Original Article

Discharge to the skilled nursing facility: patient risk factors and perioperative outcomes after total knee arthroplasty

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Background: Patients receiving a total knee arthroplasty (TKA) who fail to meet inpatient criteria for outpatient physical therapy or an acute rehabilitation facility are increasingly being discharged to skilled nursing facilities (SNFs). However, in some facilities, postoperative care and therapy may be suboptimal. In order to recognize the circumstances predisposing patients to a SNF discharge and quantify perioperative risks, we used a nationwide TKA database to compare those who were and were not discharged to SNFs with respect to: (I) patient and hospital characteristics; (II) comorbidities; (III) lengths of stay (LOS); and (IV) inpatient complications.

Methods: The National Inpatient Sample database was queried for all individuals who received primary TKA (ICD-9-CM 81.54) between January 1st, 2009 and December 31st, 2013, yielding a total of 3,218,419 patients. Discharge disposition was readily identifiable, and the SNF patients numbered 403,575 (12.5%) *vs.* 2,814,574 discharged to home or a non-SNF setting (87.5%). A multi-level logistic regression analysis was conducted using patient and hospital specific factors as predictor variables in order to see if differences existed between the two cohorts. A two-tailed P value was set as the threshold for statistical significance.

Results: Patients discharged to SNFs post-TKA were older (mean, 72 *vs.* 65 years, P<0.001), more often female [odds ratio (OR) 1.74, P<0.001], black (OR 1.246, P<0.001), from the South (OR 1.856, P<0.001), and had various comorbidities including: preexisting psychoses (OR 1.703, P<0.001), history of drug abuse (OR 1.682, P<0.001), neurological disorders (OR 1.359, P<0.001), and depression (OR 1.334, P<0.001). The mean LOS for TKA patients discharged to SNFs was 17% longer (P<0.001). Patients discharged to SNFs were more likely to endure inpatient medical complications (OR 1.3, P<0.001), specifically pulmonary congestion or edema.

Conclusions: Patients discharged to SNF had specific demographic characteristics and risk factors, increased LOS, more frequent inpatient medical complications, and greater hospital costs. Knowledge of these risk factors may be critical from the perspective of the new value-based reimbursement system for orthopaedic surgeon to intervene early and appropriately select the patients likely and capable of completing the rigorous postoperative TKA rehabilitation.

Keywords: Skilled nursing facility; discharge; disposition; total knee arthroplasty (TKA)

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Introduction

The setting of physical therapy after total knee arthroplasty (TKA) varies, ranging from inpatient rehabilitation facility, skilled nursing facility (SNF), or home care (1,2). Those patients who fail to meet either the criteria for outpatient physical therapy or an inpatient rehabilitation facility are often discharged to SNFs. To date, several predictors are common to patients being discharged to acute rehabilitation facilities following TKA, namely living status, age, pre-operative systemic health and medical insurance, in addition to the functional testing outcomes, length of hospital stay, and pain management (3-5).

SNFs have historically provided both long-term residential care and short-term post-acute rehabilitation visits, but have increasingly shifted focus to cater to post-operative, post-acute rehabilitation needs (2,6,7). In a recent 2014 Medicare survey on SNF usage, 65% of residents in nursing homes were over the age of 75 years, with more than 60% with impairments of four or more activities of daily living (ADLs) (6,8). When compared to inpatient rehabilitation, patients in SNFs may not receive the continuous benefits of a dedicated postoperative rehabilitation program (7). In addition, many primary lower extremity total joint arthroplasty studies identified post-acute care as a focal point to improve outcomes and reduce cost of care (9-12). As a result, understanding the risk factors and predictors resulting in non-home discharges is important for clinicians to optimize post-operative outcomes and reduce costs (2,5,11,13).

As more patients are being discharged to SNFs, which may provide variable and unpredictable post-operative rehabilitation, it is important to understand the factors that result in this disposition status. In order to better characterize the patients predisposed to a SNF discharge post-TKA and quantify the peri-operative risks incurred, we used a nationwide TKA database to compare who were and were not discharged to SNFs with respect to: (I) patient and hospital characteristics; (II) comorbidities; (III) lengths of stay (LOS); and (IV) inpatient complications.

