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Factors Influencing Discharge Destination After Total Knee Arthroplasty: A Database Analysis

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Abstract

Introduction: The demand for total knee arthroplasty (TKA) continues to challenge hospital financial resources. Hospitals have countered this economic demand by reducing patient length of stay (LoS), thus requiring a higher utilization of extended care facilities (ECF) and home with home health care (HHC). With an increase in the number of insured low-income families following the Affordable Care Act (ACA), TKA patients' demographics are anticipated to change. Both trends have significant economic implications, and predicting the discharge destinations of TKA patients would help plan for future health expenditures. The purpose of this study was to determine which variables are significant in predicting discharge destinations of patients treated with TKA. **Methods:** We utilized the California Hospital Discharge data set of the year 2010. For each hospitalization, the data set includes information about patient demographics (age, gender, race, and ethnicity), insurance type, diagnoses and procedures, and patient disposition. Discharge to home was the reference category. Discharges to a skilled nursing home and discharge to home with home care were the 2 additional alternatives. Independent variables included the Charlson comorbidity index, payer category (private, Medicare, Medical, and other), race, ethnicity, age, and gender. **Results:** Over 28 611 TKAs were reviewed with 45.9% discharged to HHC, 29.9% going to ECF, and 24.2% going home without home health care. Race, age, insurance, and morbidity proved to be highly significant factors influencing patient discharge destination ($P < .001$). Medicare coverage relative to private payers was a strong predictor for discharge destination (relative risk ratio (RRR) 1.69, $P < .001$). The strongest predictors were black and Asian races relative to whites (RRR 1.54, $P < .01$). Male gender was the only factor that lowered the risk of discharge to a nursing home (RRR 0.43, $P < .001$). **Conclusions:** This study provides insight on which patient characteristics influence discharge destination after TKA. Race, age, insurance, and morbidity were highly significant ($P < .001$) factors on patient discharge destination.

Keywords

total knee arthroplasty, extended care facility, discharge destination, home health care

Introduction

In the last decade, the number of primary total knee arthroplasties (TKAs) performed annually has doubled.¹ In 2009, more than 620 000 TKAs were performed, and this number continues to increase annually.¹ The demand for primary TKA is expected to grow by 673% to 3.48 million procedures by 2030.^{2,3} Multiple factors contribute to this projection, which include the increasing obesity epidemic, increased longevity, the aging Baby Boom generation, and the increasing number of younger individuals (aged 45-64 years) in need of TKA.⁴ In fact, the average age of patients receiving a TKA has decreased over time.¹ The increased demand for TKA in younger people combined with increased life expectancy and obesity epidemic suggest that more individuals will need TKA.

This projected increase in demand for TKA will challenge hospital facilities and their financial resources. In 2004, Medicare (in the United States) reimbursed approximately 60% of all costs related to total joint replacement placing a large

demand on hospitals because of the fixed bed capacity and overhead costs.⁵ This economic demand requires hospitals to increase patient turnover by decreasing length of inpatient stay. With an estimated 1.4 million TKAs in 2015,⁶ the cost of

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performing a total joint arthroplasty (TJA) should be controlled to allow our health-care system continued sustainability.

The economic demand has continued to encourage protocols allowing for decreased length of stay (LoS) following TJA. The decreased LOS has led to a higher probability of patients being discharged to an extended care facility (ECF) or home with home health care (HHC).^{7,8} The initial introduction of total joint pathways in the 1990s decreased the LoS to 4.6 days following primary TKA.⁹ The LoS further decreased to around 3.8 days with advances in pain management and accelerated rehabilitation protocols.¹⁰ Earlier discharges have also led to an exponential increase in the use of ECF and HHC. Bozic et al supported this notion as the percentage of patients admitted to ECF following TJA grew from 17.1% to 54.6% during the years 1993 to 2003.¹¹ The LoS does continue to decrease with even a recent article showing that a 2-day LoS is not inferior to a 3-day LoS with regard to readmission rates.¹²

The economic burden compels hospital facilities to encourage a decreased LoS allowing greater patient turnover. It also emphasizes investigating further modalities such as payment models. Payment models bundle hospital and post-hospital care. In order to establish an efficient payment model, an investigation regarding the most cost-effective location of posthospital care is needed.

The purpose of this study was to examine the factors affecting posthospital placement after TKA on a large population—all patients undergoing TKA in California. We utilized the 2010 California Patient Discharge data collected by the State of California Office of Statewide Health Planning and Development (OSHPD) and statistically analyzed it in order to determine which variables are significant for predicting discharge destinations. We hypothesize that patient demographics and socioeconomic profile will influence posthospital placement of a patient following TKA to an ECF versus HHC or home without any home health care while controlling for patient clinical severity.

