Are All Patients Going Home after Total Knee Arthroplasty? A Temporal Analysis of Discharge Trends and Predictors of Nonhome Discharge (2011–2020)

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Abstract

Value-based orthopaedic surgery and reimbursement changes for total knee arthroplasty (TKA) are potential factors shaping arthroplasty practice nationwide. This study aimed to evaluate (1) trends in discharge disposition (home vs nonhome discharge), (2) episode-of-care outcomes for home and nonhome discharge cohorts, and (3) predictors of nonhome discharge among patients undergoing TKA from 2011 to 2020. The National Surgical Quality Improvement Program database was reviewed for all primary TKAs from 2011 to 2020. A total of 462,858 patients were identified and grouped into home discharge ($n = 378{,}771$) and nonhome discharge ($n = 84{,}087$) cohorts. The primary outcome was the annual rate of home/nonhome discharges. Secondary outcomes included trends in health care utilization parameters, readmissions, and complications. Multivariable logistic regression analyses were performed to evaluate factors associated with nonhome discharge. Overall, 82% were discharged home, and 18% were discharged to a nonhome facility. Home discharge rates increased from 65.5% in 2011 to 94% in 2020. Nonhome discharge rates decreased from 34.5% in 2011 to 6% in 2020. Thirty-day readmissions decreased from 3.2 to 2.4% for the home discharge cohort but increased from 5.6 to 6.1% for the nonhome discharge cohort. Female sex, Asian or Black race, Hispanic ethnicity, American Society of Anesthesiology (ASA) class > II, Charlson comorbidity index scores > 0, smoking, dependent functional status, and age > 60 years were associated with higher odds of nonhome discharge. Over the last decade, there has been a major shift to home discharge after TKA. Future work is needed to further assess if perioperative interventions may have a positive effect in decreasing adverse outcomes in nonhome discharge patients.

Keywords
- knee arthroplasty
- nationwide trends
- discharge disposition
- predictors
- outcomes

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Total knee arthroplasty (TKA) is the mainstay treatment of end-stage knee osteoarthritis and has demonstrated consistent growth annually, increasing by 148% from 2000 to 2014 in the United States.[1] Various surgical advancements have potentially enabled the growing utilization of TKA, including the improvements in anesthetic techniques, development of enhanced recovery programs, increased optimization of modifiable comorbidities, and improvements in venous thromboembolism prophylaxis.[2–10] Recent changes in legislation have incentivized high-value care in total joint replacement. Notable examples from the Center for Medicare and Medicaid Services (CMS) are the Comprehensive Care for Joint Replacement bundled payment model in 2016[11,12]; the Bundled Payment for Care Improvement initiative in 2011[13,14]; and public reporting of risk-standardized complication rates and risk-standardized readmission rates in 2013.[15] Thus, the landscape of TKAs has changed dramatically within the last decade, emphasizing value-based care. Indeed, compared with the early 2010s, postoperative complication rates have been steadily decreasing.[2,15] However, the risk of adverse outcomes remains in a smaller subset of the population, which warrants improved optimization for these patients.

Evaluating the factors associated with increased health care utilization, such as nonhome discharges, is critical to the success of value-based health care. While it may not be feasible for some patients to be discharged home following TKA, home discharges are five to seven times less costly than discharges to various nonhome facilities.[16] Understanding predictors of nonhome discharge may allow for enhanced optimization of high-risk patients and increased vigilance for postoperative complications that may be more common in this subpopulation, and potentially mitigate costs associated with perioperative care following joint replacement.

While risk factors for home and nonhome discharge dispositions have been reported, these studies do not report temporal trends and were conducted primarily with data prior to recent legislative changes.[17–19] Therefore, this study utilized nationally aggregated data to evaluate (1) trends in discharge disposition (e.g., home vs nonhome discharge rates). (2) episode-of-care outcomes for home and nonhome discharge cohorts, and (3) predictors of nonhome discharge among patients undergoing TKA from 2011 to 2020.

Materials and Methods

Data Source

The American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database was retrospectively queried for TKA patients from January 2011 through December 2020.[20] The ACS-NSQIP is a registry of surgical patients aggregated from hundreds of institutions throughout the country. In 2019, over 700 hospitals contributed to the database, allowing for broad coverage and representation of patients across the United States. Preoperative patient demographics are available for analysis with a maximum 30-day follow-up interval for >20 postoperative complications. These data points were extracted from patient charts by ACS-certified Surgical Clinical Reviewers and audited extensively to ensure data quality. This study utilized publicly available, deidentified data and was exempt from institutional review board approval.

Patient Selection

Inclusion criteria comprised all patients aged $\geq$ 18 years who underwent primary TKA from 2011 to 2020. No exclusion criteria were applied to the patients who met the inclusion criteria. Patients were identified using Current Procedural Terminology codes indicative of TKA—27440, 27441, 27442, 27443, 27445, and 27447.

Outcomes

The ACS-NSQIP codes for discharge are as follows: (1) skilled care, other than the patient's preoperative residence (i.e., skilled nursing facility); (2) unskilled facility other than the patient's preoperative residence (i.e., assisted living facilities); (3) same facility of the patient's preoperative residence; (4) home; (5) separate acute care; and (6) rehabilitation center.[20] Patients in this study were divided into two cohorts: those discharged to a nonhome location, defined as a location other than the patient's preoperative residence, and those discharged home, defined as home or facility of preoperative residence. Procedural characteristics of the 30-day readmission rate, 30-day mortality rate, 30-day all-cause complications, the average length of stay, and various specific complications were recorded for qualitative analysis.

Statistical Analysis

Descriptive statistics were reported as frequency and percentages or as means $\pm$ standard deviation (SD) where appropriate. Analyses conducted between home and nonhome discharge on patient demographics of age, sex, body mass index (BMI), race, smoking status, American Society of Anesthesiology (ASA) classification, modified Charlson comorbidity index (CCI), functional status, and type of anesthesia utilized the χ^2 test for goodness of fit. Multivariable logistic regression models were constructed to identify predictors for nonhome discharge, accounting for the above-mentioned variables with the addition of smoking and functional status. These variables were chosen for analysis for their prognostic utility, and results were reported in odds ratios (ORs) with corresponding 95% confidence intervals (CIs).[21–24] Statistical significance was set to $p < 0.01$ to account for the large sample size. All statistical analyses were conducted in SAS statistical environment (SAS 9.4, SAS Institute, Cary, NC, 2020).

Results

A total of 462,858 patients were isolated from the years 2011–2020. Patients were separated into home and nonhome discharge cohorts (►**Table 1**). The home discharge cohort yielded 378,771 patients with an average age of 66.1 years (SD: $\pm$ 9.2), of which 59.3% were female and had an average BMI of 32.7 kg/m^2 (SD: $\pm$ 6.9). The nonhome discharge cohort yielded 84,087 patients with an average age of 70.6 years (SD: $\pm$ 9.7), of which 70.7% were female and had an average BMI of 33.4 kg/m^2 (SD $\pm$ 7.6).

