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Overlapping Surgery Increases Operating Room Efficiency Without Adversely Affecting Outcomes in Total Hip and Knee Arthroplasty

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ABSTRACT

Background: Several recent studies have demonstrated that overlapping surgeries in total hip (THA) and knee (TKA) arthroplasty do not increase the rates of complications, but whether this practice is cost-effective has yet to be addressed in the literature. The purpose of this study is to determine the effect of overlapping surgery on procedural costs and surgical productivity during THA and TKA.
Methods: We identified all patients undergoing primary THA or TKA from 2015 to 2018 by 18 surgeons at a single orthopedic specialty hospital. Procedural and personnel costs were calculated for each case using a time-driven activity-based costing algorithm. Overlap of surgical time by at least 30 minutes was used to define an overlapping procedure. We compared costs and outcomes between overlapping and nonoverlapping procedures, standardizing all costs to 8-hour time blocks. A multivariate regression analysis was performed to determine independent effect of overlapping procedures on costs and outcomes.
Results: Of the 4786 consecutive procedures, 968 (20.2%) overlapped by at least 30 minutes. Although overlapping rooms increased mean operative time by 8.3 minutes ($P < .0001$) and operating room personnel costs by $80 per case (<.0001), overlapping surgeons could perform significantly more procedures per 8 hours (7.6 vs 6.4; $P < .0001$), increasing total 8-hour profit margin by $1215 per procedure. There was no difference in 90-day readmission rate, length of stay, or rates of discharge home between the groups.
Conclusion: Overlapping noncritical portions of procedures in primary THA and TKA appear to be both a safe practice and an effective strategy.

Controversy regarding the practice of overlapping surgery was first publically recognized following a Boston Globe report titled “Clash in the Name of Care,” which identified a lawsuit where a patient who developed paralysis following spinal surgery was not aware that his surgeon had 2 operating rooms (ORs) running [1]. This article generated national attention, prompting a response from the American College of Surgeons (ACS), as well as senate inquiry. The ACS responded with a written statement defining the acceptable practice of overlapping surgeries. Within this statement, the ACS advised that concurrent operations where “key” or “critical” components of an operation are occurring in 2 separate rooms are inappropriate; however, the surgeon can define the critical or key portion of each procedure [2].

As a means to address the public outcry about the practice of overlapping surgery and the lack of literature on the subject, multiple groups published data reviewing their experiences. Two large single-institution retrospective studies evaluated total hip arthroplasty (THA) and total knee arthroplasty (TKA) performed in an overlapping or nonoverlapping manner. The results indicated that overlapping surgery did not result in increased intraoperative complications, medical complications, readmission rates, return to the OR, radiographic alignment, need for revision, or mortality [3,4]. Additionally, the results suggested that running 2 ORs does not increase the cost of care for each patient [5]. These findings have been corroborated in the ambulatory orthopedic surgery setting, as well as in the otolaryngology and neurosurgery literature [5–9]. Many of the studies highlighting the safety of overlapping surgery focus on the potential negative consequences and do not attempt to identify the positive aspects of overlapping surgery [10].

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According to the Massachusetts General Hospital website, overlapping surgery provides numerous benefits, such as the ability to optimize OR time, provide access to more patients, perform more emergency cases, and expand opportunities for the education of residents and fellows [11]. Additionally, overlapping surgery has the potential to be cost-effective. The aim of this study is to determine the effect overlapping surgery has on procedural costs and surgical productivity during THA and TKA at a single institution. We first sought to determine whether overlapping cases affect procedural costs. Second, we asked whether overlapping cases improve productivity by allowing surgeons to increase their operative volume. Lastly, we analyzed the effect of overlapping cases on risk of adverse outcomes. We hypothesized that overlapping surgery would produce equivalent outcomes while increasing total facility reimbursement.

