A Comparison of 30-Day Hospital Readmission and Complication Rates After Outpatient Versus Inpatient 1 and 2 Level Anterior Cervical Discectomy and Fusion Surgery: An Analysis of a Medicare Patient Sample

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■ BACKGROUND: **Same-day surgery has been demonstrated to be a safe and cost-effective alternative to traditional inpatient surgery. Several studies have demonstrated no differences in the postoperative complication profile or 30-day hospital readmission rates with outpatient versus inpatient anterior cervical discectomy and fusion (ACDF). However, none of these studies compared the outcomes in elderly patients (aged >65 years) undergoing ACDF. Whether the results from previous studies can be applied to this subgroup pf patients remains unknown. The aim of the present study was to compare the 30-day hospital readmission rates for Medicare patients (aged >65 years) undergoing outpatient versus inpatient ACDF.**

■ METHODS: **We performed a retrospective analysis of a Medicare database, including data from 17,421 patients. Of the 17,421 patients, 16,386 had undergone inpatient ACDF and 1035, outpatient ACDF. Age, sex, comorbidities, postoperative complications, readmission rates, and overall financial costs were compared between the 2 cohorts.**

■ RESULTS: **In a Medicare sample (aged >65 years), inpatient ACDF was associated with a greater incidence of postoperative complications compared with outpatient ACDF. Outpatient surgery was associated with significantly lower rates of postoperative complications (urinary tract infection, surgical site infection, deep vein thrombosis, pulmonary embolism, and myocardial infarction) and significantly lower treatment costs ($P \leq 0.001$). All-cause 30-day hospital readmission rates were also greater for inpatients (10.1% vs. 4%; $P = 0.17$).**

■ CONCLUSION: **The results from the present study suggest that outpatient ACDF appears to be safe and effective with low complication and readmission rates in a Medicare patient sample.**

INTRODUCTION

Anterior cervical discectomy and fusion (ACDF) procedures have been increasingly performed in an outpatient setting.[1-3] Several studies have demonstrated that outpatient ACDF is safe and effective, with overall low complication rates compared with inpatient ACDF procedures.[4-6] Outpatient ACDF has been associated with a decreased likelihood of developing perioperative durotomy, hematoma, neurological deficit, or cardiopulmonary complications.[7] Previous studies, however, did not focus on the geriatric population; thus, it is unknown whether the results of these studies can be applied to this patient population.[8,9]

The present study assessed the outcomes, complication rates, and cost differences between inpatient and outpatient ACDF

Key words
- ACDF
- Geriatric
- Inpatient
- Medicare
- Outcomes
- Outpatient
- Readmission

Abbreviations and Acronyms
ACDF: Anterior cervical discectomy and fusion
BMI: Body mass index
CCI: Charlson comorbidity index
CI: Confidence interval
CPT: Current Procedural Terminology
ICD-9: International Classification of Diseases, 9th revision
OR: Odds ratio

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procedures in the geriatric population. To the best of our knowledge, the present study is the first to use the Medicare Standard Analytic Files database, derived from Medicare parts A and B, which include 100% of inpatient and outpatient facility records billed to Medicare and cover >51 million lives.

METHODS

The institutional review board approved the present study (reference, PDRUNSG). Patients undergoing ACDF from 2007 to 2012 were identified retrospectively from the Medicare Standard Analytic Files using the International Classification of Diseases, 9th revision (ICD-9), diagnosis codes, ICD-9 procedure codes, and Current Procedural Terminology (CPT) codes.

METHODS

Patients undergoing ACDF were identified by querying the database for 2 CPT codes: CPT code 22551 (arthrodesis, anterior interbody, including disc space preparation, discectomy, osteophytectomy, and decompression of spinal cord and/or nerve roots] and CPT code 22554 (arthrodesis, anterior interbody technique, including minimal discectomy to prepare interspace [other than for decompression]). Only those cases with both codes plus ICD-9 code 81.62 for 1- or 2-level fusion were included in the present study. Outpatients and inpatients were identified using the service location modifiers 21 for inpatient and 22 for outpatient. The service location modifier 22 represents discharge occurring from either a hospital or ambulatory surgery setting without an associated inpatient hospital admission and an absolute length of stay of <24 hours.