Table 1 Population characteristics, demographics, and anesthetic utilization of home and nonhome discharge cohorts

Variable	Home discharge ($n = 378,771$)	Nonhome discharge ($n = 84,087$)	*p*-Value
Age, mean (SD)	66.1 (9.2)	70.6 (9.7)	**<0.001**
Age group, *n* (%)			
18–29 y	283 (0.1%)	29 (0%)	
30–39 y	1,326 (0.4%)	106 (0.1%)	
40–49 y	12,342 (3.3%)	1,391 (1.7%)	
50–59 y	75,259 (19.9%)	9,768 (11.6%)	
60–69 y	152,210 (40.2%)	25,438 (30.3%)	
70–79 y	111,109 (29.3%)	31,138 (37%)	
80–89 y	25,621 (6.8%)	15,368 (18.3%)	
90+ y	621 (0.2%)	849 (1%)	
Sex, *n* (%)			
Female	224,642 (59.3%)	59,405 (70.7%)	**<0.001**
Male	154,040 (40.7%)	24,653 (29.3%)	
Nonbinary	11 (0%)	1 (0%)	
BMI, mean (SD)	32.7 (6.9)	33.4 (7.6)	**<0.001**
BMI classification, *n* (%)			
$< 18.5\ kg/m^2$	2,150 (0.6%)	484 (0.6%)	
$18.5–25\ kg/m^2$	34,597 (9.1%)	8,377 (10%)	
$25–30\ kg/m^2$	103,184 (27.2%)	20,892 (24.8%)	
$30–35\ kg/m^2$	112,130 (29.6%)	22,739 (27%)	
$35–40\ kg/m^2$	75,161 (19.8%)	16,472 (19.6%)	
$> 40\ kg/m^2$	51,549 (13.6%)	15,123 (18%)	
Race, *n* (%)			
American Indian/Alaska Native	2,152 (0.6%)	229 (0.3%)	**<0.001**
Asian/Pacific Islander/Native Hawaiian	9,021 (2.4%)	2,373 (2.8%)	
Black	26,702 (7%)	9,364 (11.1%)	
White, not Hispanic	255,733 (67.5%)	61,541 (73.2%)	
White, Hispanic	13,898 (3.7%)	4,173 (5%)	
Not Hispanic	66,338 (17.5%)	5,198 (6.2%)	
Hispanic	4,927 (1.3%)	1,209 (1.4%)	
Smoking status, *n* (%)			
No	347,616 (91.8%)	77,994 (92.8%)	**<0.001**
Yes	31,155 (8.2%)	6,093 (7.2%)	
ASA classification, *n* (%)			
I	7,843 (2.1%)	665 (0.8%)	**<0.001**
II	192,126 (50.8%)	31,372 (37.3%)	
III	173,185 (45.8%)	49,451 (58.8%)	
IV	5,172 (1.4%)	2,538 (3%)	
V	20 (0%)	2 (0%)	
Modified CCI, *n* (%)			
0	292,487 (77.2%)	57,367 (68.2%)	**<0.001**
1	76,392 (20.2%)	22,158 (26.4%)	
2	8,265 (2.2%)	3,643 (4.3%)	

Table 1 (*Continued*)

Variable	Home discharge ($n = 378,771$)	Nonhome discharge ($n = 84,087$)	*p*-Value
3	1,112 (0.3%)	693 (0.8%)	
4+	515 (0.1%)	226 (0.3%)	
Functional status, *n* (%)			
Independent	374,198 (98.8%)	81,080 (96.4%)	<**0.001**
Partially dependent	2,664 (0.7%)	2,324 (2.8%)	
Totally dependent	78 (0%)	99 (0.1%)	
Unknown	1,831 (0.5%)	584 (0.7%)	
Anesthesia, *n* (%)			
Epidural	2,961 (0.8%)	826 (1%)	<**0.001**
General	154,489 (40.8%)	45,647 (54.3%)	
Local	108 (0%)	41 (0%)	
MAC/IV sedation	59,176 (15.6%)	8,405 (10%)	
Regional	7,093 (1.9%)	1,981 (2.4%)	
Spinal	154,431 (40.8%)	27,120 (32.3%)	

Abbreviations: ASA, American Society of Anesthesiology; BMI, body mass index; CCI, Charlson comorbidity index; MAC/IV, monitored anesthesia care and intravenous; SD, standard deviation.

Discharge and Patient Outcome Trends from 2011 to 2020

From 2011 to 2020, the overall distribution of home discharge increased from 65.5 to 94%, while nonhome discharge decreased from 34.5 to 6% (►**Fig. 1**). Readmission within 30 days decreased from 3.2 to 2.4% for home discharge, while it increased from 5.6 to 6.1% for nonhome discharge (►**Fig. 2**). The percentage of patients that underwent outpatient TKA increased from 0.8 to 42.9% for home discharge and from 0.9 to 17.6% for nonhome discharge (►**Fig. 3**). The reoperation rate decreased from 1.1 to 0.9% for home discharge and increased from 1.5 to 2.0% for nonhome discharge

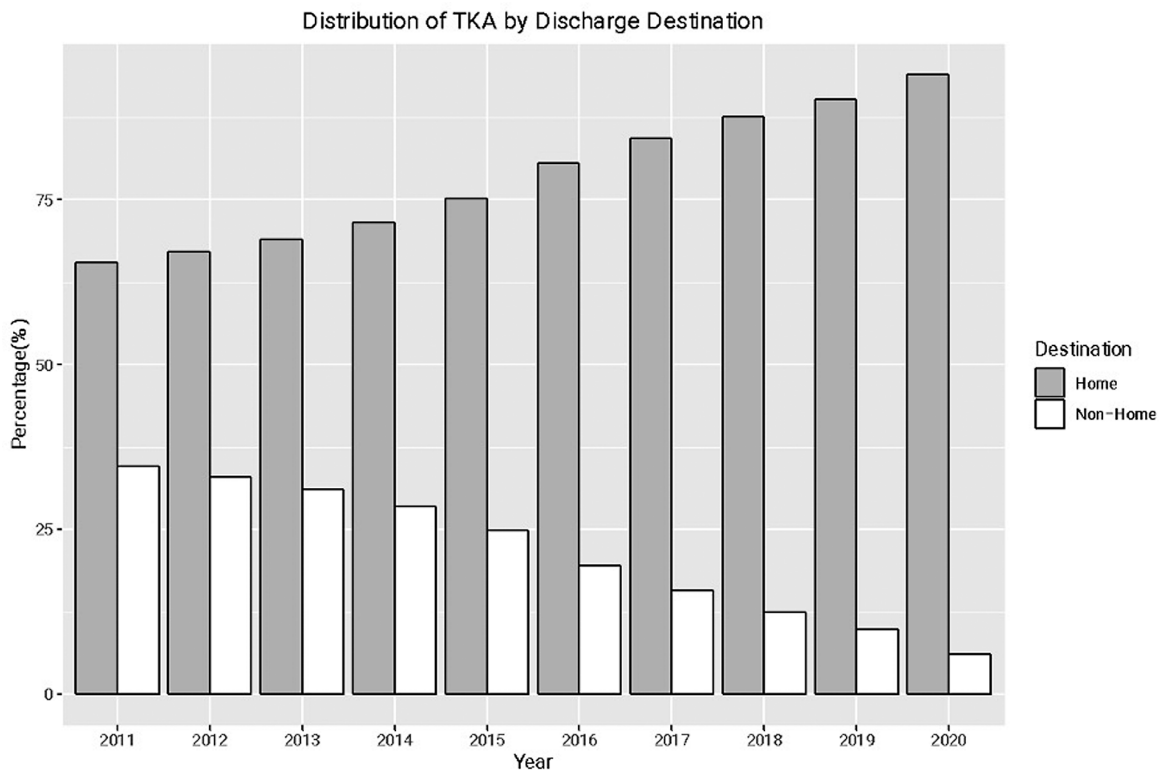

Fig. 1 Annual trends in home and nonhome discharge destinations for patients who underwent TKA from 2011 to 2020. TKA, total knee arthroplasty.