Materials and Methods

We retrospectively reviewed a consecutive series of patients who underwent unilateral, elective primary THA or TKA from January 2015 to January 2019 at a single orthopedic specialty hospital. The specialty hospital is a joint financial partnership between our physician practice and our health system partners. Surgical team members vary, but potentially include the attending surgeon, clinical fellows, orthopedic residents, and registered nurse first assistants. This study was approved by and conducted according to regulations set forth by our Institutional Review Board. No external source of funding was provided to conduct this study. All procedures were performed by 1 of 18 fellowship-trained orthopedic surgeons. Medical records were reviewed to collect patient demographics, including age, gender, and body mass index as well as medical comorbidities, including congestive heart failure, chronic obstructive pulmonary disease, cerebrovascular disease, dementia, diabetes mellitus, cancer, myocardial infarction, chronic liver disease, peripheral vascular disease, chronic kidney disease, and connective tissue disease. Operative details collected included the type of surgery, anesthesia type, and case duration from start of incision to close. Length of hospital stay and discharge disposition were also collected. Our practice has implemented a nurse navigator program, who prospectively track and record readmissions for patients during their 90-day episode of care. This database was cross-referenced with our cohort to determine which patients were readmitted. Our third-party vendor (Avant-garde Health, Boston, MA) calculated and provided inpatient procedural costs, which were categorized into supply costs (implant cost, medication cost, all other supplies cost) and personnel costs. This was further subdivided into 2 groups: preoperative through OR personnel costs and postanesthesia care unit (PACU) through discharge personnel costs. Costs were estimated using a time-driven activity-based costing algorithm, which uses the time spent with the patient and personnel salary to determine the cost of each personnel in providing care to the patient as well as the cost of disposable supplies used at or near the patient bedside [12]. This method of accounting has demonstrated superiority in accurately estimating costs of total joint arthroplasty in several recent studies [13–15]. Additionally, we reviewed the Centers for Medicare and Medicaid Services claims data to determine the mean inpatient facility cost for this hospital for each year included in the study. Total procedural costs were subtracted from inpatient facility claims cost to estimate profit margin for each case.

Overlapping cases were defined as those which overlapped with either the prior or subsequent case performed by the same surgeon by 30 or more minutes. This time was chosen in order to ensure that the overlapping time frame was clinically relevant and did not simply involve wound closure and completion of anesthesia. We compared patient demographics, comorbidities, case duration, costs, and short-term outcomes between overlapping and nonoverlapping cases. To analyze productivity, total costs and number of cases for each surgeon's operative day were standardized to an 8-hour time block. We then compared the number of cases performed and total costs between surgical days when the surgeon overlapped cases and days when cases were not overlapped.

Statistical Analysis

Continuous variables were reported as means with standard deviations and compared between patient groups using a Mann-Whitney *U* test as they were not parametrically distributed. Categorical variables were reported as incidence with percentages and compared using either a chi-square analysis or Fisher exact test in cases where the observed or expected incidence was 5 or less. Stepwise, multivariate linear regression analysis was performed to identify the independent effect of overlapping cases on costs and outcomes per case and per 8-hour time block. Sensitivity analysis was performed by redefining overlap as a time frame of 45 minutes or more and repeating all analyses. Statistical significance was set at $P < .05$.

Results

A total of 4786 operative cases were included in our analysis, of which 2995 (62.5%) overlapped with either the preceding or subsequent case. Only 968 (20.2%) of these cases overlapped by 30 minutes or more and were classified as overlapping cases. Between overlapping and nonoverlapping cases, statistical differences in patient characteristics were only observed for diabetes mellitus (7.8% vs 5.9%; $P = .0437$; Table 1). A greater proportion of THA procedures were observed in the overlapping cohort than in the nonoverlapping cohort (55.7% vs 65.8%; $P < .0001$).

Overlapping cases were longer (66 vs 74 minutes; $P < .0001$) and had greater OR personnel costs ($1123 vs $1,196; $P < .0001$), greater total costs ($6682 vs $6,998; $P = .0004$), and lower estimated profit per case ($4827 vs $4,521; $P = .0005$; Table 2). Multivariate analysis revealed that overlapping cases increased operative time by 8.3 minutes ($P < .0001$), OR personnel cost by $80 ($P < .0001$), and

Table 1
Comparison of Patient Characteristics.

