ORIGINAL RESEARCH

Resource Utilization of Total Knee Arthroplasty Patients Cared for on Specialty Orthopedic Surgery Units

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BACKGROUND: The use of specialized orthopedic surgery (SOS) units in total knee arthroplasty (TKA) patients is well established. The number and costs of arthoplasty surgeries continue to increase, requiring institutions to reexamine their existing practices for financial sustainability.
OBJECTIVE: The objective of this study was to determine whether having elective TKA patients in SOS units affects resource utilization and outcomes.
DESIGN: The study was designed to retrospectively compare elective TKA patients from 1996 to 2004 admitted directly to SOS units with those admitted to nonorthopedic nursing (NON) units.
SETTING: The setting was an academic teaching hospital.
PATIENTS: Five thousand five hundred and thirty-four patients met inclusion criteria. Of these, 5082 (patients 91.8%) were admitted to SOS units and 452 (8.2%) to NON units.
MEASUREMENTS: The primary outcomes measured were length of stay (LOS) and costs, adjusted for age, sex, surgical year, comorbidities, and American Society of Anesthesiologists status. Secondary outcomes were 30-day mortality, readmissions, reoperations, and discharge disposition.
RESULTS: Mean age of the patients in SOS and NON units was 68.3 and 67.9 years, respectively ($P = .50$). Adjusted LOS was 0.234 days shorter in SOS units (95% CI: 0.083, 0.385). Adjusted total and hospital cost savings in the SOS unit group were $600 (95% CI: $122, $1079) and $594 (95% CI: $141, $1047), respectively. More NON-unit patients required unanticipated transfers to the intensive care unit (ICU) from the general postoperative nursing unit (3.1% vs. 1.63%; $P = .023$); however, the mean number of ICU days did not differ between groups. NON-unit patients were more likely to be discharged with home health care ($P < .001$). There were no differences in 30-day outcomes.
CONCLUSIONS: Patients on SOS units following elective TKA have a reduced LOS and decreased total and hospital costs. Our results should encourage hospitals to reevaluate postoperative patient flow to optimize resource utilization. ***Journal of Hospital Medicine*** **2008;3:218–227.** *© 2008 Society of Hospital Medicine.*

KEYWORDS: resource utilization, total knee arthroplasty, length of stay, hospital flow, multidisciplinary care

Hospital practices are increasingly responsible for ensuring enhanced patient safety, satisfaction, and cost containment. Recently developed models of care have achieved the necessary efficiency to attain these measures, not only in the use of hospitalists managing general medical[1,2] and postoperative orthopedic patients,[3,4] but also in the use of midlevel providers in busy primary care settings.[5] In addition, stroke units[6] and geriatric

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evaluation and management units[7,8] worldwide have demonstrated reduced disability and improved survival and importantly have been proven to provide cost-effective care. Specialized orthopedic surgery (SOS) units may be a means to reproduce the results observed in these other models.

The economic potential of SOS units will become more significant with changing demographics. The percentage of patients greater than 65 years old will increase, from 12.3% in 2002 to 20% by 2030, with a parallel increase in the prevalence of osteoarthritis (OA).[9] The World Health Organization has declared 2000-2010 the Bone and Joint Decade,[10,11] reflecting that OA affects some 43 million people, with more than 60 million projected to be affected by 2020.[12,13] The National Center for Health Statistics reported that more than 280,000 total knee arthroplasties (TKAs) are performed annually in the United States, which marks an increase in frequency in the last decade that is likely to continue.[14–19]

Approximately 75% of all TKAs are reimbursed under Medicare,[17] whereas elective TKA continues to be one of the most common surgeries in the Medicare-age patient population,[20] foreshadowing the prominent cost burden of osteoarthritis in the aging population. The concomitant decreasing reimbursement for arthroplasty in general supports an examination of what constitutes efficient, high-quality, and cost-effective care[21] for TKA. At our institution, patients undergoing TKA are preferentially triaged to an SOS nursing unit for postoperative care. As hospital bed capacity continues to decline, patients may be triaged to open beds at locations that may not be the optimal choice for nursing care. The primary purpose of this study was to determine the impact of SOS units versus nonorthopedic nursing (NON) units on resource utilization for and outcomes of patients undergoing elective knee arthroplasty. We hypothesized that length of stay would be shorter and cost of inpatient care would be lower for patients cared for on SOS units.