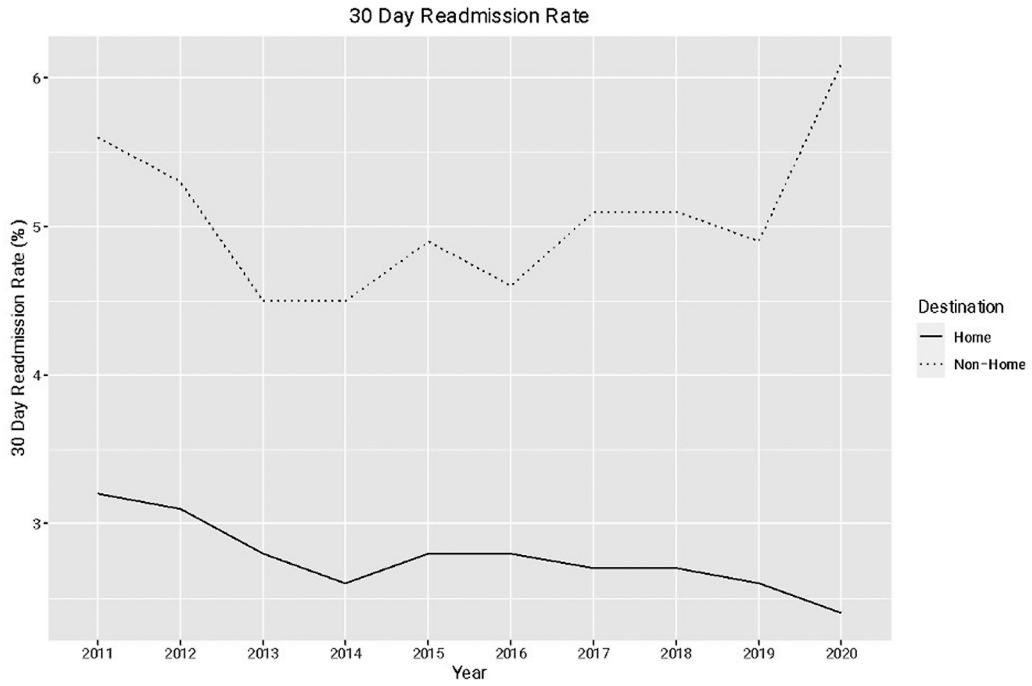

Fig. 2 Annual trends in 30-day readmission rates for home and nonhome discharge cohorts (2011–2020).

(►**Fig. 4**). Operative time decreased from 95.8 minutes (SD: ± 41) to 90 minutes (SD: ± 33.5) for home discharge, while it increased from 97.8 minutes (SD: ± 37.2) to 102.3 minutes (SD: ± 41.6) for nonhome discharge (►**Fig. 5**). Mortality at 30 days of follow-up decreased from 0.1 to 0.03% for home discharge, while it increased from 0.11 to 0.3% for nonhome discharge (►**Fig. 6**). All-cause complications at 30 days of follow-up decreased from 16.3 to 2.3% for home discharge and from 25.3 to 7.4% for nonhome discharge (►**Fig. 7**). The average length of stays decreased from 3.3 days (SD: ± 4.5) to 1.4 days (SD: ± 1.6) for home discharge, while it marginally decreased from 3.7 days (SD: ± 5.9) to 3.6 days (SD: ± 3.1) for nonhome discharge (►**Fig. 8**). A summary of these findings and other specific postoperative complications is found in ►**Appendix A (Table A1**).

Patient Predictors of Nonhome Discharge

Patient attributes of age, sex, BMI, race, smoking status, ASA classification, modified CCI classifications, functional status, and type of anesthesia all demonstrated significant differences

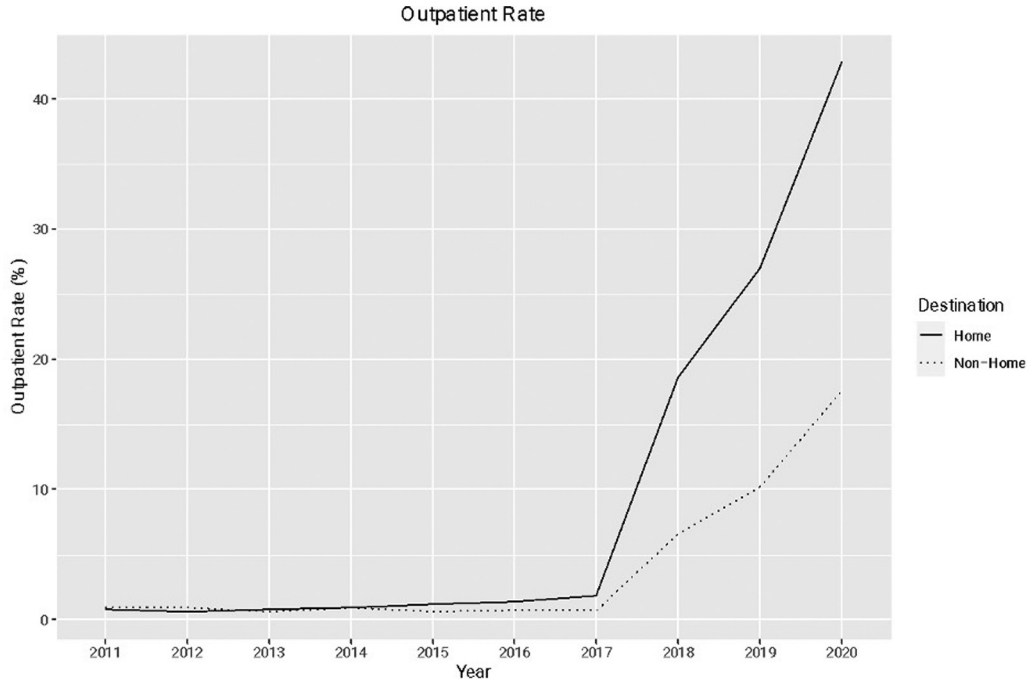

Fig. 3 Annual trends in outpatient rates for home and nonhome discharge cohorts (2011–2020).