Methods

Patient selection

The National Inpatient Sample (NIS) database was queried for all individuals who received a primary TKA using the International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM) 81.54 between the years 2009 and 2013. The NIS database is developed and maintained through private-government partnership and is a valid representation of all non-federal in-patient hospitalizations in the United States during their respective years (14,15). Our query for primary TKA yielded 3,218,419 patients. The patient demographics and pre-operative factors that were recorded for each patient included: sex, age, race, region, hospital bed size, teaching status, and hospital control/ownership. See *Table 1* for demographics.

Table 1 Demographic summary of patients analyzed

Category	Discharged to SNF	Not discharged to SNF	P value
Total number (%)	403,575 (12.5)	2,814,574 (87.5)	
Median age in years (SD)	72.0 (9.7)	65.0 (10.1)	<0.001
Length of stay in days (SD)	3.7 (1.8)	3.1 (1.6)	<0.001
Sex			<0.001
Female (%)	291,930 (72.3)	1,720,831 (61.2)	
Male (%)	111,645 (27.7)	1,091,743 (38.8)	
Charlson-Deyo Comorbidity score (%)			<0.001
0	402,203 (99.7)	2,806,982 (99.7)	
1	1,068 (0.3)	4,948 (0.2)	
2	259 (0.1)	2,028 (0.1)	
≥3	45 (0.0)	616 (0.0)	

SNF, skilled nursing facility; SD, standard deviation.

Table 2 List of patient risk factors and perioperative complications studied

Risk factors
Alcohol abuse
Deficiency anemia
Rheumatoid arthritis/collagen vascular disease
Chronic blood loss anemia
Congestive heart failure
Chronic pulmonary disease
Coagulopathy
Depression
Diabetes without complications
Diabetes with chronic complications
Drug abuse
Hypertension
Hypothyroidism
Liver disease
Lymphoma
Fluid and electrolyte disorders
Metastatic cancer
Other neurological disorders
Obesity
Paralysis
Peripheral vascular disorders
Psychoses
Pulmonary circulation disorders
Renal failure
Solid tumor without metastasis
Peptic ulcer disease
Valvular disease
Recent weight loss
Perioperative complications
Pulmonary congestion or edema
Pulmonary edema
Superficial surgical site infection
Deeps surgical site infection
General medical complications (included)

The comorbidities and risk factors, as well as perioperative complications studied, can be found in *Table 2*. Length-of-stay for each in-patient admission was also recorded. The relevant regions for the NIS database are obtained from the AHA Annual Survey of Hospitals, with the Census region is defined by the U.S. Census Bureau, namely the Northeast, Midwest, South, and West. All noted comorbidities, including psychoses, peripheral vascular disorders, and neurological disorders were based off of the Agency for Healthcare Research and Quality (AHRQ) comorbidity classification available in NIS disease severity measures files.

Data analysis

Charlson-Deyo comorbidity score was calculated to assess patient comorbidity status. Continous and categorical variables were assessed via independent samples *t*-test and chi-square analysis respectively. Mann-Whiney U test was used for non-parametric continuous data with the median value reported. A multi-level logistic regression analysis was conducted using patient and hospital specific factors as predictor variables in order to generate odd ratios. A two-tailed P value of 0.05 was set as the threshold for statistical significance.

Results

Patient and hospital characteristics

There were statistically significant differences found between patients discharged to SNFs and patients discharged to home with respect to age, sex, Charlson-Deyo Comorbidity scores, race, hospital size, teaching setting, and hospital ownership. See *Table 3* for patient and hospital characteristics. From a demographic perspective, patients discharged to a SNF post-TKA were older (OR 1.07, P<0.001), more likely to be female (OR 1.74, P<0.001), and had a slightly lower Charlson-Deyo Comorbidity scores. Patients discharged to SNFs were more likely to be black (OR 1.246, P<0.001), from the South (OR 1.856, P<0.001), from medium- (OR 1.153, P<0.001) and large-size hospitals (OR 1.354, P<0.001), and be based in rural and community teaching settings (OR 1.083, P<0.001) that are privately owned (OR 1.196, P<0.001).