Methods

Data and Sample

This study utilized the California Hospital Discharge data set collected by the OSHPD. The data included 1 record for each inpatient hospitalization in the state. The data set contained information about patient demographics (age, gender, race, and ethnicity), insurance type, diagnosis, procedures, and patient disposition for each hospitalization. We obtained data for all hospitalizations in the state of California for the year 2010. The study cohort included 28 611 patients undergoing TKA identified by *International Classification of Diseases, Ninth Revision (ICD-9)* procedure code 81.54.

Variables

Patient disposition was the dependent variable. It was defined as a categorical variable. The reference category was discharge to home with discharge to an ECF and discharge to HHC as the alternative categories. Discharge to an ECF included both

patients discharged to a subacute nursing facility and an acute rehabilitation facility (the discharge data did not differentiate between the two). Home health-care services included both physical therapy and nursing services as needed by the individual patient and were not quantified in the data set.

Independent variables included the Charlson comorbidity index,^{13,14} which captures patients' medical comorbidities, payer category (private pay, MediCare, MediCal—the California version of Medicaid, and Other), race (white, black, Native American/Eskimo/Aleut, Asian/Pacific Islander, and other race), ethnicity (Hispanic or not), age (defined by 5-year age groups), and gender. The variables were initially chosen based on our hypothesized significance on discharge destinations. The TKA patients typically have multiple comorbidities. In fact, they display more comorbidities than total hip arthroplasty (THA) patients—which have an average of 2.2 comorbidities.^{14,15} Comorbidities tend to increase with advancing age; patients aged 65 years and older have a 60% to 88% chance of having at least 1 comorbidity.¹⁶ The Charlson comorbidity index serves as an indicator as to whether the patient's extended illnesses affected their discharge destination.

The demographic variables had a large percentage of missing (masked) values, upward of 30% of the observations. These variables are masked by the State of California because of concerns for breach of confidentiality due to small sample sizes (ZIP code areas with small population sizes). The imputation techniques were determined to be unreliable because of the relatively high percentage of missing (masked) variables. As an alternative strategy, we estimated regression models for the full sample without the demographic variables, the smaller sample with the full data, and the smaller sample without the demographic variables. The estimates for all nondemographic covariates were similar leading to the conclusion that the smaller sample with a complete set of demographic variables is representative of the entire sample. We present only the estimates for this model in the article.

Analyses

We estimated multinomial regression models for TKA in which the unit of observation is the patient discharge. The reference category is discharge to home with the dependent variable being the observed discharge destinations. For each independent variable, these models provide 2 relative risk ratios (RRRs)—one ratio is of the risk of discharge to a nursing home divided by the risk of a discharge to home and the other is the risk ratio of discharge to home with home care divided by the risk of discharge to home without care.

All statistical analyses were done in STATA software V-12 (StataCorp LP, College Station, Texas). The data sets were received deidentified, making the study exempt by our Institutional Review Board.

Results

Results are illustrated in both tables with Table 1 demonstrating the descriptive statistics and Table 2 showing the results

Table 1. Patient Demographics.

Descriptive Statistic: Knee Replacement		
Variable	Mean/Percentage	Frequency/Standard Deviation
Discharge destinations		
Home routine	24.2	6909
SNF	29.9	8564
HHC	45.9	13 138
Charlson index	0.52	0.82
Payer category		
Private coverage	32.5	9300
Medicare	60.8	17 393
Medicaid	2.6	738
Other pay	4.1	1180
Race		
White	86.9	24 862
Black	4.2	1190
Native American	0.1	23
Asian	3.2	924
Other race	5.6	1612
Ethnicity		
Hispanic	11.4	3255
Non-Hispanic	88.6	25 356
Age	68.17	
Gender		
Female	62.7	17 930
Male	37.3	10 681

Abbreviations: SNF, skilled nursing facility; HHC, home health care.

from the multivariate analyses. Table 1 shows that of the 28 611 TKA patients, almost half—13 138 (45.9) patients—went to HHC. Of the remaining patients, 8564 (29.9%) went to an ECF and 6909 (24.2%) went home without home health care. The Charlson Index, a predictor of 10-year mortality of patients with identified comorbidities, for this specific cohort was 0.52 with a standard deviation of 0.82, which relates to a lower comorbidity risk. The average age of patients following TKA was 68.7 years with the higher percentage (62.7%) of them being female. An overwhelming 86.9% of patients undergoing TKA were white with the remaining percentage being distributed to black (4.2%), Asian (3.2%), Native American (0.1%), and other races (5.6%). Non-Hispanic patients accounted for 88.6% of TKA, while Hispanic accounted for the remaining 11.4%. Medicare did majority of reimbursement at 60.8%, while private coverage accounted for 32.5%. MediCal—California equivalent of Medicaid—took care of 2.6% of reimbursement. It is important to note that the population of California often masks the variables of race and ethnicity in areas where the sample size is small and there is a risk to patient confidentiality.