MATERIALS AND METHODS

Study Design and Setting

We conducted a retrospective observational cohort study of all patients undergoing elective primary TKA from January 1, 1996, to December 31, 2004, comparing outcomes of patients assigned to SOS units with those of patients assigned to NON units. Patients were admitted to Rochester Methodist Hospital, Mayo Clinic, a tertiary-care primary surgical teaching hospital that has 794 beds and more than 15,000 admissions annually. There were 13 faculty orthopedic surgeons performing elective nontraumatic lower-extremity joint procedures during the study period, each with orthopedic residents rotating as part of the patient care team.

Study Population

All patients at Mayo Clinic who had undergone a joint replacement were followed prospectively, and data were collected using standardized forms and protocols, the methodologies of which have been described previously.[22] Follow-up was greater than 95% complete. Using the joint registry, patients who had undergone a TKA were identified (n = 9798). Postoperative patients initially transferred from the postanesthesia care unit to a general care floor were included. We excluded patients who required urgent, revision, or bilateral arthroplasties; who had been treated at or transferred from another institution; and whose primary surgical indication was trauma or septic arthritis. Subjects admitted to the hospital on the day prior to the procedure and subjects initially transferred directly from the postanesthesia care unit to the intensive care unit (ICU) were excluded, including patients requiring immediate postoperative cardiac monitoring. All primary surgical interventions were performed between Monday and Friday. The study authors identified 5883 eligible patients.

Patient clinical and demographic data including surgical indication; age; sex; height and weight at surgery; and dates of admission, surgery, death, discharge, and last follow-up were abstracted from the registry. Type of anesthesia (general, regional, combined), American Society of Anesthesiologists (ASA) physical status class, and date and time of ICU admission and discharge were abstracted from individual departmental databases. The Decision Support System (DSS) administrative database (Eclipsys, Boca Raton, FL) was utilized to abstract relevant clinical variables, including major comorbid conditions such as cancer, cerebrovascular disease, chronic pulmonary disease, congestive heart failure, dementia, diabetes, hemiplegia, HIV/AIDS, metastatic solid tumors, myocardial infarction, peripheral vascular disease, renal disease, rheumatologic disease, and ulcers. A composite Charlson comorbidity score was computed as previously described.[23,24] Administrative variables regarding patient encounters including inpatient stay variables—length of stay, costs, patient location, nursing care units, admission times, discharge disposition and date—were also obtained from the DSS database.

Variables and Definitions

Length of stay was defined as the number of days from time of admission for the surgical episode to time of discharge. All costs were based on a provider perspective using standardized 2005 costs based on inflation-adjusted estimates as previously described.[3,25,26] We assessed resource utilization among patients who received care on an SOS unit by determining length of stay and total, hospital, and physician costs for the specified surgical episode. We also assessed blood bank, ICU, laboratory, pharmacy, physical therapy, occupational therapy, respiratory therapy, radiology, and room-and-board costs. Blood bank costs consisted of the costs of storing, processing, and administering the transfusion. Surgical procedure, anesthesia, and preoperative service costs were excluded from our cost analyses, as our aim was to examine hospital flow and resource utilization from time of transfer from the postanesthesia care unit to hospital discharge in order to specifically examine the impact of an SOS unit. We compared unexpected ICU admissions and stays and the resources utilized of patients in these 2 groups.

State and federal death registries confirmed patient expiration and primary cause of death. In-hospital mortality was defined as death during the same hospital admission as the indexed surgical episode. Thirty-day mortality was defined as death occurring within 30 days of the surgical procedure. Readmission at 30 days was defined as any admission to our institutions within a 30-day period whose purpose was possibly related to the initial surgical episode and not a result of an elective admission. A priori we were aware of the small number of these events in the elective joint population. Therefore, we combined inpatient 30-day mortality, 30-day reoperation, and 30-day readmission rates as a composite endpoint.