Comorbidities

Patients discharged to SNFs were more likely to have

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Table 3 Summary of patient and hospital factors predisposing to SNF discharge

Category	Odds ratio	P value	95% CI
Age (years)	1.07	<0.001	1.069 to 1.071
Length of stay	1.173	<0.001	1.168 to 1.179
Sex			
Male	Ref	–	–
Female	1.74	<0.001	1.713 to 1.767
Race			
White	Ref	–	–
Black	1.246	<0.001	1.214 to 1.279
Hispanic	0.828	<0.001	0.804 to 0.852
Asian or Pacific Islander	0.375	<0.001	0.341 to 0.412
Native American	0.305	<0.001	0.271 to 0.343
Other	1.155	<0.001	1.101 to 1.211
Region			
Northeast	Ref	–	–
Midwest	0.925	<0.001	0.782 to 0.838
South	1.856	<0.001	1.732 to 1.989
West	0.843	<0.001	0.786 to 0.905
Hospital bed size			
Small	Ref	–	–
Medium	1.153	<0.001	1.125 to 1.183
Large	1.354	<0.001	1.325 to 1.385
Teaching status			
Rural/community	Ref	–	–
Urban nonteaching	0.937	<0.001	0.919 to 0.956
Urban teaching	0.909	<0.001	0.879 to 0.930
Control/ownership of hospital			
Government/public	Ref	–	–
Private, not-for profit	0.93	<0.001	0.910 to 0.950
Private, investor-owned	1.196	<0.001	1.169 to 1.224

SNF, skilled nursing facility; CI, confidence interval.

comorbidities including: deficiency anemia (OR 1.057, P<0.001), rheumatoid arthritis/collagen vascular disease (OR 1.161, P<0.001), chronic blood loss anemia (OR 1.3, P<0.001), preexisting psychoses (OR 1.703, P<0.001), history of drug abuse (OR 1.682, P<0.001), neurological disorders (OR 1.359, P<0.001), and depression (OR 1.334, P<0.001). Patients discharged to non-SNFs were more likely to have pulmonary circulation disorders, valvular disease, and have recently lost weight. A full summary of pre-operative comorbidities and statistical significance can

be found in *Table 4*.

Length of stay

Post-operatively, our analysis found that the TKA patients discharged to SNFs had 17% longer mean LOSs (P<0.001) when compared to those who were discharged home.

Inpatient complications

There was statistically significant difference found between patients discharged to SNFs and patients discharged to their home with respect to overall inpatient medical complications related to COPD (OR 1.181, P<0.001), chronic blood loss with anemia (OR 1.3, P<0.001), and diabetes-related complications (OR 1.271, P<0.001). Notably, there was no statistically significant difference found between patients discharged to an SNF and patients discharged to their home with respect to superficial surgical site infection and deep surgical site infection. A full summary of intra-operative complications can be found in *Table 5*.

Discussion

Many primary lower extremity total joint arthroplasty studies identified post-acute care as a focal point to improve outcomes and reduce cost of care (11,12). Indeed, patient discharge disposition following TKA plays a crucial role in determining the total costs, with nearly $2 billion being spent annually on post-operative stays at rehabilitation facilities (16). In addition, when compared to inpatient rehabilitation, patients in SNFs may not receive the continuous benefits of a dedicated postoperative rehabilitation program (7). As a result, understanding the risk factors and predictors resulting in non-home discharges is important for clinicians to optimize post-operative outcomes and decrease costs (2,11,13). To date, several predictors are common to patients being discharged to acute rehabilitation facilities following TKA, namely living status, age, pre-operative systemic health and medical insurance, in addition to the functional testing outcomes, length of hospital stay, and pain management (3,4). This study demonstrated that patients discharged to SNF were more likely to be black, from the South, and from large-size hospitals in community settings. While inpatient, these patients discharged to SNF had more frequent inpatient medical complications. Knowledge of these risk factors may be critical from the perspective of the newly value-based orthopaedic surgeon to intervene early, medically optimize, and preemptively plan with case management care after TKA.

Our study has limitations, consistent with those inherent to many large administrative database studies. The NIS database in particular may not be fully reflective of all national hospital patient discharges as it captures 20% of community hospitals (14). In addition, this database captures data specific to inpatient admission to discharge and is not linked to the past or future encounters of a particular patient. As a result, it does not contain information regarding post-discharge complications and mortality, among other outcomes. However, investigators consider this database to be an appropriate representation of hospital admissions, procedures, diagnoses, and discharges in the United States.

