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Original Article

Which Hospital and Clinical Factors Drive 30- and 90-Day Readmission After TKA?

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ABSTRACT

Background: The purpose of this study was to analyze the hospital, clinical, and patient factors associated with inpatient readmission after total knee arthroplasty (TKA) in the Medicare population and to understand the primary reasons for readmission.

Methods: The Medicare 100% national hospital claims database was used to identify 952,593 older patients (65+) with a primary TKA in 3848 hospitals between 2010 and 2013. A multilevel logistic regression analysis with a clustered data structure was used to investigate the risk of all-cause 30- and 90-day readmission, incorporating hospital, clinical, and patient factors.

Results: At 30 days, readmission ranged from 0% to 22% (median, 4.9%), whereas at 90 days, readmission ranged from 0% to 32% (median, 8.6%). Geographic census region, hospital procedure volume, rural hospital location, and nonprofit ownership were the only significant hospital factors among those we studied. Evaluation of clinical factors showed use of a perioperative transfusion was associated with 13% greater risk; patients discharged to home had 25% lower risk; and surgeon volume and length of stay were also significant. These effect sizes were at least comparable to patient factors, such as age, gender, comorbidities, and socioeconomic status. The top 5 most frequently reported primary reasons for 30- or 90-day readmission in TKA were surgery and medical related: wound infection, deep infection, atrial fibrillation, cellulitis and abscess of leg, or pulmonary embolism.

Conclusion: The results of this study support further optimization of anti-infection measures, both intraoperative and postoperative, to reduce the broad variation in hospital readmissions.

Health care reform and the Patient Protection and Affordable Care Act of 2010 (ACA) have introduced all-cause hospital readmission as an important metric for the quality of care across several fields of surgery, including orthopedics. Both 30-day and 90-day readmissions rates after primary total knee arthroplasty are relevant hospital benchmarks in today's era of health care reform, although for slightly different reasons. The 30-day, all-cause, risk-standardized readmission rate after total hip and knee arthroplasty (THA and TKA) is evaluated by the Center of Medicare and Medicaid (CMS) as a quality measure for individual hospitals and is available as an online search tool for prospective patients (https://www.medicare.gov/hospitalcompare/search.html). Under the provisions of the ACA, which were extended in 2015 to specifically include readmission after primary TKA, hospitals will be penalized to the

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extent that they have "excess" 30-day readmissions. The magnitude of the financial penalty ranges from 1% to 3% of the hospital reimbursement for the TKA surgery. Bundling of health services into an episode of care is another innovation of health care reform and the ACA. As payers including CMS move forward with implementing a bundled payment system, hospitals will be accountable for the costs of readmissions for any reason, up to 90 days from discharge. As orthopedic surgeon and hospital interests will be increasingly aligned in a bundled payment system, both parties have incentive to reduce all-cause 30- and 90-day hospital readmissions after TKA [1].

Despite the growing influence of health care reforms, such as these new readmission rules, on the practice of orthopedic surgery and patient care, relatively few recent studies have investigated the national hospital level of readmission after total knee arthroplasty and factors that explain interhospital and intrahospital variation. Cram et al [2] observed a trend of increasing hospital 30-day readmissions for Medicare beneficiaries between 1991 and 2010, coincident with a trend of decreasing length of stay (LOS), suggesting that perhaps a patient's failure to cope with early discharge may be partly responsible for the readmission trend [3]. By analyzing data from a single institution, Mesko et al [4] found that increased risk of 30-day readmission was predicted by longer LOS, discharge to a nursing facility, blood transfusion, general anesthesia, and anticoagulation therapy, as well as Charlson Comorbidity Index greater than 2. Singh et al [5] showed that rheumatoid arthritis is a risk factor for 90-day readmission, whereas Raines et al [6] found that hospital acquired conditions were responsible for over 40% of 30-day readmissions. Pugely et al [7] analyzed the American College of Surgeons National Surgical Quality Improvement Program database and identified several patient factors (eg, age, gender, cancer history) that were associated with 30-day readmission after TKA. Overall, previous studies of readmissions after TKA have either focused on the patient as the unit of analysis across multiple hospitals [2,5-7] or a group of patients within a single hospital setting [4,8].

To add to the knowledge base on 30- and 90-day readmissions after TKA, we studied the hospital as the unit of analysis and asked the following research questions for the Medicare population of primary TKA patients: (1) Which hospital factors influence 30-day and 90-day readmission after primary TKA? (2) Which clinical factors influence 30- and 90-day readmission? (3) What are the principal reasons for 30- and 90-day hospital readmission and are they procedure related?