Table 2 discusses the RRR with the discharge of home without home health care being the reference compared with discharge to HHC or discharge to an ECF. A ratio greater than 1 represents a higher likelihood of discharge to an ECF or HHC. The table also consists of the 95% confidence interval to further evaluate significance.

Table 2. Predicted Relative Risk Ratios of Discharge to SNF and Home Health Relative to Home.

	95% Confidence Interval		95% Confidence Interval	
	RRR	Interval	RRR	Interval
Home	Reference (Base Outcome)			
SNF			HHC	
Charlson comorbidity index	1.37 ^a	1.32-1.43	1.08 ^a	1.03-1.12
Types of pay				
Medicare	1.69 ^a	1.53-1.86	1.13 ^c	1.04-1.22
Medicaid	1.21	0.98-1.51	0.75 ^c	0.63-0.90
Other Pay	0.99	0.82-1.20	0.79 ^a	0.69-0.90
Race				
White	Reference			
Black	2.44 ^a	2.03-2.92	1.54 ^a	1.30-1.81
Native American	1.66	0.60-4.60	0.48	0.16-1.43
Asian	2.66 ^a	2.15-3.30	1.54 ^a	1.25-1.90
Other race	1.38 ^b	1.14-1.66	1.62 ^a	1.37-1.92
Ethnicity				
Non-Hispanic	Reference			
Hispanic	1.51 ^a	1.32-1.71	0.95	0.84-1.07
Age	1.46 ^a	1.42-1.49	1.07 ^a	1.04-1.09
Gender				
Female	Reference			
Male	0.43 ^a	0.40-0.46	0.94	0.89-1.00

Abbreviations: RRR, relative risk ratio; SNF, skilled nursing facility; HHC, home health care.

^a.001 > P.

^b.01 > P ≥ .001.

^c.05 > P ≥ .01.

Discharge to ECF

Numerous factors proved to be statistically significant for a higher likelihood of discharge to an ECF compared to home without home health care. An increased Charlson Index and age were found to be statistically significant in predicting a higher rate of discharge to an ECF with an RRR of 1.37 ($P < .001$) and 1.46 ($P < .001$), respectively. The greatest predictors of discharge to an ECF were Asian ethnicity at 2.66 ($P < .001$) and blacks at 2.44 ($P < .001$). Other race and Hispanic ethnicity did reveal as well statistically significant data at 1.38 ($P < .01$) and 1.51 ($P < .001$), respectively. As far as payment modalities are concerned, Medicare patients did show a higher likelihood of discharge to an ECF at 1.69 ($P < .001$). The only factor that *decreased* the likelihood of discharge to an ECF was male gender (0.43, $P < .001$).

Discharge to HHC

Certain factors proved to be significant in discharge to HHC compared to that of home without home health care. An elevated Charlson index and age did show a minimal increase in likelihood of discharge HHC at 1.08 ($P < .001$) and 1.07 ($P < .001$), respectively. Race proved to be the strongest predictor of discharge to HHC with RRR of blacks and Asians at

1.54 ($P < .001$). Other race was the largest predictor at 1.62 ($P < .001$). Payment modalities did prove to be significant with Medicare at 1.13 ($P < .05$). Nevertheless, MediCal and other payment proved to *decrease* the likelihood of discharge to HHC at 0.75 ($P < .05$) and 0.79 ($P < .001$), respectively.

Discussion

This study serves to aid in predicting discharge destination following TKA. Factors such as age, race, insurance, and patient comorbidity can determine posthospital placement. As stated earlier, with the economic demand placed on hospitals to keep up with procedural cost and volume, it is imperative to determine whether patients should be discharged to an ECF, HHC, or home without any home health care.

Our cohort revealed that certain patient characteristics and socioeconomic status helped predict discharge destination following TKA. Among all patients (>28 000 TKAs), 75.8% were discharged to either an ECF or an HHC. Only 1 of every 4 patients was discharged to home without any home health care. These trends are most likely a result of the demand to turnover patients within the hospital and reduce the length of stay. Our cohort also parallels a study performed by Bozic et al, where they identified numerous patient characteristics in their cohort of 7818 patients who underwent total joint replacement at 3 high-volume centers. Their analysis confirmed that an increased age, higher ASA score, Medicare insurance, and female sex increased the likelihood of being discharged to an ECF.¹¹ As anticipated, our study matches those results and showed that age and more comorbidity predicted a discharge destination to an ECF. Although Bozic et al did not differentiate between ECF and HHC, our study revealed that age and multiple comorbidities led to a slight increase in likelihood of a discharge destination of HHC. As LOS continues to shorten, further investigation is needed to differentiate between discharge to an ECF and discharge to HHC at home.