Comorbidities

The demographic data from the aggregate records included sex and age. Only patients aged ≥65 years were included, with age further categorized as 65–69, 70–74, 75–79, 80–84, and >85 years. ICD-9 clinical modification diagnosis codes were used to identify comorbidities (**Table 1**). The comorbidities recorded were as follows: anemia, diabetes mellitus, myocardial infarction, atrial fibrillation, pulmonary condition, smoking, and body mass index (BMI) ≥30 kg/m^2. A summary of the ICD-9 codes used to identify the comorbidities are listed in **Supplementary Table 1**.

Complications

Descriptive statistics were calculated for age, sex, comorbidities, and postoperative complications. The following postoperative complications were recorded: urinary tract infection, surgical site infection, deep vein thrombosis, pulmonary embolism, and myocardial infarction. A summary of the ICD-9 codes used to identify postoperative complications is listed in **Supplementary Table 2**. For the selected variables, logistic regression analysis was used to model the odds ratios (ORs) for various comorbidities against the readmission rates for the inpatient and outpatient cohorts.

Statistical Analysis

The statistics for age, sex, comorbidities, and postoperative complications were calculated. Logistic regression analysis was used to model the ORs for the various comorbidities against the readmission rates for selected variables in both outpatient and inpatient cohorts. These comorbidities were then compared with the readmissions in each cohort using the χ^2 test. R statistical software, version 3.42 (R Foundation, Vienna, Austria), was used to analyze the data.

RESULTS

From 2007 to 2012, 17,421 geriatric patients who had undergone 1- or 2-level ACDF were identified. Of these 17,421 patients, 16,386 (94.1%) had undergone inpatient ACDF and 1035 (5.9%) had undergone outpatient ACDF.

The baseline comorbidities were similar between the 2 cohorts, although the inpatient cohort had a greater percentage of patients with a BMI of ≥30 kg/m^2. Men accounted for 50.0% ($n = 517$) of the outpatient population and 51.7% ($n = 8474$) of the inpatient population. For the entire population, the common preoperative comorbidities included anemia (37.7%), diabetes mellitus (41.2%), smoking (15.1%), BMI of ≥30 kg/m^2 (13.2%), pulmonary condition (8.8%), atrial fibrillation (6.9%), and myocardial infarction (2.6%).

The postoperative complication rates were greater in the inpatient cohort. Specifically, the incidence of postoperative urinary tract infection, surgical site infection, deep vein thrombosis, and myocardial infarction was significantly greater in the inpatient cohort (2.4%, 0.8%, 0.6%, and 0.2% respectively) compared with the incidence in the outpatient group (1.4%, 0.5%, 0%, and 0% respectively). In contrast, the incidence of postoperative pulmonary embolism was the only postoperative complication that was significantly greater in the outpatient cohort (7.7%) than in the inpatient cohort (0.4%; $P = 0.03$).

The 30-day hospital readmission rates were greater in the inpatient cohort than in the outpatient cohort (10.1% vs. 4%). However, the observed difference was not statistically significant. The risk factors for 30-day hospital readmissions in the elderly patients were assessed using ORs.

The inpatient cohort had an increased risk of readmission with the comorbidities of anemia (OR, 2.22; 95% CI, 2.12–2.32; $P < 0.0001$), diabetes mellitus, type 1 or 2 (OR, 1.57; 95% CI, 1.50–1.64; $P < 0.0001$), previous myocardial infarction (OR, 1.98; 95% CI, 1.81–2.18; $P < 0.0001$), atrial fibrillation (OR, 1.68; 95% CI, 1.59–1.79; $P < 0.0001$), a pulmonary condition (OR, 1.71; 95% CI, 1.61–1.82; $P < 0.0001$), smoking (OR, 2.21; 95% CI, 2.09–2.34; $P < 0.0001$), and BMI of ≥30 kg/m^2 (OR, 1.63; 95% CI, 1.55–1.71; $P < 0.0001$). This cohort also had an increased risk of readmission because of postoperative complications of urinary tract infection (OR, 2.58; 95% CI, 2.37–2.81; $P < 0.0001$), surgical site infection (OR, 3.89; 95% CI, 3.35–4.52; $P < 0.0001$), deep vein thrombosis (OR, 2.84; 95% CI, 2.41–3.34; $P < 0.0001$), pulmonary embolism (OR, 1.48; 95% CI, 1.15–1.89; $P = 0.002$), and myocardial infarction (OR, 2.51; 95% CI, 1.84–3.42; $P < 0.0001$) (**Tables 2** and **3**).

