RESEARCH ARTICLE

Total Knee Arthroplasty and Homelessness: A Database Study

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Abstract

Objectives: Homelessness affects over 550,000 individuals in the United States each night, with the number and average age of homeless individuals steadily rising. This population suffers from a higher prevalence of chronic diseases, increasing their vulnerability to adverse health outcomes. Total knee arthroplasty (TKA) is a frequently performed surgery in the United States and is typically successful; however, concerns about postoperative complications are heightened for homeless patients. This study aimed to compare complication rates between homeless and non-homeless patients undergoing TKA.

Methods: A retrospective cohort study was conducted using the TriNetX Research Network database. Patients who underwent primary TKA were identified using CPT codes 27447, with homeless patients classified using ICD-9 and ICD-10 codes. A total of 245,567 patients were included, with 463 categorized as homeless. Demographic variables and postoperative complications were analyzed, and odds ratios (OR) were calculated for various outcomes, comparing homeless to non-homeless patients. Chi-square analysis and Fisher's exact test were used to determine statistical significance.

Results: Homeless patients were more likely to be over 65, obese, diabetic, and smokers, all of which are risk factors for poor postoperative outcomes. Superficial surgical site infections (0.6 versus 0.1% p=0.008, OR 7.52; 95% CI: 2.40–23.63), prosthetic joint infections (2.2 versus 0.8% p=0.005, OR 2.70; 95% CI: 1.44–5.06), acute renal failure (4.5 versus 1.9% p<0.001, OR 2.44; 95% CI: 1.57–3.78), blood loss anemia (13.2 versus 6.1% p<0.001, OR 2.25; 95% CI: 1.72 –2.95), and pulmonary embolism (2.4 versus 0.9 p<0.003, OR 2.81; 95% CI: 1.54–5.12) occurred more frequently in homeless patients.

Conclusion: Homeless patients undergoing TKA face significantly higher risks of postoperative complications compared to their non-homeless counterparts. These findings underscore the need for targeted preoperative optimization and tailored postoperative care to improve outcomes for this vulnerable population.

Level of evidence: IV

Keywords: Complications, Homelessness, Knee, Total knee arthroplasty, Vulnerable populations

Introduction

Across the United States, over 550,000 people are affected by homelessness every night.[1] Furthermore, there has been a continuous rise in the total number and average age of homeless individuals over the last consecutive four years.[1,2] Given the aging population, individuals experiencing homelessness suffer from a greater prevalence of chronic diseases.[3] Specific to patients experiencing unsheltered homelessness, where individuals are living on the streets or abandoned buildings, mortality risk is significantly higher than sheltered homelessness.[4] Moreover, individuals experiencing homelessness seek healthcare services more often for acute care rather than primary care.[5] Homeless patients, therefore, represent a vulnerable population with disparities in patient demographics and outcomes being multifactorial, ranging from inadequate access to care and

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food insecurity.[6]

Total knee arthroplasty (TKA) is a safe, consistently successful orthopedic procedure and the most performed inpatient surgical intervention in the USA, with nearly 3.5 million procedures estimated annually by 2030.[7] Primarily performed in elderly patients, TKA treats patients suffering from end-stage degenerative knee osteoarthritis by replacing the damaged knee with prosthetic components and thereby alleviating debilitating symptoms such as severe joint pain, stiffness, and reduced mobility.[8,9] Although a 99% survivorship at 5 years post-TKA has been reported in the literature, both minor and major postoperative complications can occur.[10-13] Octogenarian and older patient populations are at a higher risk for postoperative complications, ranging from periprosthetic fracture and joint infection to wound dehiscence and hematomas.[9,14] Multiple patient comorbidities have also been associated with an increased risk of complications after TKA.[15]

Total joint arthroplasties (TJAs) are often considered contraindicated for homeless patients because of unaddressed socioeconomic issues.[16-18] For example, food insecurity, which the homeless population has a higher risk of than the general population,[19] was associated with increased length of stay and total cost of care for patients undergoing TKA.[20] Patients experiencing homelessness can present with a variety of medical comorbidities, including infections, cardiovascular disease, liver disease, and dermatological conditions – all of which can be relative contraindications to elective procedures such as TKA.[21] Additionally, homeless patients are more likely to have independent risk factors for increased postoperative complications and poorer outcomes.[22] Although these challenges exist, some healthcare systems with large homeless populations, such as safety net hospitals and some Federal health care systems, are performing TKA in patients experiencing homelessness after thoughtful education and preoperative optimization.[23,24]