Our study also demonstrated that race proved to be a strong predictor of discharge destination following TKA. Black, Asian, and other races were more likely to be discharged to an ECF or HHC. Native American race did not significantly influence discharge destination. While comparing costs between an ECF and HHC, ECFs are inherently more expensive than HHC due to capital and staffing requirements.¹⁷ Moreover, there is evidence showing an increase in readmission rate, even among healthy patients, for the TJA patients discharged to an ECF.¹⁸ Of all the patients in our cohort, only 4.2% were black, 3.2% were Asian, 0.1% were Native American, and 5.6% were other races. Socio-cultural barriers can be cited for these low numbers. Prior studies have shown that African American physicians care for about 25% of African respondents, while Hispanic physicians care for about 25% of the Hispanic respondents, despite their underrepresentation in the health care community.^{19,20} The scarcity of diverse health professionals has been correlated with the perceived effectiveness of the quality of care. Native Americans—like other minorities—have a preference for alternative medicine and would respond more positively to their health

needs if consulted by a physician of their own race, ethnicity, or beliefs. Along with preconceived beliefs in health care, a possible lack of health education might contribute to the determent of receiving advanced surgical treatment.

As mentioned previously, Bozic et al showed Medicare patients were more likely to be discharged to an ECF. Our study confirmed the significance that Medicare patients were more likely to go to an ECF but also that they were more likely to be discharged HHC. On the other hand, MediCal (MediCaid) was a significant predictor to be discharged to home without home health care. Other payer also showed a strong significance for being discharged home without home health care. HHC is an affordable destination while still an effective destination. It will be interesting to see how the implementation of the Affordable Care Act influences the discharge destination, as more of the population will be insured and have health care available to them. By 2016, a projected estimate of 3.4 million people younger than 65 years will be insured, with 1.4 million people enrolled in MediCal.²¹ As more of the population becomes insured, further verification of discharge destination will be required in order to determine the most efficient, and cost effective destination.

In determining discharge destination, it is important to recognize which comorbidities would require further intervention or monitoring. Munin et al showed that patients with more comorbidities were at risk of requiring postacute care rather than being discharged to home.²² Further investigation should be performed to determine which comorbidities require additional monitoring and management. This would provide information or show trends regarding best discharge destination for specific comorbidities in TKA patients. Another working example would be to delineate the hospital identification number (oshpd_id) from which the TKA was performed in order to determine regional characteristics surrounding the procedure. Also, assuming patients determine their location of hospital care based on geographic convenience, the demographics surrounding the area would help clarify the distribution of race, ethnicities, and more. Specific to rural areas, patients following TJA received less intensive care in the institution compared to a home setting. This shows that these patients may prefer a HHC rather than being discharged to an ECF.²³

The growing demand for TKA is and will continue to fuel the unsustainable increase in health-care spending. To address this, the Center for Medicare and Medicaid Services (CMS) created alternative payment models designed to control cost and improve quality.²⁴ Under these initiatives CMS will pay hospitals a set amount, for all care provided to the patient during the index admission and for a period of 90 days following discharge including the costs for ECF and HHC. Post-discharge costs can account to almost 40% of total episode of care cost, when ECF are utilized. In doing so, Medicare aims to increase the value of health care for its patients.²⁵ For physicians and hospitals to remain financially solvent, the quality and cost of health care must be reexamined and improved.

This study does provide significant information regarding patient characteristics and socioeconomic status that affect

discharge destination following a TKA. However, the study does have limitations. The study was limited to the experience of patients undergoing TKA in California. The data are recent but do not reflect the population of the entire country. Also, the restrictions placed on obtaining data hindered us to fully investigate the associations of all socioeconomic and race variables. Other data sets that do not have restrictions should be utilized in future studies.

Conclusions

This study provides information regarding patient characteristics that influence discharge destination following TKA. Race, age, insurance, and comorbidity were highly predictive for patients being discharged to a location other than home—either an ECF or an HHC. These findings are an important first step in beginning to understand the dynamic relationship between patient characteristics and discharge destination. This will aid in providing information that will determine placement of patients following a TKA allowing for the movement toward bundle payments and financial planning.

Declaration of Conflicting Interests

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