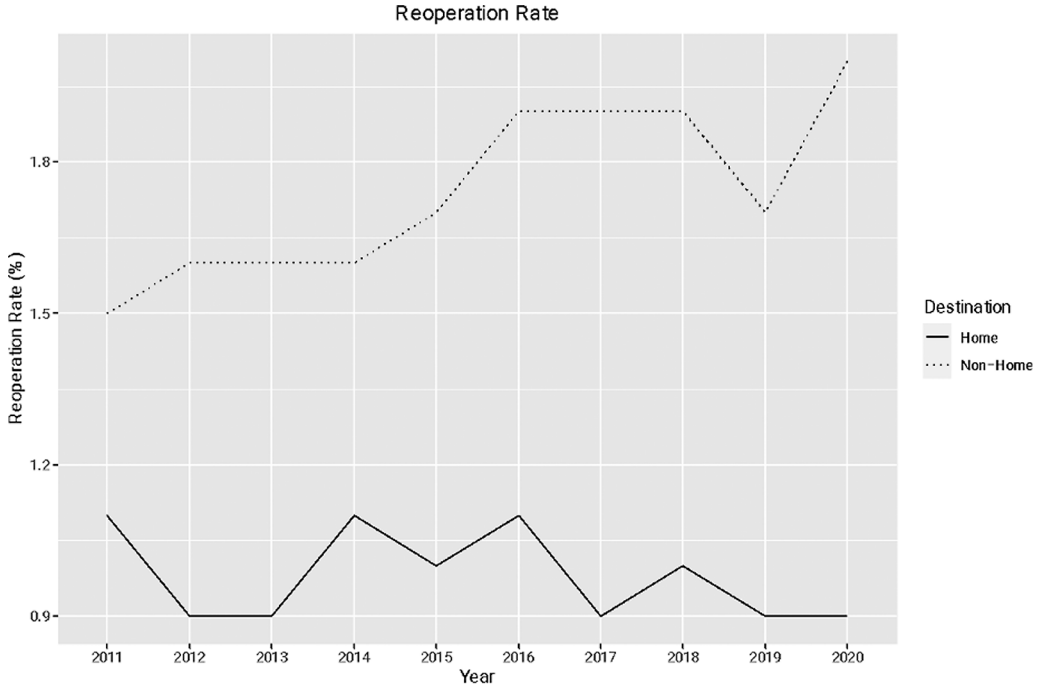

Fig. 4 Annual trends in reoperation rates for home and nonhome discharge cohorts (2011–2020).

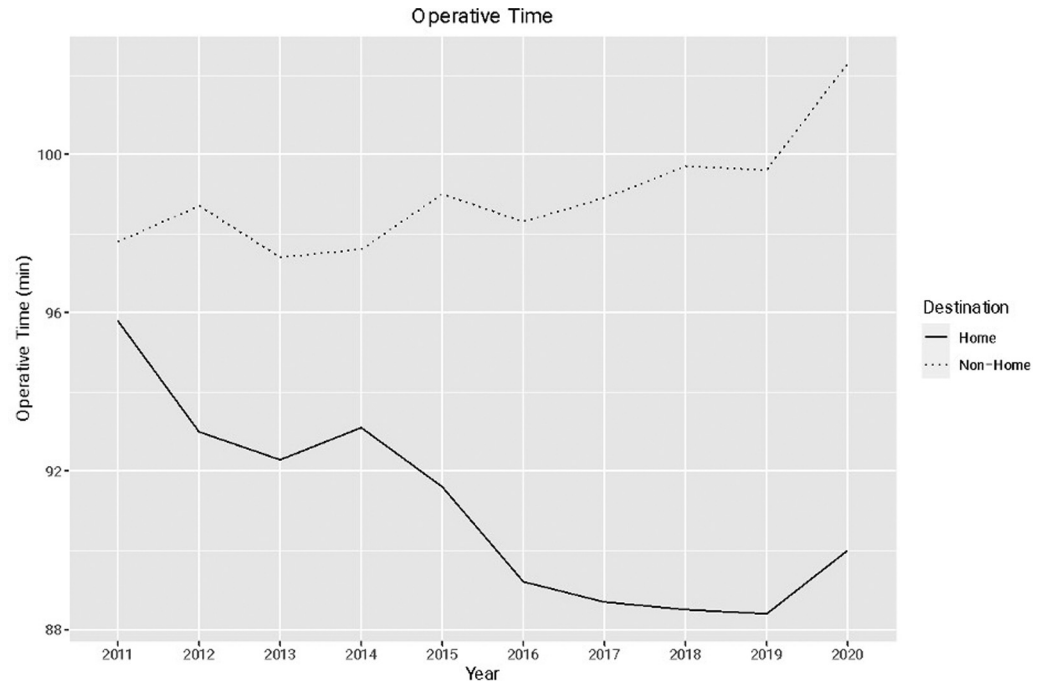

Fig. 5 Annual trends in operative time for home and nonhome discharge cohorts (2011–2020).

between the home discharge and nonhome discharge groups (►**Table 1**). Multivariable regression demonstrated that compared with the 18 to 29 age group, patients in the 60 to 69 (OR: 1.93; 95% CI: 1.23–3.01), 70 to 79 (OR: 3.59, 95% CI: 2.30–5.6), 80 to 89 (OR: 8.67; 95% CI: 5.55–13.54), and 90+ (OR: 23.40; 95% CI: 14.72–37.18) age groups exhibited a higher OR of nonhome discharge. Female sex was associated with a higher OR of nonhome discharge (OR: 1.63; 95% CI: 1.60–1.66). Compared with patients with a BMI $< 18.5\,kg/m^2$, patients with BMI of 18.5 to $25\,kg/m^2$ (OR: 0.79; 95% CI: 0.69–0.90) and 25 to $30\,kg/m^2$ (OR: 0.80; 95% CI: 0.71–0.91) demonstrated lower OR of nonhome discharge, while patients with BMI > 40 kg/m^2 (OR: 1.33; 95% CI: 1.17–1.52) exhibited a higher OR.

Compared with White patients, American Indian/Alaska Native (OR: 0.47; 95% CI: 0.40–0.54) and Native Hawaiian/Pacific Islanders (OR: 0.51; 95% CI: 0.43–0.60) exhibited lower OR of nonhome discharge, while Asian (OR: 1.22; 95% CI: 1.16–1.29) and Black patients (OR: 1.55;

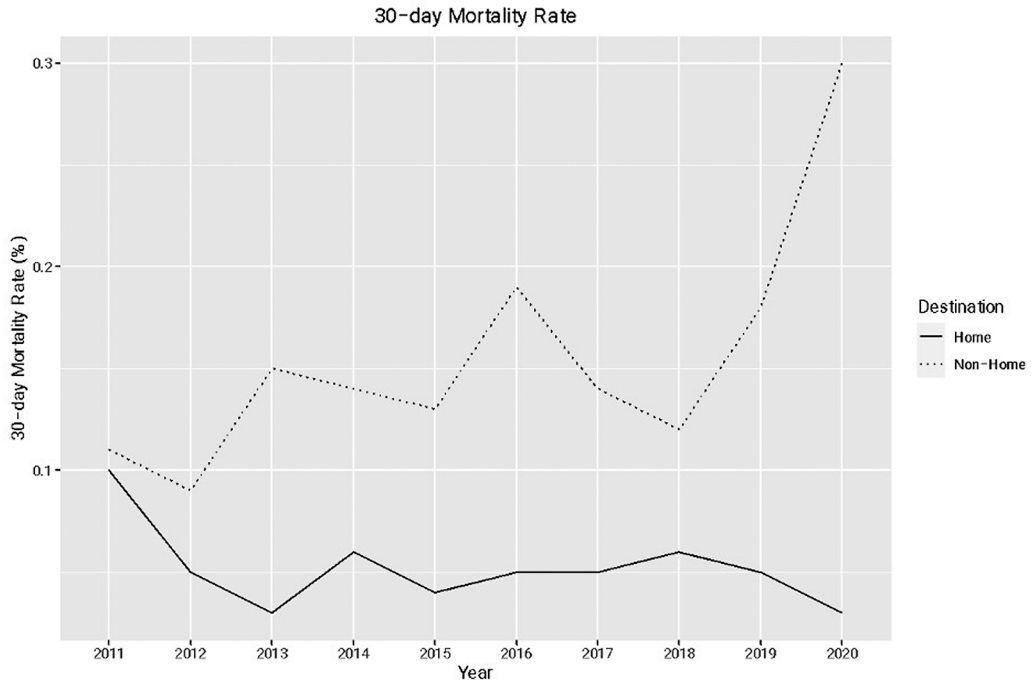

Fig. 6 Annual trends in 30-day mortality rates for home and nonhome discharge cohorts (2011–2020).