The literature on TKA outcomes and effectiveness for patients experiencing homelessness is sparse. Given the multifactorial disparities of homelessness, there is a need for investigation of the multiple complications and patient outcomes. A large multicenter database offers the ability to compare numerous results across numerous institutions and aid in generalizability. Considering this, the purpose of this study is to compare complication rates between patients experiencing homelessness and non-homeless patients following TKA, in a large, nationally representative patient population. We hypothesize that homeless patients will have more perioperative and postoperative complications for TKA compared to patients who were not homeless.

Materials and Methods

Data Acquisition

For this retrospective cohort study, we utilized the TriNetX Research network database (Cambridge, MA, USA). This network houses one of the largest collections of healthcare data from the United States, Canada, and Western Europe, covering inpatient, outpatient, and emergency visits from more than 80 healthcare organizations (HCOs) and representing over 120 million patient records. Additionally, patient information from these HCOs is enhanced by data from over 100 commercial and government payers, including Medicare. This study was deemed Institutional Review Board exempt because the data is a secondary analysis of existing data, does not involve intervention or interaction with human subjects, and was de-identified per the de-identification standard defined in Section 164.514(a) of the Health Insurance Portability and Accountability Act (HIPAA) Privacy Rule. Current Procedural Terminology (CPT) code 27447 was utilized to identify patients who had undergone primary TKA. A total of 245,567 unique patients were retrieved for this study. These patients were then classified as homeless (n=463) or non-homeless based on ICD-9 code V60.0 and ICD-10 code Z59. 0. Data was collected from 1973 to May 2024. ICD-9 and ICD-10 codes were used to identify preoperative comorbidities and complications, as outlined in [Appendix A].

Data Output and Outcome Assessment

The demographic analysis included age 65 or older, sex, the presence of obesity, diabetes, and smoking. Additionally, racial and ethnic differences were analyzed, focusing on the proportions of individuals identified as White, Black or African American, Asian, Native American or Alaska Native, Hispanic, and Unknown Race. Data on postoperative complications within 30 days after TKA were gathered including superficial surgical site infection (SSI), deep SSI, wound dehiscence, prosthetic joint infections, periprosthetic fracture, mechanical complications involving the prosthesis. blood loss anemia, acute renal failure (ARF), deep vein thrombosis (DVT), pulmonary embolism (PE), myocardial infarction (MI), pneumonia, cardiac arrest, ventricular fibrillation (VF), and the need for blood transfusion. All postoperative complications were identified using ICD 9, ICD 10 or CPT codes.

Statistical Analysis

Chi-square analysis with continuity correction or Fisher's exact test was utilized to compare percentages of demographic variables in the homeless group versus the non-homeless group.[25] Odds ratios (ORs) were calculated to compare the frequency of complications between the exposure (homeless) and comparison (non-homeless) groups, with 95% confidence intervals (CIs) provided for all OR calculations. SPSS Version 29.0 (IBM, Armonk, New York, United States) was used for compilation and analysis of the data. *P* values less than 0.05 were considered statistically significant. The analytical procedures were verified independently by all co-authors.

Data integrity and ethical considerations. All information within the TriNetX database is compliant with HIPAA and contains only de-identified aggregate information.

Results

Males comprised 32.4% of the homeless group and 39.1% of non-homeless group $p=0.004$. Homeless patients had a higher percentage of adults age 65 or older (58.1 versus 38.4%, $p<0.001$), higher percentage of obese patients (59.2 versus 34.2%, $p<0.001$), higher percentage of diabetic patients (36.5 versus 19.7%, $p<0.001$), and higher percentage of patients that were smokers (36.5 versus 19.7%, $p<0.001$) compared to non-homeless patients. Native American patients comprised 0.4% of the homeless

group and 0.2% of the non-homeless group. While African American/Black patients comprised 26.2% of the homeless group compared to 9.2% of the non-homeless group. The homeless group consisted of 55.9% white patients while the non-homeless group was made up of 71.6% white patients. Differences in racial/ethnic composition of the homeless and non-homeless groups were statistically significant. Demographic data categorized by homelessness and demographic statistical analysis is summarized in [Table 1].