Our findings are largely consistent with other outlined findings. Neuman *et al.* reported that patients discharged to SNFs after acute-care hospitalization, when risk-adjusted, were not statistically different in terms of performance measures, death, and readmission rates (7). Multiple studies have demonstrated that increased age, female sex, Medicare insurance, living alone, obesity, longer LOS, and persisting postoperative pain are associated with increased risk of non-home discharge after TKA (2,11). The findings that SNF patients had a greater inpatient LOS is in concordance with the report by Sibia *et al.* (17). As several studies have evaluated drivers for longer LOS in non-home discharge settings for TKA patients, none to our knowledge have evaluated factors implicated in SNF disposition for TKA at a national level. Multiple studies have focused on increased age, female sex, Medicare insurance, living alone, obesity, longer LOS, and persisting postoperative pain to be associated with increased risk of non-home discharge (2,7,17).

Other reports, including that by Keswani *et al.*, identified infection, functional status, history of smoking, diabetes, pulmonary disease, among other risk factors as independent predictors of non-home discharges (12). However, this report is the first to provide the evidence behind particular factors such as depression, deficiency anemia, rheumatoid arthritis, and neurological disorders specifically linked to TKA. Furthermore, it is the first study to specifically evaluate the likelihood of SNF discharge post-TKA specifically.

Conclusions

Our study serves to identify patient demographics and

Table 4 Risk factors associated with discharge to SNF, after adjusting for insurance, patient, and hospital demographics

Risk factors	Odds ratio	P value	95% CI
Alcohol abuse	1.056	0.205	0.971 to 1.150
Deficiency anemia	1.057	<0.001	1.037 to 1.077
Rheumatoid arthritis/collagen vascular disease	1.161	<0.001	1.122 to 1.201
Chronic blood loss anemia	1.3	<0.001	1.238 to 1.366
Congestive heart failure	1.092	<0.001	1.048 to 1.137
Chronic pulmonary disease	1.181	<0.001	1.159 to 1.204
Coagulopathy	1.066	0.006	1.019 to 1.115
Depression	1.334	<0.001	1.306 to 1.362
Diabetes without complications	1.287	<0.001	1.266 to 1.309
Diabetes with chronic complications	1.271	<0.001	1.209 to 1.337
Drug abuse	1.682	<0.001	1.504 to 1.882
Hypertension	1.028	0.001	1.011 to 1.045
Hypothyroidism	1.064	<0.001	1.044 to 1.083
Liver disease	1.073	0.084	0.991 to 1.163
Lymphoma	0.891	0.155	0.760 to 1.045
Fluid and electrolyte disorders	1.134	<0.001	1.108 to 1.161
Metastatic cancer	1.186	0.236	0.895 to 1.573
Other neurological disorders	1.359	<0.001	1.316 to 1.403
Obesity	1.049	<0.001	1.029 to 1.069
Paralysis	1.622	<0.001	1.438 to 1.829
Peripheral vascular disorders	0.994	0.81	0.949 to 1.041
Psychoses	1.703	<0.001	1.627 to 1.783
Pulmonary circulation disorders	0.929	0.023	0.872 to 0.990
Renal failure	1.164	<0.001	1.127 to 1.202
Solid tumor without metastasis	0.912	0.12	0.813 to 1.024
Peptic ulcer disease	1.949	0.004	1.235 to 3.075
Valvular disease	0.926	<0.001	0.894 to 0.960
Recent weight loss	0.832	0.005	0.732 to 0.945

SNF, skilled nursing facility; CI, confidence interval.

Table 5 Predictive model for adverse events adjusting for insurance, patient demographics, hospital demographics, and patient comorbidities

Inpatient complications	Odds ratio	P value	95% CI
Pulmonary edema/congestion	0.668	<0.001	0.572 to 0.781
Superficial surgical site infection	0.944	0.095	0.883 to 1.010
Deep surgical site infection	0.889	0.246	0.728 to 1.085

CI, confidence interval.

risk factors associated with discharge to SNFs, elucidate medical comorbidities resulting in inpatient complications, and highlight the increased LOS in order to potentially implement early case management planning. Patients discharged to SNF had common demographics and risk factors, increased LOS, more frequent inpatient medical complications, and greater hospital costs. Knowledge of these risk factors may be critical from the perspective of the newly value-based orthopaedic surgeon to intervene early and appropriately select the patient likely and capable of completing the rigorous postoperative TKA rehabilitation.

Acknowledgements

Footnote

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