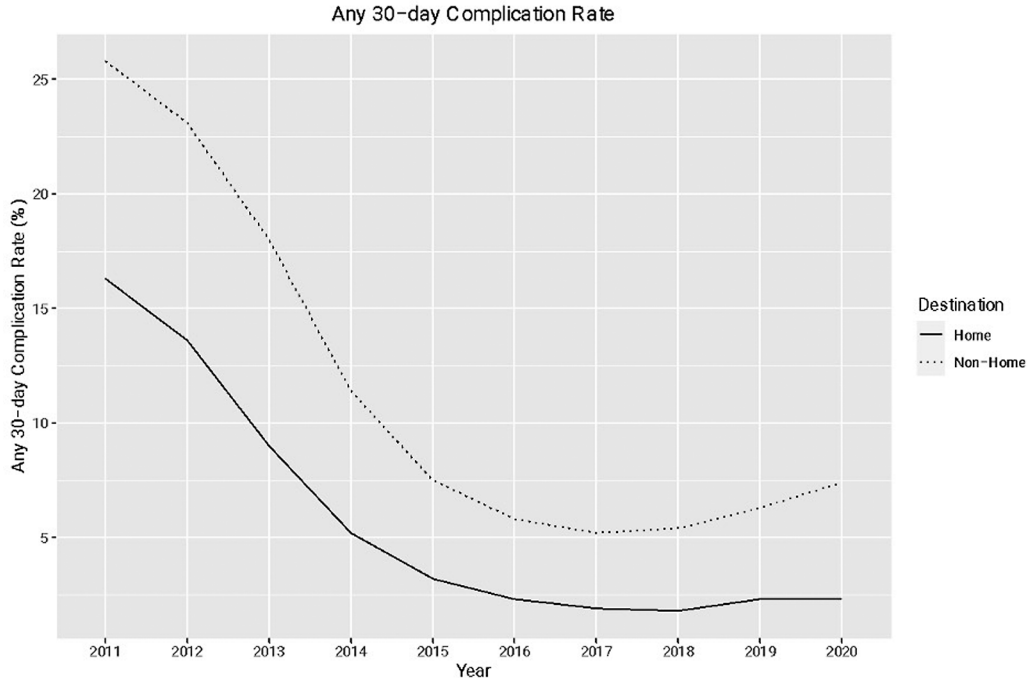

Fig. 7 Annual trends in all-cause 30-day complication rates for home and nonhome discharge cohorts (2011–2020).

95% CI: 1.51–1.59) demonstrated a higher OR. Smokers (OR: 1.17; 95% CI: 1.13–1.21) had a higher OR of nonhome discharge. Compared with ASA class I, patients in class II (OR: 1.16; 95% CI: 1.06–1.27), class III (OR: 1.56; 95% CI: 1.43–1.72), and class IV (OR: 2.57; 95% CI: 2.30–2.86) exhibited higher OR of nonhome discharge. Compared with a CCI score of 0, those with CCI I (OR: 1.23; 95% CI: 1.27–1.32), CCI II (OR: 2.18; 95% CI: 1.96–2.43), and CCI III+ (OR: 1.68; 95% CI: 1.37–2.07) had higher odds of nonhome discharge. Compared with functionally independent patients, partially dependent (OR: 3.10; 95% CI: 2.89–3.32) and totally dependent patients (OR: 3.89; 95% CI: 2.66–5.69) exhibited higher OR. Compared with spinal anesthetics, epidural (OR: 1.51; 95% CI: 1.38–1.65), general (OR: 1.43; 95% CI: 1.40–1.45; $p < 0.01$), regional (OR: 1.39; 95% CI: 1.31–1.47), and local anesthetics (OR: 2.86; 95% CI: 1.88–4.33) exhibited a higher OR of nonhome discharge, while monitored anesthesia care and intravenous sedation (OR: 0.77; 95% CI: 0.75–0.80)

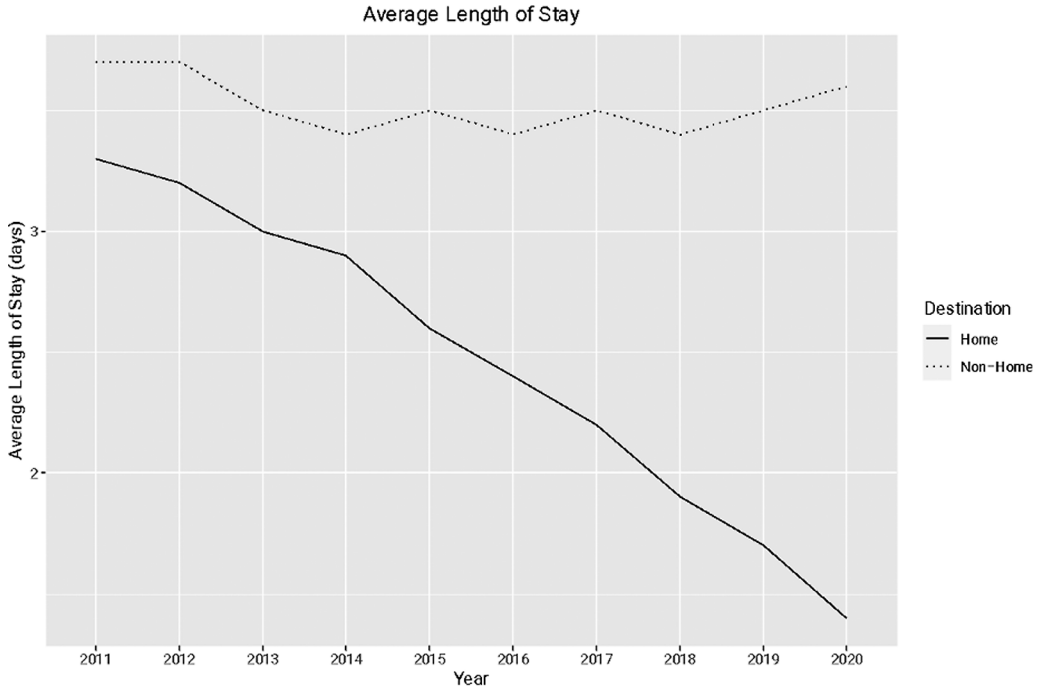

Fig. 8 Annual trends in the average length of stay for home and nonhome discharge cohorts (2011–2020).

exhibited lower OR of nonhome discharge. A summary of these results can be found in ►**Table 2**.