The outpatient cohort had an increased risk of readmission with the comorbidities of anemia (OR, 2.26; 95% CI, 1.78–2.87; $P < 0.0001$) diabetes mellitus, type 1 or 2 (OR, 2.43; 95% CI, 1.91–3.09; $P < 0.0001$), myocardial infarction (OR, 0.02; 95% CI, 0.0013–0.35; $P = 0.007$), atrial fibrillation (OR, 1.43; 95% CI, 1.03–1.97; $P = 0.031$), pulmonary condition (OR, 2.39; 95% CI, 1.75–3.28; $P < 0.0001$), and smoking (OR, 3.16; 95% CI, 2.43–4.10; $P < 0.0001$).

Table 1. Patient Characteristics

Parameter	Total (n = 17,421)	Inpatient (n = 16,386)	Outpatient (n = 1035)	P Value
Age group (years)				0.023
65–69	7704 (44.2)	7,204 (44.0)	500 (48.3)	
70–74	5083 (29.2)	4,814 (29.4)	269 (26.0)	
75–79	2981 (17.1)	2,801 (17.1)	180 (17.4)	
80–84	1180 (6.8)	1,113 (6.8)	67 (6.5)	
≥85	473 (2.7)	454 (2.8)	19 (1.8)	
Sex				0.27
Male	8991 (51.6)	8,474 (51.7)	517 (50.0)	
Female	8430 (48.4)	7,912 (48.3)	518 (50.0)	
Comorbidities				
Anemia	6560 (37.7)	6,219 (38.0)	341 (32.9)	0.001*
Diabetes mellitus, types 1 and 2	7177 (41.2)	6,755 (41.2)	422 (40.8)	0.77
Myocardial infarction	750 (2.6)	633 (2.4)	116 (5.6)	0.07
Atrial fibrillation	1966 (6.9)	1560 (5.9)	406 (19.7)	0.67
Pulmonary condition	2504 (8.8)	2116 (8.0)	388 (18.8)	0.10
Smoker	4288 (15.1)	4001 (15.2)	287 (13.9)	0.06
BMI ≥30 kg/m^2	3764 (13.2)	3764 (14.3)	0 (0.0)	<0.001*
Postoperative complications				
Urinary tract infection	659 (2.3)	630 (2.4)	29 (1.4)	<0.001*
Surgical site infection	220 (0.8)	209 (0.8)	11 (0.5)	<0.001*
Deep vein thrombosis	158 (0.6)	158 (0.6)	0 (0)	<0.001*
Pulmonary embolism	256 (0.9)	97 (0.4)	159 (7.7)	0.03*
Myocardial infarction	42 (0.1)	42 (0.2)	0 (0)	<0.001*
All-cause 30-day readmission	2746 (9.7)	2664 (10.1)	82 (4)	0.17
Average charge ($)	$4865.78 ± $4015.00	$7956.75 ± $3945.67	$7774.80 ± $4084.33	<0.001*

Data presented as n (%) or mean ± standard deviation.
BMI, body mass index.
*Statistically significant ($P < 0.05$).

The outpatient cohort also had an increased risk of readmission with postoperative complications of urinary tract infection (OR, 11.63; 95% CI, 6.60–20.5; P < 0.0001) (Tables 2 and 3).

Overall, the total direct costs were greater for in the inpatient cohort than for the outpatient cohort (inpatient costs, $7956.75 vs. outpatient costs, $7774.80; P < 0.001).

DISCUSSION

In the present Medicare patient sample of 17,421 geriatric patients who had undergone 1- or 2-level ACDF in either an inpatient or outpatient setting, we observed a significantly greater complications rate with the inpatient than with the outpatient procedures. The 30-day all-cause readmission rates were greater in the inpatient cohort, although the difference was not statistically significant (inpatient, 10.1% vs. outpatient, 4%; P = 0.17).

Previous studies of 1- and 2-level ACDF have shown its safety and effectiveness as an outpatient procedure compared with the traditional inpatient setting.[1,5-7,10-23] A retrospective analysis of 117 patients who had undergone 1- and 2-level ACDF (59 outpatients and 58 inpatients) by Trahan et al.[20] had demonstrated low complication rates in the outpatient cohort with only 1 readmission (1.4%). That patient had presented with neck swelling and difficulty breathing on the same day of surgery, had remained in hospital for observation and conservative treatment for 23 hours, and was discharged in stable condition the next day. The average age of the outpatients in their study was 47.6 years. A subsequent meta-analysis by McClelland et al.[14] of a total of 2448 outpatient ACDF procedures from several single-institution studies from 1996 to 2016 showed outpatient ACDF to be an overall safe procedure with low readmission rates (total 2.0%) and complication rates similar to those after inpatient