Variable	Nonoverlapping Case (N = 3818)		Overlapping Case (N = 968)		*P* Value
Patient age	63.10	9.91	61.49	9.96	.2791
BMI	29.96	5.06	30.02	5.01	.2886
CCI	0.30	0.61	0.28	0.61	.2652
Gender					.0739
Male	1700	44.5	462	47.7	
Female	2118	55.5	506	52.3	
Joint					<.0001
TKA	1691	44.3	331	34.2	
THA	2127	55.7	637	65.8	
Congestive heart failure	16	0.4	2	0.2	.3112
Chronic pulmonary disease	329	9.2	93	9.9	.5025
Cerebrovascular disease	29	0.8	4	0.4	.2833
Dementia	10	0.3	2	0.2	1.0000
Diabetes mellitus	279	7.8	55	5.9	**.0437**
Cancer	60	1.7	13	1.4	.5285
Myocardial infarction	42	1.2	13	1.4	.5990
Chronic liver disease	76	2.1	16	1.7	.4187
Peripheral vascular disease	33	0.9	8	0.9	.8411
Chronic kidney disease	38	1.1	6	0.6	.2408
Connective tissue disease	121	3.4	33	3.5	.8393

BMI, body mass index; CCI, Charlson comorbidity index; TKA, total knee arthroplasty; THA, total hip arthroplasty.
Bold indicates $P < .05$.

Table 2
Comparison of Costs and Outcomes.

Overlap by 30 min or More	Nonoverlapping Case (N = 3818)		Overlapping Case (N = 968)		P Value
	Mean	SD	Mean	SD	
Case duration (min)	66.13	17.06	73.75	20.26	**<.0001**
Length of stay (d)	1.14	0.42	1.15	0.41	.8253
Total OR personnel cost	1123.19	204.65	1196.11	238.23	**<.0001**
Total cost	6681.52	732.09	6997.56	966.39	**.0004**
Reimbursement	11,508.47	182.38	11,518.25	181.88	.5299
Estimated profit	4826.94	754.49	4520.69	976.63	**.0005**
Discharge disposition					.9641
Home	3740	99.3	953	99.3	
Facility	28	0.7	7	0.7	
Readmissions	71	1.9	27	2.9	.0814

SD, standard deviation; OR, operating room.
Bold indicates $P < .05$.

total costs by $332 ($P < .0001$), while reducing estimated profit by $325 ($P < .0001$) per case (Table 3).

In comparing operative days, 348 (33.1%) days were categorized as overlapping while 704 operative days were nonoverlapping (Table 4). Per 8-hour time block, surgeons who overlapped cases were able to perform a greater number of cases (6.4 vs 7.6; $P < .0001$). This resulted in greater OR personnel costs ($7167 vs $8,624; $P < .001$), total procedural costs ($42,449 vs $52,021; $P < .0001$), and inpatient facility claims costs ($73,471 vs $87,218; $P < .0001$). However, overlapping days resulted in an increased estimated total profit as compared to nonoverlapping days ($35,196 vs $31,022; $P < .0001$). Multivariate analysis determined that with each overlapping case, the total number of cases a surgeon could perform in an 8-hour block increased by 0.3 cases ($P < .0001$). While each overlapping case increased OR personnel costs by $393 ($P < .0001$) and total costs by $2419 ($P < .0001$), total inpatient facility claims increased by $3635 ($P < .0001$). This resulted in a total estimated profit of $1215 for each overlapping case per 8 hours ($P < .0001$; Table 5).

No differences were observed in hospital length of stay (LOS; 1.1 vs 1.2 days; $P = .8253$), discharge to rehabilitation facility (0.7% vs 0.7%; $P = .9641$), or 90-day readmissions (1.9% vs 2.9%; $P = .0814$; Table 2). Multivariate analysis showed overlapping to have no significant effect on rate of discharge to facility (odds ratio = 1.3; 95% confidence interval, 0.5-3.0; $P = .5837$) or 90-day readmissions (odds ratio = 1.4; 95% confidence interval, 0.9-2.3; $P = .1822$; Table 6). We also report the results of overlapping THA and TKA separately (Table Appendix 1 and Appendix 2).

Discussion

Although the practice of overlapping surgery has been commonplace for many years, new scrutiny has led to investigation into its safety and utility. Following the 2015 Boston Globe article highlighting the potential harm of overlapping surgery, multiple authors have presented data challenging this notion. The practice has consistently demonstrated equivalent medical and surgical complication rates, hospital LOS, risk of readmission, and mortality rates as compared to nonoverlapping surgery, both in the orthopedic and in the nonorthopedic literature [3,4,6,7,9,16–19]. However, there is a paucity of literature evaluating the cost-effectiveness and differences in surgical productivity with overlapping surgery, specifically in the setting of THA and TKA. As the demand for THA and TKA continues to increase [20], it is paramount to improve surgeon efficiency with the aim of improving patient access to care. Murphy et al [16] recently published a retrospective analysis of all primary TKAs performed at their institution over a 3-year period. They noted that overlapping surgery increased surgical productivity by 1.25 cases per day while not affecting postsurgical costs. Our study established a similar increase in surgeon productivity of 1.2 cases per day. Moreover, we believe our data is the first to demonstrate that overlapping surgery increases surgeon caseload while simultaneously increasing total facility claims and estimated institutional profits.