Discussion

From 2011 to 2020, home discharges following TKA increased from 65.5 to 94%, while nonhome discharges decreased from 34.5 to 6%. During this interval, the home discharge cohort exhibited a decrease in 30-day readmissions, reoperations, operative time, 30-day mortality, 30-day all-cause complications, and length of stay, while outpatient TKA rates increased. In contrast, the nonhome discharge cohort exhibited a decrease in 30-day all-cause complications and length of stay, while outpatient rate, 30-day readmission, reoperation, operative time, and 30-day mortality increased.

Even though value-based care initiatives have improved health care utilization outcomes following TKA, there is still a considerable proportion of patients not being discharged home. This group should receive special attention as nonhome discharge has been associated with several disadvantages. For instance, the average total cost for TKA patients discharged to inpatient rehabilitation ($22,921) and skilled nursing facilities ($15,489) is significantly more than those discharged home with no additional intervention ($3,241).[16] Additionally, Keswani et al[17] conducted a multivariable analysis accounting for baseline patient characteristics, common comorbidities, and predischarge complications of 106,360 ACS-NSQIP patients from 2011 to 2013. Compared with those discharged home, severe postdischarge adverse events and unplanned readmission were more significant in patients discharged to skilled nursing facilities (OR: 1.46, $p \leq 0.001$, and OR: 1.42, $p \leq 0.001$, respectively) and inpatient rehabilitation facilities (OR: 1.59, $p \leq 0.001$, and OR: 1.38, $p \leq 0.05$, respectively). These findings extend to cardiac and

Table 2 Factors associated with nonhome discharge after primary TKA

Covariate	Odds ratio (95% CI)	*p*-Value
Age (y)		
18–29	Reference	Reference
30–39	0.72 (0.44–1.19)	0.20
40–49	1.04 (0.66–1.63)	0.86
50–59	1.34 (0.86–2.10)	0.19
60–69	1.93 (1.23–3.01)	<0.01
70–79	3.59 (2.30–5.60)	<**0.0001**
80–89	8.67 (5.56–13.54)	<**0.0001**
90+	23.40 (14.72–37.18)	<**0.0001**
Sex		
Male	Reference	Reference
Female	1.63 (1.60–1.66)	<**0.0001**
BMI (kg/m^2)		
< 18.5	Reference	Reference
18.5–25	0.79 (0.69–0.90)	<**0.001**
25–30	0.80 (0.71–0.91)	<**0.001**
30–35	0.87 (0.76–0.99)	0.04
35–40	0.97 (0.86–1.11)	0.73
> 40	1.33 (1.17–1.52)	<**0.0001**
Race		
White	Reference	Reference
American Indian/ Alaska Native	0.47 (0.40–0.54)	<**0.0001**
Asian	1.22 (1.16–1.29)	<**0.0001**

(*Continued*)

Table 2 (*Continued*)

Covariate	Odds ratio (95% CI)	*p*-Value
Black	1.55 (1.51–1.59)	<**0.0001**
Native Hawaiian/ Pacific Islander	0.51 (0.43–0.60)	<**0.0001**
Ethnicity		
Non-Hispanic	Reference	Reference
Hispanic	1.28 (1.23–1.32)	<**0.0001**
ASA classification		
I	Reference	Reference
II	1.16 (1.06–1.27)	<**0.01**
III	1.56 (1.43–1.72)	<**0.0001**
IV	2.57 (2.30–2.86)	<**0.0001**
V	0.84 (0.18–3.85)	0.83
Modified CCI		
0	Reference	Reference
1	1.29 (1.26–1.32)	<**0.0001**
2	2.18 (1.96–2.43)	<**0.0001**
3+	1.68 (1.37–2.07)	<**0.0001**
Smoking status		
Nonsmoker	Reference	Reference
Smoker	1.17 (1.13–1.21)	<**0.0001**
Functional status		
Independent	Reference	Reference
Partially dependent	3.10 (2.89–3.32)	<**0.0001**
Totally dependent	3.89 (2.66–5.69)	<**0.0001**
Anesthesia		
Spinal	Reference	Reference
Epidural	1.51 (1.38–1.65)	<**0.0001**
General	1.43 (1.40–1.45)	<**0.0001**
Local	2.86 (1.88–4.33)	<**0.0001**
MAC/IV sedation	0.77 (0.75–0.80)	<**0.0001**
Regional	1.39 (1.31–1.47)	<**0.0001**

Abbreviations: ASA, American Society of Anesthesiology; BMI, body mass index; CCI, Charlson comorbidity index; CI, confidence interval; MAC/IV, monitored anesthesia care and intravenous.
Note: Reference group is home discharge.
Statistical significance is set to $p<0.01$ to account for the large sample size.

general surgery studies that have demonstrated inferior outcomes at nonhome discharge,[25,26] suggesting nonhome discharge may carry inherent risks and lead to prolonged institutionalization and hospitalization. Indeed, care provided in special care facilities has been called into question previously, with studies demonstrating higher rates of mortality and hospitalization.[27,28] Alternatively, discharge to a facility could be a surrogate for sicker, comorbid patients at baseline. These findings echo the observations in our study in which rates of 30-day readmission, reoperation, operative time, 30-day mortality, and 30-day all-cause complications increased from 2011 through 2020 for the nonhome discharge cohort. As patient optimization, surgical technology, and anesthetic techniques continue to improve in the field of knee reconstruction, requiring nonhome discharge could be a marker of debility.[3–7,9,25] However, it is unclear whether nonhome discharge itself, patient attributes, or a combination of both contributes more to poor outcomes. Nonetheless, it highlights an opportunity to improve upon the care of patients who require a nonhome discharge.

Isolating the independent factors that influence nonhome discharge provides additional information that allows surgeons to customize their care algorithms to patient-specific needs. As a matter of fact, we were able to demonstrate multiple predictors of nonhome discharge in our multivariable regression analyses. Females exhibited a higher risk of nonhome discharge compared with males. As patients increase in age (60 years or older), they exhibited a continuously increasing risk of being discharged to nonhome facilities compared with patients aged 18 to 29 years. As expected, higher ASA status and CCI scores correlated with higher likelihood of discharge home due to the effect of comorbid conditions influencing patient recovery. Patients with poor preoperative functional statuses were also at increased risk for nonhome discharge. Previous studies have corroborated these findings that females, advanced age, high comorbidity index scores, and low baseline functional statuses were associated with a higher likelihood of nonhome discharge.[15,18,29] Moreover, patients with BMI at either ends of the extremes on the BMI scale exhibited increased risk of nonhome discharge, and patients with a BMI $> 40\,kg/m^2$ possessed the greatest risk. These findings on the effect of body habitus are not unique to our study and have been replicated in numerous other studies.[30–33] Racial disparities have also been demonstrated in orthopaedic surgery and other surgical specialties. The increased risk of nonhome discharge in Black and Asian patients may represent a proxy for the increased risk associated with socioeconomic factors, which increase the risk of postoperative complications.[34,35] Finally, smoking has been well documented to delayed wound healing from the impact of inflammation on collagen deposition and cellular proliferation.[36–39] Macroscopically, this may partially explain the increased OR for nonhome discharge resulting from inferior clinical outcomes due to underlying biochemical mechanisms. Indeed, a systematic review by Santiago-Torres et al[40] demonstrated inferior functional outcome scores in smokers undergoing rotator cuff repair. Acknowledgment of the impact of these comorbidities can guide surgeons in perioperative decisions for optimization.