Table 2. Odds of All-Cause Readmission Stratified by Comorbidities After 1- and 2-Level Anterior Cervical Discectomy and Fusion Surgery

	Total			Inpatient			Outpatient		
Parameter	**OR**	**95% CI**	***P* Value**	**OR**	**95% CI**	***P* Value**	**OR**	**95% CI**	***P* Value**
Anemia	2.24	2.14–2.34	<0.0001*	2.22	2.12–2.32	<0.0001*	2.26	1.78–2.87	<0.0001*
Diabetes mellitus, types 1 and 2	1.59	1.52–1.66	<0.0001*	1.57	1.50–1.64	<0.0001*	2.43	1.91–3.09	<0.0001*
Myocardial infarction	1.90	1.74–2.08	<0.0001*	1.98	1.81–2.18	<0.0001*	0.02	0.0013–0.35	0.007*
Atrial fibrillation	1.68	1.58–1.78	<0.0001*	1.68	1.59–1.79	<0.0001*	1.43	1.03–1.97	0.031*
Pulmonary condition	1.73	1.63–1.84	<0.0001*	1.71	1.61–1.82	<0.0001*	2.39	1.75–3.28	<0.0001*
Smoker	2.22	2.10–2.34	<0.0001*	2.21	2.09–2.34	<0.0001*	3.16	2.43–4.10	<0.0001*
BMI $\geq$30 kg/m^2	1.65	1.57–1.73	<0.0001*	1.63	1.55–1.71	<0.0001*	2.09	1.61–2.72	<0.0001*

OR, odds ratio; CI, confidence interval; BMI, body mass index.
*Statistically significant ($P < 0.05$).

ACDF (2%–5%). Although patients from these previous studies had an average age of 43.2–52.8 years,[5,12,15,18,20,24,25] the results from the present study have shown that outpatient ACDF is also safe in the geriatric population.

Previous data have shown relatively low readmission rates after ACDF performed in an outpatient setting, and several studies have even reported significantly fewer complications compared with inpatient ACDF. Studies by Stieber et al.[18] and Liu et al.[12] both reported a 0% readmission rate for their respective outpatient ACDF populations ($n = 30$ and $n = 45$, respectively). Similar studies by Khalid et al.,[6] Trahan et al.,[20] Lied et al.,[24] and Adamson et al.[25] all reported significantly low readmissions rates in the outpatient setting (4%, 1.7%, 1.0%, and 2.2%, respectively). Khalid et al.[26] demonstrated in a 3- and 4-level ACDF patient population that the readmission rates were not significantly different statistically between the inpatients and outpatients (3.1% vs. 1%, respectively). Regarding the complications, an observational study by Martin et al.[13] noted an overall 30-day complication rate of 3.2%, with reoperation as the most common adverse event (1.2%). The other common complications noted were wound-related complications (0.6%), deep vein thrombosis (0.2%), and pulmonary embolism (0.1%).[13] After 1- and 2-level ACDF, Khalid et al.[6] found that the outpatients had only experienced a 1.4% rate of urinary tract infection, 0% rate of deep vein thrombosis, and 0% rate of myocardial infarction, all lower than that of their inpatient counterparts (2.4%, 0.6%, and 0.2%, respectively). A retrospective study by Liu et al.[12] of 109 patients who had undergone 1-level ACDF showed no differences in patient outcomes between the inpatients and outpatients. Of the outpatients, 82.6% reported excellent results, with no patient reporting a fair or poor outcome at a mean follow-up of 64.2 days.[12] Only 4 complications were reported (hematoma, cerebrospinal fluid leak, syncope, and dysphagia), and all had occurred in the inpatient group alone.[12] In a recent retrospective study, Fu et al.[27] analyzed 1- and 2-level ACDF (1-level ACDF, 10,967 inpatient and 1429 outpatient; 2-level ACDF, 5461 inpatient and 1429 outpatient). They demonstrated a significantly greater incidence of postoperative complications in the inpatient cohort

Table 3. Odds of All-Cause Readmission Stratified by Postoperative Complications After 1- and 2-Level Anterior Cervical Discectomy and Fusion Surgery