We defined overlapping surgery as those cases in which there was greater than 30 minutes of overlapping surgical time. In order to abide by the ACS "Statement on Principles," this means no "critical or key components of the procedures for which the primary attending surgeon [was] responsible [were] occurring all or in part at the same time." As there is no clear definition of "critical" or "key" components of the procedure in the literature or from the Centers for Medicare and Medicaid Services, our institution leaves these definitions to the discretion of the attending surgeon. However, this consistently includes bony cuts, component implantation, cementation, and soft tissue balancing. Many of the surgical tasks that do not require the level of expertise of the attending surgeon, such as surgical exposure and wound closure, are the aspects of the procedure not deemed "critical." Because our institution relies heavily on resident and fellow participation in the surgical care of patients, it can be assumed that the medical trainees were involved in the

Table 3
Stepwise, Multivariate Linear Regression Analyses of Operative Case Metrics.

Independent Variables	Coefficient	95% Confidence Interval	P Value
Case duration			
Age	−0.1742	−0.23 to −0.12	**<.0001**
BMI	0.7320	0.62 to 0.84	**<.0001**
Dementia	15.5243	5.49 to 25.56	**.0024**
Joint (TKA vs THA)	8.5923	7.46 to 9.72	**<.0001**
Rheumatic	4.4929	1.49 to 7.5	**.0034**
Case overlap	8.2933	6.99 to 9.59	**<.0001**
OR personnel cost			
Age	−1.9937	−2.66 to −1.33	**<.0001**
BMI	9.0329	7.75 to 10.32	**<.0001**
Dementia	171.2210	50.96 to 291.49	**.0053**
Joint (TKA vs THA)	94.8796	81.35 to 108.41	**<.0001**
Rheumatic	52.0728	16.07 to 88.07	**.0046**
Case overlap	80.4591	64.86 to 96.06	**<.0001**
Total cost			
BMI	11.2416	6.67 to 15.82	**<.0001**
CCI	46.7951	9.04 to 84.55	**.0152**
Dementia	601.9370	163.41 to 1040.47	**.0072**
Male gender	−193.4466	−239.74 to −147.15	**<.0001**
Case overlap	332.0859	275.56 to 388.61	**<.0001**
Estimated profit			
BMI	−11.3051	−15.98 to −6.63	**<.0001**
Dementia	−520.3843	−968.24 to −72.53	**.0228**
Male gender	197.9794	150.49 to 245.46	**<.0001**
CKD	−275.1224	−530.8 to −19.44	**.0350**
Case overlap	−325.6335	−383.62 to −267.65	**<.0001**

BMI, body mass index; TKA, total knee arthroplasty; THA, total hip arthroplasty; OR, operating room; CCI, Charlson comorbidity index; CKD, chronic kidney disease.
Bold indicates $P < .05$.

Table 4
Comparison of 8-Hour Surgical Days.

Surgical Day	Nonoverlapping Surgical Day (N = 704)		Overlapping Surgical Day (N = 348)		P Value
	Mean	SD	Mean	SD	
Number of cases per 8 h	6.39	1.89	7.57	1.90	**<.0001**
8-h OR personnel cost	7166.55	1525.73	8623.63	1449.15	**<.0001**
8-h Total cost	42,449.09	11,739.69	52,021.54	11,773.58	**<.0001**
8-h Total reimbursement	73,470.66	21,757.54	87,217.71	21,968.15	**<.0001**
8-h Profit	31,021.58	10,856.54	35,196.17	11,266.11	**<.0001**

SD, standard deviation; OR, operating room.
Bold indicates $P < .05$.

Table 5
Stepwise, Multivariate Linear Regression Analyses of Surgical Day Metrics.