Compared with spinal anesthesia, the increased risk of nonhome discharge associated with general anesthesia may be partially explained by the risk of delirium and cognitive complications in older patients.[41] Additionally, spinal anesthesia has been reported to demonstrate decreased pain, reduced consumption of opioids, and increased satisfaction among patients undergoing arthroplasty procedures.[42,43] Because optimal pain control has been identified as a crucial part of successful rehabilitation, these benefits of spinal anesthetics may explain the increased likelihood for home discharge after

TKA.[43,44] However, it is entirely possible that spinal anesthesia attracts better-optimized patients with fewer comorbidities compared with their general anesthesia counterparts. Without more detailed patient characteristics of each anesthetic approach, a definitive conclusion cannot be made.

A precipitous increase in outpatient TKA was demonstrated in 2018 due to CMS's removal of TKA from the inpatient-only (IPO) list. Prior research has demonstrated the safety profile and efficiency of outpatient TKA. Hoffmann et al[45] conducted a systematic review on outpatient total joint arthroplasty analyzing 1,009 patients and demonstrated no deaths, only one major complication, and a 90-day reoperation/readmission rate of 1.98%. In a 64-patient study comparing inpatient and outpatient TKA protocols, Kolisek et al[46] demonstrated no perioperative complications in either cohort and nearly identical functional scores at a mean follow-up of 24 months. This is also reflected in our study by an increased proportion of home discharge TKA procedures conducted outpatient from 1.8 to 42.9% within 3 years without a substantial increase, and in some cases decrease, in postoperative complications. Additionally, home discharge rates consistently demonstrated an annual increase since 2011, with no noticeable change in trends despite TKA IPO removal in 2018. Outpatient rates have also increased for nonhome discharge, although at a slower rate than home discharge. This observation may be explained by an increasing push to reduce hospital length of stay by treating subacute conditions at other facilities.[25]

This study should be interpreted in light of its limitations. ACS-NSQIP is restricted to a 30-day follow-up interval, which limits the ability to follow long-term complications that may reveal more nuanced differences between home and nonhome discharge. For instance, our study was unable to follow whether those discharged to nonhome facilities experienced deterioration or died due to prolonged institutionalization. Although ACS-NSQIP has developed rigorous measures to ensure database accuracy, a baseline error rate in coding is not unavoidable. However, it was determined that the external validity afforded by the large sample size outweighed this limitation. Additionally, we were not able to definitively evaluate the financial impact of nonhome discharges after TKA due to the lack of data availability. Our multivariable regression combined data spanning almost a decade, which does not account for changes between years and precluded the identification of temporal trends with respect to the variables included in the analysis. However, it was determined that the aggregated data over 10 years provided external validity that outweighed the benefits of identifying minute and potentially insignificant changes in risk factors that may be demonstrated in analyzing each year separately.

Conclusion

Over the last decade, there has been a major shift to home discharge after TKA. As most patients are being discharged to home and the proportion of procedures conducted as outpatient continues to increase, it is valuable that the complication rates remain low. However, a small proportion of patients are still discharged to nonhome locations and still experience an increased risk of readmission and potentially worse prognoses and postoperative outcomes. Overall, risk factors associated with nonhome discharge may be of value for hospital administrators, clinicians, and patients to manage expectations and introduce specific risk calculators and care pathways to improve outcomes. With the goal of improving safe discharge after TKA, there is a need to use predictors of nonhome discharge, which may allow for enhanced optimization of high-risk patients and implementation of specialized care pathways to prevent or increase vigilance for postoperative complications. Future work is needed to further assess if perioperative interventions guided by predictive modeling of risk factors for nonhome discharge may have a positive effect in decreasing adverse outcomes in nonhome discharge patients.

Conflict of Interest
N.S.P. disclosed serving as a board or committee member for the American Association of Hip and Knee Surgeons, International Society for Cell and Gene Therapy, and Orthopaedic Research Society, serving on the editorial boards for the *Journal of Hip Surgery* and *Journal of Knee Surgery*, serving as a paid consultant for Regeneron and Stryker, and receiving research support from Osteal Therapeutics, Signature Orthopaedics, RegenLab, and Zimmer.
R.M.M. reports personal fees and grants from Striker, grants from Zimmer, other from American Academy of Hip and Knee Surgeons, outside the submitted work.
V.E.K. reports personal fees royalties, and grants from Striker, serving on the editorial boards for the *Journal of Arthroplasty*,
All other authors have no disclosures.

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Table A1 Trends in procedural characteristics and postoperative events from 2011 to 2020