Specialized Orthopedic Surgery Units

An SOS unit was defined as a general care nursing unit where patients receive all their postoperative care after elective TKA. Such a unit has a multidisciplinary staff that has orthopedic expertise. The differences between an SOS unit and a NON unit are described in Table 1. Bed availability at the time of discharge from the postanesthesia care unit was the exclusive factor for admission to this unit. Bed availability was dependent on staff availability or whether there was an excess number of operative cases. The number and severity of patient medical comorbidities or complications, the time of discharge from the postanesthesia care unit, and patient room preference had no impact on which unit patients were admitted to. Patients were allocated to the SOS group or the NON unit group according to their physical location the evening of admission. Monitored beds at this facility are solely located in the ICU, and neither SOS nor NON units have this capability. Any patient requiring a monitored bed at any time, regardless of the reason, would be transferred directly to the ICU. Daily rounds were performed on either unit by the primary orthopedic team. The need for either medical or pain service consultation was at the discretion of the primary orthopedic team and not dependent on the patient's physical location.

All data were subsequently combined into a single database to facilitate data analysis. We further excluded 44 patients because no cost information was available, 9 patients who had multiple joint replacements performed during the specified surgical hospitalization, 69 patients because they had not authorized their medical records to be used for the purposes of research; 163 patients admitted directly to the ICU, 63 patients admitted the day prior to surgery, and 1 patient whose billing data suggested an outpatient encounter. A final patient cohort of 5534 patients was in the analysis. With the observed sample size and the overall variability, our study had 80% power to detect a difference between the 2 groups as small as 0.22 days in length of stay and $761 in hospital costs. The study was approved by our institutional review board. All study patients had authorized the use of their medical records for the purposes of research. Funding was obtained through an intramurally sponsored Small Grants Program by the Division of General Internal Medicine, which had no impact on the design of the study, reporting, or decision to submit an article on the study for publication.

Statistical Analysis

The statistical analysis compared baseline health and demographic characteristics of the patients cared for on SOS units with those cared for on NON units using chi-square tests for nominal factors and the 2-sample Wilcoxon rank sum tests for continu-

TABLE 1
Characteristics of Specialized Orthopedic Surgical Units and Nonorthopedic Nursing Units

	Specialized orthopedic surgical unit (SOS)	Nonorthopedic nursing unit (NON)
Type of unit	Orthopedic general care unit.	General surgical care unit.
Patient type	Postoperative elective orthopedic only.	Any patient—medical or surgical.
Determinants of physical location for orthopedic patient	Primary bed assignment.	Admitted only if SOS units have reached full bed capacity.
Orthopedic-trained nursing staff	Yes—required to have additional post-RN* training in orthopedics. These RNs rarely float to nonorthopedic units.	No—may have additional training or experience in an unrelated medical or surgical discipline. Floating to other units may occur.
Orthopedic-specific physical + occupational therapy	Provided by certified physical therapists trained in lower-extremity joint procedures. Site-based therapy available to all patients on SOS units.	Provided by certified physical therapists who do not necessarily have postoperative orthopedic lower-extremity specialization. Site-based therapy on NON unit available to all patients.
Licensed social workers	Dedicated to postoperative needs of orthopedic patients physically located on SOS units.	Not specifically dedicated to the postoperative elective orthopedic joint patient and not physically located on these units.
Interdisciplinary team meetings	Patient care addressed in a interdisciplinary team meeting 3 times weekly—consists of an RN, physical and occupational therapists, social worker, and physician.	No care team meetings, as patients are "off-service."
Physician postoperative order set	Orthopedic-specific order set that is available hospitalwide. Nursing staff on these units is familiar with these order sets.	Orthopedic-specific order set available hospitalwide. Nursing staff on these units may not be entirely familiar with these order sets.
Rehabilitation protocols	Orthopedic specific.	Not orthopedic specific.
Patient-care instructions	Orthopedic diagnosis-specific instructions readily available	Orthopedic diagnosis-specific instructions available but requires staff to obtain information and forms from the SOS inits.
Discharge protocol	Specifically targeted to the postarthroplasty patient	Generic hospitalwide protocol.
Hospital discharge summary	Yes—cowritten by primary orthopedic team and primary orthopedic RN.	Yes—cowritten by primary orthopedic team and nonorthopedic RN.
Orthopedic-specific discharge instructions	Yes—cowritten by primary orthopedic team and primary orthopedic RN.	No.

