unplanned readmissions, the cumulative effect would be a median loss of $12,410 for each THA episode with at least one associated readmission. In this hypothetical scenario, the average THA episode at the institution under review would be reimbursed $328 less than the current reimbursement level ($P = 0.018$). The resultant profit would be $2457, as opposed to the profit of $2828 for the average THA episode in the current system ($P = 0.051$). The institution under review would need to maintain a readmission rate less than 23.6% to remain profitable in the absence of reimbursement for THA readmissions (Fig. 1).

Discussion

With increased attention on cost-containment in the healthcare industry, unplanned 30-day readmission rates have become a popular tool used by payors, most notably CMS, to levy reimbursement penalties. Such cost-cutting efforts are likely to spread to additional specialties and procedures, and the growing arthroplasty market may be a favorable future target. This study examines 1583 consecutive primary THA procedures performed at a large academic hospital network to elucidate the risk factors, causes, and financial implications associated with 30-day unplanned readmissions as well as the potential economic consequences of reimbursement penalties.

The 30-day readmission rate for THA at the institution under review was 6.51%, and episodes of care with unplanned readmissions generated significantly lower profit. Older age ($P = 0.004$), higher BMI ($P = 0.001$), and longer LOS ($P = 0.003$) were associated with significantly higher rates of readmission, while gender, race, and revision surgery had no influence. The most common readmission diagnoses observed in our sample were “other postoperative infection” (18.3%) and “infection and inflammatory reaction due to internal joint prosthesis” (11.5%). These codes both typically represent deep infections and are often used interchangeably for that purpose; superficial infections are normally denoted by ICD-9 codes for cellulitis and abscess (3.8%) or infected seroma (1%). Thus, 29.8% of readmissions were likely prompted by deep joint infections, though the use of administrative data, as discussed below, limits our full understanding of these readmissions. Other common causes of readmission were pain in the limb or pelvis (10.6%), hematoma (6.7%), and hip dislocation (4.8%).

The academic literature detailing the causes and rates of readmission after THA is mixed. Cram et al reviewed data on nearly two million patients undergoing THA and found that 8.5% of primary and 14.1% of revision THA patients were readmitted within 30 days of discharge [6]. A 2006 study of 769 consecutive patients undergoing primary THA in the United Kingdom observed a readmission rate of 8.5%; the main causes of readmission were DVT, atraumatic dislocation, and wound complications such as superficial infection and hematoma [8]. In contrast, 6.8% of 1809 THA patients were readmitted in a 2011 analysis of Medicare Patient Safety Monitoring System data. In this case, cardiac complications (e.g., congestive heart failure, ischemic heart disease, dysrhythmias) were the most common causes of readmission, while DVT and dislocation were not included in the top ten diagnoses [9]. These seemingly conflicting results may be the result of differences in populations studied, data recording methodologies, inclusion criteria, and definitions of readmission itself.

Despite the lack of consensus as to the predominate causes of readmissions, much work has already been done in an attempt to prevent them. Hansen et al performed a systematic review of interventions to reduce 30-day readmission and identified 43 articles evaluating initiatives aimed at reducing readmission. Interventions included strategies for enhanced patient education, discharge planning, and follow-up communication [10]. The fact that the authors were unable to identify an intervention that consistently reduced readmission risk emphasizes the need for further research on the topic. Our financial analysis demonstrates that unplanned readmissions have a significant negative impact on THA profit, providing further incentive for such research as well as process changes aimed at preventing readmissions. The elimination of payment for unplanned readmissions would greatly expand that incentive. Of note, our investigation identified a substantial number of patients with planned readmission within 30-days of THA for reasons such as inpatient rehabilitation and skilled nursing care. Future reimbursement programs, quality improvement initiatives, and research studies should thus make rigorous efforts to distinguish between planned and unplanned readmissions.

One limitation of this study is its reliance on administrative data, which may result in underestimation of morbidity rates if complications are not coded properly or do not require hospitalization [11].

Table 5
Economic analysis with hypothetical CMS policy extension revoking reimbursement for THA readmissions.

	Avg Readmission Visit in Current System	Hypothetical Readmission Without Reimbursement	Avg Difference With & Without Reimbursement	Avg THA Episode in Current System	Hypothetical Avg THA Episode Without Reimbursement for Readmissions	Avg Difference Per Episode With & Without Reimbursement for Readmissions
Revenue	$10,840	$0	$10,840 ($P < 0.001$)	$21,613	$21,285	$328 ($P = 0.018$)
Cost	$11,494	$11,494	$0 ($P = 1.000$)	$17,636	$17,636	$0 ($P = 1.000$)
Profit	$227	−$11,494	$11,721 ($P < 0.001$)	$2,828	$2,457	$371 ($P = 0.051$)

Profit values do not exactly equal revenue less cost because these are median observed values from the study sample, not calculated figures.

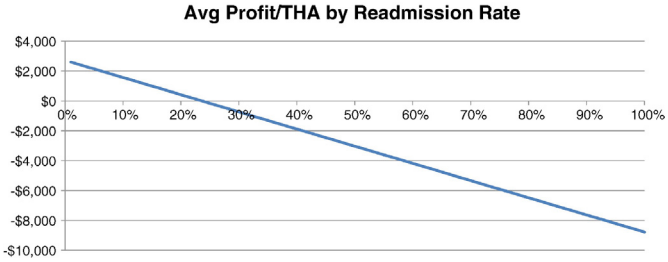

Fig. 1. Scatterplot depicting break-even analysis for readmission rate based on profits from the initial visit and from hypothetical readmission(s) without reimbursement. The X-intercept represents the break-even point, which occurs at a readmission rate of 23.6%.

The most likely negative impact on this study is potential inaccuracy in the rates of specific diagnoses associated with readmissions, which would be expected if ICD-9 codes were recorded inaccurately or inconsistently. Future research into the causes of readmissions relying solely on clinical data will be helpful in verifying our results. Still, our primary outcomes of readmission and cost should be largely immune to subjectivity in the coding process. A second limitation is the use of data from a single institution. While the hospital system under review is large and offers most of the care for the local community, it is possible that some patients presented to outside facilities for postoperative readmission; these readmissions would not have been captured in our results.

In conclusion, unplanned readmissions have become a prime target for cost cutting as the US strives to reign in health care expenditures. While current policies are limited to Medicare reimbursements for a select few conditions, financial penalties for elevated readmission rates are likely to become more widespread as additional disease states are added to the list and as private payers follow suit [1]. Demand for total hip arthroplasty, already at record-high levels, is expected to grow significantly in the coming years which may position the procedure squarely in the crosshairs of cost-cutting initiatives. If Medicare stops reimbursing for THA readmissions altogether and if our findings are generalizable to hospitals across the country, hospitals will begin sustaining a substantial net loss for each readmitted patient. In order to achieve quality improvement and to remain financially viable in this increasingly demanding reimbursement environment, it is critical for hospitals to perform similar analyses so that they can identify the risk factors for unplanned readmissions most relevant to their particular population and invest in programs to address them.

Acknowledgments

The authors thank Theresa Larivee and the Office of Financial Operations and Budget at the University of Pennsylvania Health System, and the staff at the Penn Data Store.

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