Independent Variable	Coefficient ($)	Standard Error	*P* Value
Cases per 8 h			
Average patient age	0.05333	0.03 to 0.07	**<.0001**
Average patient BMI	−0.04495	−0.08 to −0.01	**.0220**
TKA:THA ratio	−1.2440	−1.62 to −0.87	**<.0001**
No. of overlapping cases	0.3153	0.27 to 0.36	**<.0001**
8-h OR personnel cost			
Average patient age	28.7812	14.87 to 42.69	**.0001**
General:regional anesthesia ratio	−1284.7961	−2546.35 to −23.24	**.0462**
No. of overlapping cases	392.5389	354.28 to 430.8	**<.0001**
8-h Total cost			
Average patient age	332.8392	219.31 to 446.37	**<.0001**
General:regional anesthesia ratio	−8550.4414	−18307.52 to 1206.64	.0862
Average patient BMI	−204.8531	−439.72 to 30.02	.0877
TKA:THA ratio	−8776.4163	−11078.83 to −6474.01	**<.0001**
Male:female ratio	−2593.0588	−5036.9 to −149.22	**.0378**
No. of overlapping cases	2419.4131	2120.69 to 2718.13	**<.0001**
8-h Reimbursement			
Average patient age	615.7445	402.17 to 829.31	**<.0001**
General:regional anesthesia ratio	−15569.3282	−34015.5 to 2876.84	.0984
Average patient BMI	−509.5603	−953.57 to −65.55	**.0247**
TKA:THA ratio	−14189.1818	−18541.99 to −9836.37	**<.0001**
No. of overlapping cases	3634.6785	3069.93 to 4199.43	**<.0001**
8-h Profit			
Average patient age	265.5916	155.47 to 375.71	**<.0001**
Average patient BMI	−306.9331	−536.34 to −77.53	**.0089**
TKA:THA ratio	−5440.2647	−7688.27 to −3192.26	**<.0001**
No. of overlapping cases	1214.9507	923.17 to 1506.73	**<.0001**

BMI, body mass index; TKA, total knee arthroplasty; THA, total hip arthroplasty; OR, operating room.
Bold indicates $P < .05$.

overlapping portion of procedures. Contribution from medical trainees has repeatedly been demonstrated to be safe [18,21–26]. However, medical trainee participation has also been shown to prolong surgical times [18,24,27]. This is consistent with our data, which indicate overlapping cases were on average 8 minutes longer than nonoverlapping cases. This resulted in increased OR personnel costs and total procedural costs. Nevertheless, the increased operative time and procedural costs were offset by the greater number of cases each attending surgeon was able to perform per 8-hour block, resulting in a total estimated profit of $1215 for each overlapping case per 8 hours. As many hospitals continue to operate on negative margins and rely on total joint arthroplasty as an important means of revenue, overlapping surgery may be a resource for these hospitals to remain viable and productive.

The practice of overlapping surgery is intended to improve surgeon efficiency, increase patient access to care, and provide surgeons in training with adequate surgical experience [6]. Surgeons must balance achieving these goals while not compromising patient safety. Previous studies have consistently shown that overlapping surgery does not affect patient outcomes or complication rates [3,4,6,7,9,16,19,28]. Our primary outcome data corroborate these findings, noting no change in LOS, discharge disposition, or 90-day readmission rates between groups. Although we did find an increased rate of periprosthetic fracture following THA in the overlapping cohort, it is difficult to attribute this finding to the practice of overlapping surgery, as all bony preparation and component implantation are deemed a "critical" portion of the case and are performed by or under direct supervision of the attending surgeon. Thus, our data strongly support the use of overlapping surgery to improve surgeon efficiency and improve access to care. Overlapping surgery is a safe practice and also allows for increased efficiency.

Table 6
Stepwise, Multivariate Logistic Regression Analyses of Outcomes.

Independent Variables	Odds Ratio	95% Confidence Interval	*P* Value
Discharge to facility			
Age	1.1903	1.1316 to 1.2520	**<.0001**
Body mass index	1.1268	1.0522 to 1.2067	**.0006**
Male gender	0.1566	0.0475 to 0.5160	**.0023**
Overlapping case	1.2690	0.5412 to 2.9757	.5837
Readmissions			
Age	1.0420	1.0173 to 1.0674	**.0008**
Body mass index	1.0369	0.9948 to 1.0807	.0863
Myocardial infarction	3.1785	1.0953 to 9.2241	**.0334**
Connective tissue disease	3.3969	1.7041 to 6.7714	**.0005**
Overlapping case	1.3908	0.8565 to 2.2584	.1822

Bold indicates $P < .05$.