*RN, registered nurse.

ous variables. We used the chi-square test to test for unadjusted differences in sex, patient residence (local or referred), race, individual Charlson comorbid conditions, anesthesia type, admitting diagnosis, 30-day readmission rate, and discharge location. The 2-sample Wilcoxon rank sum test assessed unadjusted differences in length of stay, costs, age, ICU days of stay, number of reoperations, total Charlson score and ASA class. Thirty-day mortality rates were tested using the Fisher exact test.

Differences between patients in SOS and NON units in length of stay (LOS) and costs were the study's primary outcomes. We adjusted for baseline and surgical covariates using generalized linear regression models for these outcomes. The effect of the nursing unit was based on regression coefficients for age, sex, ASA class, anesthesia type, Charlson comorbidities, and surgical year. Age was analyzed using 5 categories: <55; 55-64; 70-74; 54-69, and >75 years, with 65-69 years used as the reference group. Each Charlson comorbid condition was treated as an indicator variable. Indicator variables were also assigned to surgical year, with 2004 used as the reference. These variables were subsequently entered into the model to calculate the differences between patients on an SOS unit and those on a NON unit.

Our secondary outcomes included ICU utilization and 30-day outcomes of mortality, reoperations, and readmissions. We then assessed the effect of treatment on the SOS unit using the entire cohort (n = 5534) for unplanned postoperative ICU stay (yes or no) and on our combined endpoint after adjusting for the variables listed previously, using logistic regression models. A P value < 0.05 was considered statistically significant. All analyses were performed using statistical software (SAS, version 9.1; SAS Institute Inc, Cary, NC).

RESULTS

Baseline patient characteristics are represented in Table 2. Five thousand and eighty-two patients were admitted to an SOS unit, and 452 patients were admitted to a NON unit. The annual number of patients undergoing TKA increased during our study period, as did the number of patients cared

TABLE 2
Baseline Characteristics of Patients Undergoing Unilateral Primary Total Knee Arthroplasty (n = 5534)

	Specialized orthopedic surgery unit (n = 5082)		Nonorthopedic nursing unit (n = 452)		
	n	**%**	**n**	**%**	***P* value**
Age (years)					
<55	534	10.5%	57	12.6%	
55-64	1148	22.6%	101	22.4%	
65-69	802	15.8%	66	14.6%	
70-74	1106	21.8%	91	20.1%	
>75	1492	29.4%	137	30.3%	
Mean age (± SD*)	68.3 ± 10.75		67.9 ± 11.5		.50
Sex					.70
Male	2173	42.8%	189	41.8%	
Female	2909	57.2%	263	58.2%	
Race					.28
White	4731	93.1%	420	92.9%	
Other*	51	1.0%	8	1.8%	
Unknown[†]	300	5.9%	24		5.3%
Local Olmsted County patients	772	15.2%	58	12.8%	.18
Indication for surgery					.03
Osteoarthritis	4778	94%	430	95.1%	
Rheumatologic disease	184	3.6%	6	1.3%	
Avascular necrosis	62	1.2%	5	1.1%	
Congenital	6	0.1%	1	0.2%	
Cancer	22	0.4%	5	1.1%	
Other	30	0.6%	5	1.1%	
Year of surgery					< .001
1996	497	98.8%	6	1.19%	
1997	571	99.7%	2	0.35%	
1998	479	98.8%	6	1.24%	
1999	487	94.8%	27	5.25%	
2000	458	92.7%	36	7.29%	
2001	502	86.7%	77	13.3%	
2002	593	89.2%	72	10.8%	
2003	639	87.1%	95	12.9%	
2004	856	86.7%	131	13.3%	
Charlson score (mean ± SD)	0.256 ± 0.536		0.288 ± 0.593		.23
AIDS[§]	0	0%	1	0.22%	1.00
Cancer	85	1.68%	7	1.55%	.84
Cerebrovascular disease	32	0.63%	0	0%	.09
Chronic pulmonary disease	28	5.63%	23	5.09%	.63
Congestive heart failure	89	1.75%	22	4.87%	< .001
Dementia	10	0.2%	2	0.44%	.28
Diabetes	603	11.9%	58	12.8%	.54
Hemiplegia	9	0.18%	0	0%	.37
Metastatic solid tumor	11	0.22%	2	0.44%	.34
Myocardial infarction	29	0.57%	4	0.88%	.4
Peripheral vascular disease	67	1.32%	4	0.88%	.43
Renal disease	52	1.02%	5	1.11%	.87
Rheumatologic disease	12	0.24%	2	0.44%	.40
Ulcers	15	0.3%	0	0%	.25
ASA class [|]					
I	99	2.0%	12	2.7%	
II	2891	56.9%	255	56.4%	
III	2084	41.0%	183	40.5%	
IV	8	0.2%	2	0.4%	
Average ASA class (± SD)	2.39 ± 0.53		2.39 ± 0.55		.80
Anesthesia type					.02
General	1644	32.4%	143	31.6%	
Regional	2742	54%	226	50%	
Combined	696	13.7%	83	18.4%	