Materials and Methods

The Medicare 100% national hospital claims were used to identify 952,593 elderly patients (aged 65+ years) with a primary TKA in 3848 hospitals between 2010 and 2013 (Table 1). The Medicare data captured claims submitted for patients enrolled in the traditional fee-for-service program, which did not include records of medical service provided to beneficiaries enrolled in Medicare advantage or other Health Maintenance Organization-type plans. Primary TKA procedures were identified using *International Classification of Diseases, 9th rev., Clinical Modification* code 81.54. Patients younger than 65 years old, enrolled in a Health Maintenance Organization, or residing outside the 50 US states were excluded.

We used a 1-year look-back period before the index TKA to compute patient factors, including comorbidities, hospital volume, and surgeon volume. These volume measures were limited to the Medicare population, and as a proxy for experience, were assumed to correlate well with the overall volume of the hospital or of the surgeon. For those patients who received their primary TKA in 2010, we used the 100% inpatient data from 2009 for the look-back period. Patients were tracked longitudinally for up to 30 and 90 days after their primary TKA procedure. Patients who died within the 30-day or the 90-day period without encountering readmission were considered censored, because they did not have the opportunity to be readmitted. We determined readmission as the appearance of new hospital claims record for the patient within 30 or 90 days of the patient's discharge date. Patients who returned to the hospital only for rehabilitation service (*International Classification of Diseases, 9th rev., Clinical Modification* V57.x) and not associated with complications or other medical issues were not included.

Table 1
CMS LDS Inpatient Data 2010-2013.

Effect	Level	TKA	Readmit	Readmit	% TKA	% Readmit	
			30 d	90 d		30 d	90 d
	Total	952,593	47,268	79,536	100.0	100.0	100.0
Age, y	65-69	306,952	11,747	19,847	32.2	24.9	25.0
	70-74	276,702	12,443	20,690	29.0	26.3	26.0
	75-79	208,503	11,553	19,395	21.9	24.4	24.4
	80-84	118,314	7957	13,475	12.4	16.8	16.9
	85+	42,122	3568	6129	4.4	7.5	7.7
Charlson Index	00	519,176	20,282	33,654	54.5	42.9	42.3
	1-2	357,109	19,891	33,687	37.5	42.1	42.4
	3-4	63,864	5474	9289	6.7	11.6	11.7
	5+	12,444	1621	2906	1.3	3.4	3.7
Discharge type	Home	190,784	6813	11,102	20.0	14.4	14.0
	Home w/HHS	334,760	12,597	20,636	35.1	26.7	25.9
	Other facility	10,506	2469	2930	1.1	5.2	3.7
	Rehab facility	99,135	6610	11,359	10.4	14.0	14.3
	SNF	317,408	18,779	33,509	33.3	39.7	42.1
Hospital annual TJA volume	001-149	214,301	11,972	19,889	22.5	25.3	25.0
	150-299	269,863	13,554	22,988	28.3	28.7	28.9
	300-449	173,260	8390	14,049	18.2	17.7	17.7
	450-599	114,122	5305	8976	12.0	11.2	11.3
	600+	181,047	8047	13,634	19.0	17.0	17.1
Hospital beds	001-149	233,313	11,968	19,271	24.5	25.3	24.2
	150-299	267,179	13,170	22,330	28.0	27.9	28.1
	300-499	238,594	11,653	20,112	25.0	24.7	25.3
	500+	213,507	10,477	17,823	22.4	22.2	22.4
Hospital ownership	Nonprofit	160,976	8504	14,128	16.9	18.0	17.8
	Private	678,473	33,204	56,144	71.2	70.2	70.6
	Public	113,144	5560	9264	11.9	11.8	11.6
Hospital setting	Rural	133,329	6728	11,365	14.0	14.2	14.3
	Urban	819,264	40,540	68,171	86.0	85.8	85.7
Hospital stay	1-2	167,835	6482	10,081	17.6	13.7	12.7
	3-4	704,341	33,271	56,647	73.9	70.4	71.2
	5+	80,417	7515	12,808	8.4	15.9	16.1
Hospital teaching	No	682,703	33,642	56,502	71.7	71.2	71.0
	Yes	269,890	13,626	23,034	28.3	28.8	29.0
Race	Black	49,832	2987	5102	5.2	6.3	6.4
	Oth/Unk	35,090	1734	2890	3.7	3.7	3.6
	White	867,671	42,547	71,544	91.1	90.0	90.0
Resident region	Midwest	261,330	13,103	22,197	27.4	27.7	27.9
	North East	148,100	8041	13,224	15.5	17.0	16.6
	South	374,983	18,930	31,888	39.4	40.0	40.1
	West	168,180	7194	12,227	17.7	15.2	15.4
Gender	Female	604,412	27,431	48,046	63.4	58.0	60.4
	Male	348,181	19,837	31,490	36.6	42.0	39.6

Patients undergoing total knee arthroplasty and rehospitalized (all cause) in 30 or 90 days. Demographic profile and hospital characteristics of primary and readmitted patients.
HHS, home health service; LDS, limited data set; SNF, skilled nursing facility; TJA, total joint arthroplasty; TKA, total knee arthroplasty.