Our study must be viewed in light of its limitations. Based on the retrospective nature of the study, we were unable to assess clinical outcomes that did not lead to a readmission or delay in discharge. Additionally, medical and surgical complication rates were not a primary outcome measure of this study. However, they have repeatedly been demonstrated to be similar or improved with the practice of overlapping surgery. Our institution is a high-volume joint arthroplasty center with well-trained staff and a large number of clinical fellows. This allows for the attending surgeon to rely on medical trainees to perform most "noncritical" portions of the case safely and effectively. Thus, our data and results may not be applicable to all institutions or private hospitals. Moreover, we were unable to determine from our data the actual amount of time the attending surgeon was in the room or involved in the case, nor were we able to determine the impact of resident/fellow involvement on outcomes. Although our indicators of outcome showed no difference, this is important to note, as different institutions may have different guidelines as to what is a "critical" or "key" component of the case. Additionally, while the time-based approach to cost calculation has demonstrated a high degree of accuracy in estimating, it does have its limitations. For instance, the per-time cost of salary-based personnel is independent of case length or case load.

While our data do support the use of overlapping surgery both clinically and economically, we believe it is paramount to remain transparent about this practice with patients. A recent survey of the general public revealed that only 3.9% of the respondents had knowledge of the practice of overlapping surgery, and the vast majority supported the idea of the surgeon informing patients in advance about the practice [29]. Many institutions have now responded to this, implementing policies for including the possibility of overlapping surgeries on consent forms [3]. We believe the results of this study can aid surgeons in delivering appropriate informed consent about the utility of overlapping surgery, while providing administrators and hospital staff with the information to promote overlapping surgery for its economic benefits. Further study is warranted into the applicability of these data to all hospital systems.

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Appendix

Appendix Table 1
Comparison of Costs and Outcomes for TKA.

Overlap by 30 min or More	Nonoverlapping Case (N = 1691)		Overlapping Case (N = 331)		*P* Value
	Mean	SD	Mean	SD	
Case duration (min)	70.75	13.78	79.93	18.27	**<.001**
Length of stay (d)	1.19	0.49	1.26	0.53	**.005**
Total OR personnel cost	1173.80	166.32	1268.15	212.12	**<.001**
Total cost	6628.70	824.06	7263.69	1182.03	**<.001**
Reimbursement	11,508.44	181.03	11,508.97	175.92	.823
Estimated profit	4879.73	846.30	4245.28	1174.56	**<.001**
Discharge disposition					.537
Home	1645	99.1	322	98.8	
Facility	15	0.9	4	1.2	
Readmissions	35	2.2	7	2.2	**1.000**
DVT/PE	4	0.3	1	0.3	.596
Medical complication	20	1.3	3	1.0	1.000
Periprosthetic fracture	0	0.0	1	0.3	.166
Wound complication	7	0.4	2	0.6	.650
Dislocation	3	0.2	0	0.0	1.000

TKA, total knee arthroplasty; SD, standard deviation; OR, operating room; DVT, deep vein thrombosis; PE, pulmonary embolism.
Bold indicates $P < .05$.

Appendix Table 2
Comparison of Costs and Outcomes for THA.

Overlap by 30 min or More	Nonoverlapping Case (N = 2127)		Overlapping Case (N = 637)		*P* Value
	Mean	SD	Mean	SD	
Case duration (min)	62.45	18.46	70.54	20.48	**<.001**
Length of stay (d)	1.10	0.35	1.09	0.32	.918
Total OR personnel cost	1082.95	222.51	1158.67	242.23	**<.001**
Total cost	6723.51	646.48	6859.28	797.36	**<.001**
Reimbursement	11,508.49	183.40	11,523.07	184.58	.140
Estimated profit	4784.98	669.46	4663.80	846.30	**.001**
Discharge disposition					**1.000**
Home	2092	99.4	631	99.5	
Facility	12	0.6	3	0.5	
Readmissions	36	1.8	20	3.3	**.043**
DVT/PE	4	0.2	3	0.5	.366
Medical complication	10	0.5	4	0.7	.751
Periprosthetic fracture	6	0.3	6	1.0	**.041**
Wound complication	11	0.6	7	1.1	.158
Dislocation	3	0.2	0	0.0	1.000

THA, total hip arthroplasty; SD, standard deviation; OR, operating room; DVT, deep vein thrombosis; PE, pulmonary embolism.
Bold indicates $P < .05$.