All numbers are expressed as number of patients followed by percentage of patients, unless otherwise indicated.
*Includes African American, Native American, and Asian.
[†]Includes patients who were unable to provide or refused to disclose this information.
[‡]SD, standard deviation; [§]AIDS, acquired immunodeficiency syndrome; [|] ASA, American Society of Anesthesiologists.

TABLE 3
Unadjusted and Adjusted Differences in Costs between Specialty Orthopedic Surgery Units and Nonorthopedic Surgery Units

	Unadjusted values					Adjusted values			
	SOS*	SD†	NON‡	SD†	*P* value	Difference	SD†	*P* value	95% CI‡‡
Total cost	$9989	$5392	$10,067	$5075	.77	$600	$244	.01	$122, $1079
Hospital costs	$9789	$5123	$ 9805	$4647	.23	$594	$231	.01	$141, $1047
Room & board	$4399	$1825	$ 4577	$1579	.04	$244	$ 87	.005	$ 72, $ 415
ICU§ costs	$ 58	$1094	$ 107	$ 682	.35	−$ 11	$ 51	.82	−$111, $ 88
Pharmacy	$ 851	$1701	$ 931	$1823	.34	$ 87	$ 85	.30	−$ 79, $253
Laboratory costs	$ 386	$ 438	$ 395	$ 405	.65	$ 27	$ 20	.18	−$ 12, $ 65
Radiology costs	$ 98	$ 205	$ 103	$ 183	.61	$ 1	$ 10	.93	−$ 20, $ 19
PT¶/OT**/RT††	$ 739	$ 505	$ 682	$ 394	.004	$ 15	$ 19	.45	−$ 23, $ 52
Blood bank	$ 159	$ 306	$ 178	$3023	.22	−$ 6	$ 15	.69	−$ 35, $ 23
Physician costs	$ 207	$ 464	$ 258	$ 628	.09	$ 20	$ 22	.386	−$ 24, $ 63
E&M costs∥	$ 89	$ 211	$ 109	$ 238	.09	−$ 4	$ 9	.658	−$ 23, $ 14
Physician radiology	$ 63	$ 158	$ 38	$ 192	.49	$ 2	$ 8	.78	−$ 13, $ 18
Other costs	$ 34	$ 138	$ 37	$ 160	.61	−$0.64	$ 6	.92	−$ 13, $ 12

All cost data are represented as mean costs, representing costs from the time of discharge from the postanesthesia care unit to the time of hospital discharge. Adjusted data represent differences between the specialized orthopedic surgery unit (SOS) and the nonorthopedic nursing (NON) unit, after adjustment for age, sex, anesthesia, ASA class, and Charlson comorbidity. A positive adjusted dollar amount represents a cost "savings" relative to the NON unit. All values were rounded to the nearest dollar. *P* value < .05 is statistically significant.