	Total			Inpatient			Outpatient		
Parameter	**OR**	**95% CI**	***P* Value**	**OR**	**95% CI**	***P* Value**	**OR**	**95% CI**	***P* Value**
Urinary tract infection	2.72	2.50–2.96	<0.0001*	2.58	2.37–2.81	<0.0001*	11.63	6.60–20.5	<0.0001*
Surgical site infection	4.03	3.47–4.68	<0.0001*	3.89	3.35–4.52	<0.0001*	2.71	0.05–136.7	0.62
Deep vein thrombosis	2.95	2.50–3.47	<0.0001*	2.84	2.41–3.34	<0.0001*	2.71	0.05–136.7	0.62
Pulmonary embolism	1.73	1.35–2.22	<0.0001*	1.48	1.15–1.89	0.002*	0.007	0.0004–0.12	0.0005*
Myocardial infarction	2.94	2.16–4.01	<0.0001*	2.51	1.84–3.42	<0.0001*	2.71	0.05–136.68	0.62
Urinary tract infection	2.72	2.50–2.96	<0.0001*	2.58	2.37–2.81	<0.0001*	11.63	6.60–20.5	<0.0001*

OR, odds ratio; CI, confidence interval.
*Statistically significant ($P < 0.05$).

compared with the outpatient group (1-level, 4.05% vs. 1.01%; 2-level, 3.94% vs. 1.47%).[27] More specifically, the inpatient population had experienced greater rates of reoperation (1-level, 1.53% vs. 0.28%; 2-level, 1.63% vs. 0.49%), urinary tract infection (1-level, 2.22% vs. 0.6%), pulmonary complications (1-level, 1.36% vs. 0.22%; 2-level, 1.4% vs. 0.28%), and blood transfusion (1-level, 0.82% vs. 0.09%).[27] An additional study by McClelland et al.[7] indicated that the outpatient cohort had significantly lower rates of red blood cell transfusion, postoperative durotomy, paraplegia, infection, respiratory complications, hematoma/seroma, and acute posthemorrhagic anemia. Moreover, patients who had undergone outpatient ACDF were 86% less likely to develop a postoperative hematoma or seroma and 19% less likely to require intraoperative durotomy.[7] A multivariate logistic regression model from McGirt et al.[15] using data from 7288 ACDF patients (inpatient, 6120; outpatient, 1168) showed that the outpatient cohort had 58% lower odds of developing a major postoperative morbidity compared with the inpatient group. Similar to these studies, we observed an increased incidence of postoperative complications in the inpatient cohort compared with the outpatient cohort.

Few studies have assessed the effect of specific medical comorbidities on inpatient and outpatient ACDF procedures. A study by Purger et al.[28] of 50,131 patients who had undergone multilevel ACDF showed outpatient ACDF patients were significantly less likely to require readmission within 30 days postoperatively than were the inpatient group. In their study, the inpatient cohort was significantly older (mean inpatient age, 53 years; mean outpatient age, 48 years) and had a higher Charlson comorbidity index (CCI) compared with the outpatient population (inpatient CCI, 0.37%; outpatient CCI, 0.17%).[28] Furthermore, the outpatient cohort had significantly lower readmission rates regardless of the baseline CCI (a weighted comorbid illness severity score).[28] An observational study by Adamson et al.[25] of 1484 patients who had undergone 1- or 2-level ACDF (inpatients, $n = 484$; outpatients, $n = 1000$) found that age was significantly older for the outpatient group for both 1- and 2-level ACDF and depression was more prevalent for inpatient 2-level ACDF. However, they found no differences in the prevalence of coronary artery disease, chronic obstructive pulmonary disease, diabetes mellitus, or osteoporosis and the mean BMI between the inpatient and outpatient cohorts.[25] However, the 1- and 2-level ACDF inpatient cohort had a significantly greater estimated blood loss, longer operative time, and longer hospital stay compared with the outpatient procedures.[25] A recent observational study by Khanna et al.[29] of 5162 inpatient and 1778 outpatient 1-level ACDF procedures showed a significantly greater prevalence of chronic obstructive pulmonary disease, hypertension, older age, higher American Society of Anesthesiologists class (3–5), steroid usage, and bleeding disorders in the inpatient cohort and a greater prevalence of smoking among the outpatient cohort. However, no significant difference was found in the BMI, gender, diabetes mellitus, dyspnea, congestive heart failure, disseminated cancer, or dialysis usage between the 2 cohorts.[29] After adjusting for differences between these groups, Khanna et al.[29] found the inpatient cohort to have significantly greater rates of any complication and medical complications. Although the present study found no significant difference between all-cause 30-day hospital readmission rates between the 2 cohorts, the outpatients with anemia (OR, 2.26), diabetes mellitus, type 1 or 2 (OR, 2.43), pulmonary condition (OR, 2.39), smoking (OR, 3.16), and BMI of $\geq$30 kg/m^2 (OR, 2.09) had increased odds of readmission compared with the inpatients.