	2011		2012		2013		2014		2015	
	Home	Nonhome	Home	Nonhome	Home	Nonhome	Home	Nonhome	Home	Nonhome
Distribution %	65.5% (9,037)	34.5% (4,761)	67% (15,320)	33% (7,560)	68.9% (20,841)	31.1% (9,406)	71.5% (26,042)	28.5% (10,370)	75.1% (37,015)	24.9% (12,240)
Inpatient %	99.2% (8,968)	99.1% (4,719)	99.4% (15,232)	99.1% (7,492)	99.2% (20,677)	99.4% (9,348)	99.1% (25,808)	99.1% (10,277)	98.8% (36,558)	99.4% (12,168)
Outpatient %	0.8% (69)	0.9% (42)	0.6% (88)	0.9% (68)	0.8% (164)	0.6% (58)	0.9% (234)	0.9% (93)	1.2% (457)	0.6% (72)
Operative time (min)	95.8 (41)	97.8 (37.2)	93 (37.4)	98.7 (42.4)	92.3 (38.3)	97.4 (40.7)	93.1 (37.4)	97.6 (41.2)	91.6 (37.1)	99 (42.6)
Length of stay (d)	3.3 (4.5)	3.7 (5.9)	3.2 (5.2)	3.7 (6.4)	3 (2.2)	3.5 (2.2)	2.9 (2.5)	3.4 (2.3)	2.6 (2.4)	3.5 (3.1)
Readmission %	3.2% (287)	5.6% (265)	3.1% (480)	5.3% (402)	2.8% (593)	4.5% (421)	2.6% (680)	4.5% (470)	2.8% (1,047)	4.9% (601)
Mortality %	0.1% (9)	0.11% (5)	0.05% (8)	0.09% (7)	0.03% (7)	0.15% (14)	0.06% (16)	0.14% (14)	0.04% (15)	0.13% (16)
Reoperation %	1.1% (95)	1.5% (73)	0.9% (145)	1.6% (119)	0.9% (190)	1.6% (146)	1.1% (283)	1.6% (163)	1% (379)	1.7% (210)
Any complication, %	16.3% (1,476)	25.8% (1,230)	13.6% (2,082)	23.1% (1,745)	9% (1,870)	18% (1,690)	5.2% (1,360)	11.4% (1,180)	3.2% (1,180)	7.5% (916)
Major complications, %	0.7% (66)	1.2% (55)	0.6% (97)	0.9% (68)	0.6% (123)	1.1% (104)	0.6% (162)	1.3% (131)	0.6% (213)	1.2% (148)
Minor complications, %	15.8% (1,429)	25.3% (1,203)	13.1% (2,006)	22.5% (1,698)	8.5% (1,775)	17.2% (1,614)	4.7% (1,213)	10.5% (1,084)	2.7% (994)	6.5% (793)
Superficial infection, %	0.8% (75)	0.9% (43)	0.5% (75)	0.7% (50)	0.5% (98)	0.6% (59)	0.4% (109)	0.6% (65)	0.5% (201)	0.5% (59)
Deep infection, %	0.14% (13)	0.25% (12)	0.16% (24)	0.15% (11)	0.14% (29)	0.14% (13)	0.17% (44)	0.27% (28)	0.12% (44)	0.21% (26)
Wound dehiscence, %	0.19% (17)	0.23% (11)	0.14% (21)	0.2% (15)	0.19% (39)	0.26% (24)	0.17% (44)	0.29% (30)	0.18% (66)	0.26% (32)
Any wound infection, %	1% (94)	1.2% (56)	0.8% (124)	1% (74)	0.7% (154)	0.9% (87)	0.7% (184)	1% (103)	0.8% (298)	0.8% (100)
Any wound local complication, %	1.6% (147)	2.1% (99)	1.1% (171)	1.4% (109)	0.9% (178)	1.3% (118)	0.7% (188)	1.2% (123)	0.8% (311)	1% (121)
Sepsis, %	0.2% (20)	0.5% (23)	0.2% (27)	0.3% (22)	0.1% (25)	0.3% (26)	0.1% (38)	0.4% (40)	0.1% (41)	0.3% (42)
Need for transfusion, %	14.9% (1,351)	24.5% (1,165)	12.6% (1,931)	21.8% (1,645)	8% (1,674)	16.4% (1,547)	4.2% (1,094)	9.7% (1,009)	2.1% (769)	5.9% (718)
Need for mechanical ventilation, %	0.04% (4)	0.08% (4)	0.02% (3)	0.05% (4)	0.02% (5)	0.2% (19)	0.03% (8)	0.16% (17)	0.02% (8)	0.15% (18)
Acute renal failure, %	0.09% (8)	0.11% (5)	0.04% (6)	0.12% (9)	0.03% (6)	0.15% (14)	0.03% (7)	0.1% (10)	0.02% (6)	0.13% (16)
Progressive renal insufficiency, %	0.12% (11)	0.17% (8)	0.08% (13)	0.21% (16)	0.09% (19)	0.23% (22)	0.06% (15)	0.2% (21)	0.08% (28)	0.25% (30)
	2016		2017		2018		2019		2020	
	Home	Nonhome	Home	Nonhome	Home	Nonhome	Home	Nonhome	Home	Nonhome
Distribution %	80.5% (47,797)	19.5% (11,604)	84.2% (52,916)	15.8% (9,936)	87.6% (57,180)	12.4% (8,091)	90.2% (65,717)	9.8% (7,148)	94% (46,906)	6% (2,971)
Inpatient %	98.6% (47,130)	99.3% (11,523)	98.2% (51,970)	99.3% (9,863)	81.4% (46,559)	93.4% (7,558)	73% (47,941)	89.8% (6,420)	57.1% (26,800)	82.4% (2,449)
Outpatient %	1.4% (667)	0.7% (81)	1.8% (946)	0.7% (73)	18.6% (10,621)	6.6% (533)	27% (17,776)	10.2% (728)	42.9% (20,106)	17.6% (522)
Operative time (min)	89.2 (34.5)	98.3 (41.9)	88.7 (33.7)	98.9 (42.8)	88.5 (33.8)	99.7 (41.6)	88.4 (34)	99.6 (38.8)	90 (33.5)	102.3 (41.6)
Length of stay (d)	2.4 (2.3)	3.4 (2.7)	2.2 (2)	3.5 (2.9)	1.9 (1.8)	3.4 (2.7)	1.7 (1.6)	3.5 (2.5)	1.4 (1.6)	3.6 (3.1)
Readmission %	2.8% (1,356)	4.6% (533)	2.7% (1,443)	5.1% (511)	2.7% (1,528)	5.1% (411)	2.6% (1,684)	4.9% (353)	2.4% (1,125)	6.1% (180)
Mortality %	0.05% (22)	0.19% (22)	0.05% (27)	0.14% (14)	0.06% (35)	0.12% (10)	0.05% (33)	0.18% (13)	0.03% (16)	0.3% (9)
Reoperation %	1.1% (510)	1.9% (218)	0.9% (498)	1.9% (184)	1% (553)	1.9% (153)	0.9% (585)	1.7% (124)	0.9% (428)	2% (60)

(*Continued*)

Table A1 (*Continued*)

Any complication, %	2.3% (1,113)	5.8% (676)	1.9% (994)	5.2% (518)	1.8% (1,056)	5.4% (438)	2.3% (1,493)	6.3% (448)	2.3% (1,076)	7.4% (219)
Major complications, %	0.7% (311)	1.4% (164)	0.6% (326)	1.4% (143)	0.7% (385)	1.7% (135)	0.6% (383)	1.3% (92)	0.7% (330)	1.9% (57)
Minor complications, %	1.7% (826)	4.7% (541)	1.3% (698)	4% (399)	1.2% (697)	3.9% (319)	1.8% (1,154)	5.2% (375)	1.6% (769)	5.9% (174)
Superficial infection, %	0.5% (245)	0.6% (66)	0.5% (275)	0.6% (64)	0.5% (299)	0.7% (56)	1.1% (735)	1.9% (138)	1.1% (533)	2% (60)
Deep infection, %	0.09% (45)	0.16% (18)	0.09% (45)	0.1% (10)	0.1% (60)	0.17% (14)	0.07% (46)	0.08% (6)	0.1% (45)	0.1% (3)
Wound dehiscence, %	0.19% (92)	0.31% (36)	0.18% (96)	0.32% (32)	0.2% (116)	0.35% (28)	0.2% (132)	0.25% (18)	0.29% (138)	0.4% (12)
Any wound infection, %	0.8% (392)	1% (119)	0.8% (425)	1.1% (106)	0.8% (477)	1.1% (93)	1.4% (895)	2.3% (162)	1.4% (680)	2.6% (77)
Any wound local complication, %	0.8% (393)	1.1% (127)	0.8% (423)	1.3% (125)	0.8% (463)	1.2% (99)	1.4% (897)	2.4% (172)	1.5% (690)	2.9% (85)
Sepsis, %	0.2% (74)	0.4% (42)	0.2% (80)	0.4% (38)	0.1% (85)	0.5% (37)	0.1% (89)	0.3% (23)	0.1% (54)	0.6% (18)
Need for transfusion, %	1.2% (553)	3.9% (456)	0.7% (392)	3.2% (320)	0.7% (375)	3.1% (250)	0.6% (390)	3.2% (226)	0.5% (226)	3.8% (113)
Need for mechanical ventilation, %	0.01% (6)	0.2% (23)	0.01% (7)	0.22% (22)	0.02% (14)	0.23% (19)	0.01% (8)	0.18% (13)	0.02% (10)	0.3% (9)
Acute renal failure, %	0.04% (18)	0.17% (20)	0.03% (14)	0.11% (11)	0.02% (13)	0.27% (22)	0.02% (11)	0.1% (7)	0.02% (11)	0.17% (5)
Progressive renal insufficiency, %	0.08% (37)	0.23% (27)	0.07% (36)	0.19% (19)	0.05% (31)	0.28% (23)	0.05% (36)	0.31% (22)	0.04% (19)	0.27% (8)