*SOS, specialty orthopedic surgery unit; ‡NON, nonorthopedic nursing unit; †SD, standard deviation; §ICU, intensive care unit; ∥E&M costs, evaluation and management; ¶PT, physical therapy; **OT, occupational therapy; ††RT, respiratory therapy; ‡‡CI, confidence interval.

for on NON units. There were no differences between groups in the number of local county patients or in the number of patients primarily referred by other providers for elective arthroplasty. Mean length of stay was 4.9 days in both groups. After adjusting for the specified covariates, including age, sex, year of surgery, Charlson comorbidities, ASA class, and type of anesthesia, LOS was 0.234 days shorter in the SOS group (95% confidence interval [CI]: 0.08, 0.39; $P = .002$). Overall and hospital costs were significantly lower in the SOS group, as outlined with the other costs in Table 3. Room-and-board costs were 5.3% lower for SOS patients than for patients on NON units, representing a per-patient difference of $244 ± $87 (95% CI: $72, $415; $P = .005$).

There were 83 patients (1.63%) transferred from SOS units to the ICU, compared with 14 patients (3.1%) transferred from NON units ($P = .02$), but no differences in the mean number of ICU days or associated costs between groups. A priori, the authors were aware of the small number of postoperative medical events in this population. In examining the combined endpoint of reoperations, readmissions, and mortality, there were no differences observed in our regression analysis between SOS patients and NON unit patients (−0.03 events, standard error: 0.1859; odds ratio: 0.976). Table 4 demonstrates a higher percentage of patients discharged with home health on the NON units than on the SOS units (8.41% vs. 4.62%; $P < .001$).

TABLE 4
Patient Disposition at Time of Discharge

	Specialized orthopedic surgery unit		Nonorthopedic nursing unit		
	n*	%	n	%	*P* value
Home	3812	75%	328	72.6%	.252
Home health	235	4.62%	38	8.41%	< .001
Transferred to skilled nursing facility	1030	20.3%	86	19%	.529

*There were 5 in-hospital deaths in the specialized orthopedic surgery unit group.

DISCUSSION

To the best of our knowledge, this is the first study to examine the impact of specialized orthopedic surgery units on resource utilization in elective knee arthroplasty patients. Our findings demonstrate that patients admitted following elective TKA to SOS units will have a reduced length of stay, lower overall and hospital costs, and fewer unexpected transfers to higher levels of care (ICUs). We believe that these findings are a result in part of the specialized expertise allied health care providers develop by taking care of and focusing on a large volume of patients over time with the same group and type of surgeons. This multidisciplinary setting in which care providers are familiar not only with each other but with this specific population of patients creates the environment necessary for adherence to specialized clinical pathways.[27]

Patient LOS is an important determinant of resource utilization. In a study by Husted et al., the mean length of stay in Danish hospitals following TKA was 8.6 days in 2003.[28] An epidemiological study using the Nationwide Inpatient Sample database of patients in the United States showed that from 1998 to 2000, the mean LOS was 4.3 days.[18] In our study, the mean LOS was slightly higher (4.9 days), potentially reflecting referral bias. Achieving additional savings and improved outcomes by further reducing LOS in an environment in which care pathways are already in place is often difficult; hence, alternative approaches and strategies are often necessary.[29,30] Our results suggest that in TKA patients, after adjusting for other factors, there is a decrease in the length of stay of 0.234 days among those cared for on SOS units. However, we cannot state that the existence of the clinical pathway alone is responsible for our data differences because certain components of the care pathway for elective TKA patients are used throughout the hospital regardless of type of postoperative nursing unit. We believe that the interdisciplinary specialty care provided to orthopedic patients on SOS units is a critical component of a successfully implemented care pathway and not just a convenience or practice preference. The same surgeons admitting patients to the same nursing unit, with the same nurses, physical therapists and pharmacists providing care to the same type of patient population over time, leverages the collective experience of all care providers. This integrated, multidisciplinary teamwork may optimize timeliness, achieve incremental cost savings, and improve safety (including a decreased number of unanticipated transfers to an ICU setting).