Studies analyzing the cost savings between inpatient and outpatient ACDF procedures have shown significant savings for ACDF performed in the ambulatory setting. A study by Purger et al.[28] showed the average costs of outpatient ACDF ($9305.57) to be significantly lower than the costs of inpatient ACDF ($15,624.63). The 90-day cumulative charges were also significantly lower with outpatient surgery ($33,362.51) compared with inpatient surgery ($74,667.04).[28] Furthermore, a study by Silvers et al.[5] showed an average $1800 savings per patient and a total reduction of >$900,000 in hospital costs from 50 outpatient ACDF operations. Similarly, the study by Purger et al.[28] showed significantly lower costs with outpatient ACDF (average cost, $9305.57). A recent study by Mullins et al.[16] showed the average insurance reimbursement for outpatient ACDF to be $18,095 compared with $24,492 for inpatient surgery, suggesting a 74% savings with outpatient ACDF. Similar to these previous studies, the present study found a significant decrease in the cost of outpatient compared with inpatient surgery.

Study Limitations

The specific limitations of the present study stemmed from the data itself. Although administrative data allow for access to a large number of medical data files and long-term tracking of patients through certain identifiers within the coding system, these data have usually been meant for financial and administrative purposes rather than for research. The accuracy and details of these data tend to be less reliable regarding certain events that necessitate using an ICD-9 diagnostic code. In addition, which ICD-9 codes will be used, which is dependent on the subjective interpretation of the physician records by a medical reviewer, and changes in coding practices can alter the reliability and accuracy of the data. Administrative data have failed to note details such as the severity of the disease, patient-reported outcome scores, and surgeon technique and expertise, all of which can hide certain confounding factors resulting in a selection bias regarding why patients were selected for inpatient versus outpatient procedures. Given the data source, it was impossible to delineate and, thus, control for such a selection bias. Furthermore, in our study, the sole postoperative complication for the outpatients that was greater than that for the inpatients was pulmonary embolism (7.7% vs. 0.4%). This is an example of the limitations of this data source and the inability to determine the accuracy and validity and provide a way to investigate further.

CONCLUSION

The results from the present study suggest that outpatient ACDF appears to be safe and effective with low complication and 30-day readmission rates in a Medicare patient sample.

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APPENDIX

Supplementary Table 1. Summary of International Classification of Diseases, 9th revision, Clinical Modification Codes Used to Identify Comorbidities

Comorbidity	ICD-9-CM Code
Anemia	2800, 2801, 2808, 2809, 2810, 2811, 2812, 2813, 2814, 2818, 2819
Diabetes mellitus, types 1 and 2	25000, 25001, 25002, 25003, 25010, 25011, 25012, 25013, 25020, 25021, 25022, 25023, 25030, 25031, 25032, 25033, 25040, 25041, 25042, 25043, 25050, 25051, 25052, 25053, 25060, 25061, 25062, 25063, 25070, 25071, 25072, 25073 25080, 25081, 25082, 25083, 25090, 25091, 25092, 25093
Myocardial infarction	412
Atrial fibrillation	42731
Pulmonary condition	49300, 49301, 49310, 49311, 49320, 49321, 49390, 49391, 5181, 5182, 7702, 4910, 4911, 49120, 4918, 4919, 496
Smoker	3051, V1582
BMI $\geq$30 kg/m^2	V8535, V8536, V8537, V8538, V8539, V8541, V8542, V8543, V8544, V8545

ICD-9-CM, International Classification of Diseases, 9th revision, Clinical Modification.

Supplementary Table 2. Summary of International Classification of Diseases, 9th revision, Clinical Modification Codes Used to Identify Postoperative Complications

Postoperative Complication	ICD-9-CM Code
Urinary tract infection	5990
Surgical site infection	99859
Deep vein thrombosis	45382, 45383, 45384, 45385, 45386, 45387, 45340, 45341, 45342
Pulmonary embolism	41511, 41513, 41519
Myocardial infarction	41000, 41001, 41002, 41010, 41011, 41012, 41020, 41021, 41022, 41030, 41031, 41032, 41040, 41041, 41042, 41050, 41051, 41052, 41060, 41061, 41062, 41070, 41071, 41072, 41080, 41081, 41082, 41090, 41091, 41092

ICD-9-CM, International Classification of Diseases, 9th revision, Clinical Modification.