Clinical pathways are known to reduce overall costs, normally by reducing LOS,[29,31–33] and our results suggest approximately an incremental 6% cost reduction with the use of improving patient logistics by using SOS units. An economic evaluation study by Healy et al. suggests that focusing on nursing units may be a means of reducing total costs.[29] Our cost savings were slightly lower than the reported savings by other practice assessments; however, we excluded operative and anesthesia costs, both significant contributors to overall and hospital costs. By eliminating these variables, our costs were specifically limited to the postoperative course, which is highly dependent on specialized interdisciplinary care.[29]

Providing specialized care has a significant impact on society. Although there is a per-patient savings of only $600 when elective TKA patients are cared for on SOS units, this could be the difference between a positive and negative margin in the setting of fixed reimbursement. With a current average of 90 patients annually triaged postoperatively to NON units, there is a potential loss of $54,000 annually at our institution in just this single patient population with the current mechanisms of perioperative hospital flow. Multiply this potential savings to a national level, and the total is significant. With an aging population, the number of arthroplasties and concomitantly the number of hospitalizations in general are likely to increase, suggesting that changes in hospital flow are required to ensure optimal, cost-effective care in the best setting available for patients. Such care is often related to surgical volume, and our institution observes such volume. Our results indicate that SOS units are one possible means of achieving this objective of fiscal sustainability, but further studies are needed to determine the indirect and hidden costs of sustaining such units in order to observe the actual cost savings.[34] It could be argued that for elective TKA patients to have the most optimal outcomes and most efficient care, the surgical procedure should be performed only if beds are available on the nursing units whose staff has the most specific training.

Thirty-Day Outcomes

We elected to combine 30-day mortality, reoperations, and readmissions pertaining to the joint procedure as a composite endpoint and found no differences in outcomes between groups. These results suggest that these longer-term patient-specific outcomes are likely not related to the specialty nursing care. We used a 30-day endpoint assuming that a longer period may have led to the inclusion of deaths that were not directly attributable to the surgical intervention. In addition, a previous study advocated using 30 days as an endpoint for follow-up, as it adequately accounts for adverse events.[35] Our institution is also a referral center; hence, we would likely be unable to capture all events if we were to use the standard 90-day period used for payment for this procedure, as these data are not canvassed by the joint registry.

Discharge Disposition

NON unit patients tended to have a higher degree of home health arranged at discharge. The NON unit nursing staff cares for other nonorthopedic surgical patients daily and may transfer their patterns of care utilization to the orthopedic patients despite different postoperative needs. In addition, if NON unit nursing staff members care for TKA patients only intermittently, they may not have as clear a working understanding of the particular postoperative requirements of TKA patients and consequently request unnecessary home health services and general community resources. Alternatively, patients cared for on NON units may actually have needed more assistance and more services on discharge. Although purely speculative, patients cared for by dedicated orthopedic surgery staff may develop added confidence from the experience of the allied care staff and feel less of a need for postdismissal services.

Role of Hospitalists in Specialized Care Pathways

Hospitalists are known to improve efficiency without reducing patient satisfaction. Their role has been demonstrated in different patient populations.[1,2,36–38] In a study of hip fracture patients, a hospitalist care model demonstrated a reduction in length of stay and time to surgery, without compromising long-term outcomes.[4,39] Utilizing a hospitalist/midlevel care provider team approach to reduce LOS in units with a static number of beds can possibly increase bed turnover and prevent triaging of patients onto NON units. This is but one example of how a medical-surgical partnership can improve outcomes. However, in an era where cost-effective and regulatory practices require optimal resource allocation, hospitalists are in a key position to foster quality improvement projects, promote patient safety measures, and enhance systems care delivery. Becoming involved in designing specialized clinical units, with an emphasis on a multidisciplinary care approach, and developing their relationships with hospital administrators and nursing staff should be among their priorities. The Society of Hospital Medicine has also been committed to the care of the elderly through its core competencies[40] and the orthopedic population that will benefit from such process changes and care pathways. Hospital innovations such as the implementation of SOS-type units not only for other medical-surgical partnerships but also for site-based units caring for geriatric patients can be top priorities for hospitalists.

Strengths and Applicability

Our results are important in that they can likely be applied to both large tertiary-care centers and smaller community-based centers that perform specialized orthopedic surgeries. Nurses on specialized orthopedic units are very familiar with this postoperative population and have developed expertise in the care of these patients. These experienced nurses can likely be found on orthopedic units in tertiary-care centers or surgical units in smaller facilities. Furthermore, our results support the benefits of interdisciplinary advanced teamwork. When an interdisciplinary group of health care providers works together on a daily basis, certain habits and patterns inevitably develop that often are unplanned and may be difficult to measure. This enhanced patient flow may not occur if these patients are cared for by providers unfamiliar with each other's work patterns. The importance of optimized teamwork is not hospital-size dependent. Only primary elective knee arthroplasties were included to minimize confounding bias by bilateral or revision surgeries or indications such as septic arthritis, which are known to lead to increased length of stay, costs and complications.[41]

Limitations

Our study has the limitations of its retrospective nonrandomized study design, and only a prospective, randomized investigation could definitively address our aims. By excluding sicker patients, such as those referred with complicated health issues or high-risk patients who required admission in advance of the proposed surgery for monitoring of perioperative anticoagulation issues, our estimates of possible differences between our comparison groups may have been conservative. We are unaware of how these sicker patients would fare on either nursing unit. Furthermore, what occurs in the hospital setting may not only have an impact on the hospital stay but may also influence long-term outcomes. This is impossible to assess with analysis of administrative databases.

We relied on the complete and accurate recording of data from various databases, depending on the validity of data entry and collection. With a large cohort of patients, any errors in documentation or abstraction would be expected to be similar in both groups. Furthermore, confounding variables such as patient comorbidities are extracted from administrative data sets whose personnel might not be as familiar with the medical aspects of patient care. We used linear and logistic regression analyses to account for known differences in baseline characteristics despite the sample sizes being proportionally larger in the SOS group. Although we attribute the shortened length of stay in the SOS group to the interdisciplinary team approach, we were unable to determine to what extent this was a result of nursing staff or discharge planning. By using administrative databases, we were unable to abstract the consensus time and date of discharge, when all hospital staff deemed the patient ready for discharge, and hence relied on the actual time of discharge, which can be heavily reliant on availability at skilled nursing facilities. In addition, it was unknown whether patients discharged from SOS units were, by matter of protocol, discharged earlier in the day. Nevertheless, this small difference in length of stay can improve patient flow by opening up postoperative patient beds. Furthermore, such data sets are unable to provide information on patient satisfaction or quality-of-life measures, both of which are important determinants in specialized care pathways.[42] The patient population served by our institution is generally ethnically homogeneous, thereby limiting potential generalizations to tertiary-care centers or geographical areas with a population similar to ours. Our study also was not intended as a formal cost-effectiveness analysis; hence, the impact of possible startup costs to begin a similar nursing unit was not explored. Although differences in practice management can be considered a limitation of not only operative but also perioperative care, we neither expected nor encountered any significant or drastic alterations during the study period, and year of surgery was adjusted for in our analysis. However, prospective randomized controlled studies testing specific clinical pathways and practice-related innovations are needed to better examine these outcomes.

CONCLUSIONS

In conclusion, postoperative patients after elective knee arthroplasty cared for on specialized orthopedic surgery units have shorter length of stays and cost hospitals less than patients admitted to nonspecialized orthopedic nursing units. In an era in which quality indicators and external reviews are forcing practitioners and health care organizations to become increasingly responsible for their own practices, more research is required to better address specific questions pertaining to different processes of care. Our study is meant to increase the attention paid to patient flow and postoperative logistics in the elective TKA population. SOS units, as a unique model of care, may become an additional step toward ensuring quality care and improved resource utilization.

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