Table 1. Demographic Data Categorized by Homelessness and Comparative Analysis

	Demographic Variable	Homeless (n=463)	Non-Homeless (n=245,104)	X2	P value
	Male	141(32.4%)	92,297 (39.1%)	8.22	0.004
	Age 65 or older	269(58.1%)	94,036 (38.4%)	76.08	<0.001
	Obesity	274(59.2%)	83,729 (34.2%)	128.53	<0.001
	Diabetes	169(36.5%)	48,246 (19.7%)	82.57	<0.001
	Smoking	189(40.8%)	47,306 (19.3%)	137.19	<0.001
	Mortality	36(0.2%)	22,026 (99.8%)	0.829	0.414
Race	*Native American / Alaska Native*	2 (0.4%)	659(0.2%)	7.94	<0.001
	Asian	6 (1.3%)	4905(1.9%)		
	Black or African American	121 (26.1%)	23323(9.2%)		
	Pacific Islander	2 (0.4%)	478(0.2%)		
	Other Race	13 (2.8%)	5780(0.2%)		
	Unknown	60 (13.0%)	28114(2.3%)		
	White	259 (55.9%)	181845(71.6%)		

Race chi-square (X^2) analysis degrees of freedom=2. All other X^2 analysis degrees of freedom=1. Young's Continuity Correction utilized when complication event number n<10. Fischer's exact test utilized for *p* value when n < 5

None of the patients in the homeless TKA group had deep SSI, cardiac arrest/VF, or required blood transfusion. Superficial SSI (0.6 versus 0.1% *p=0.008*, *OR* 7.52; 95% CI: 2.40–23.63) and PJI (2.2 versus 0.8% *p=0.005*, OR 2.70; 95% CI: 1.44–5.06) occurred more frequently in homeless patients compared to non-homeless patients. ARF (4.5 versus 1.9% *p<0.001*, OR 2.44; 95% CI: 1.57–3.78), blood loss anemia (13.2% versus 6.1% *p<0.001*, OR 2.25; 95% CI: 1.72 –2.95), and PE (2.4 versus 0.9 *p<0.003*, OR 2.81; 95% CI: 1.54–5.12) occurred more frequently in homeless patients compared to non-homeless patients. Complications and statistical analysis of complications are summarized in [Table 2].

Table 2. Comparative Analysis of Complications Categorized by Homelessness

Complication	n	OR	95% CI	X2	P value
Superficial SSI					
Homeless Group	3 (0.6%)	7.53	2.40 – 23.63	10.85	0.008
Non-homeless Group	212 (0.1%)	---	---	---	---
Deep SSI					
Homeless Group	0	*	*	0. .053	1.000
Non-homeless Group	28 (<0.0%)	---	---	---	---
Wound Dehiscence					
Homeless Group	5 (1.1%)	2.13	0.88 – 5.15	2.95	0.091
Non-homeless Group	1,251 (0.5%)	---	---	---	---
Prosthetic Joint Infection					
Homeless Group	10 (2.2%)	2.70	1.44 – 5.06	10.41	0.005
Non-homeless Group	1,989 (0.8%)	---	---	---	---

Table 2. continued					
Acute Renal Failure					
Homeless Group	21 (4.5%)	2.44	1.57 – 3.78	16.93	<0.001
Non-homeless Group	4,685 (1.9%)	---	---	---	---
Blood Loss Anemia					
Homeless Group	61 (13.2%)	2.25	1.72 –2.95	36.57	<0.001
Non-homeless Group	15,496 (6.3%)	---	---	---	---
Cardiac Arrest and VF					
Homeless Group	0	*	*	0.217	1.000
Non-homeless Group	115 (<0.0%)	---	---	---	---
DVT					
Homeless Group	5 (1.1%)	0.83	0.35 – 2.01	0.16	1.000
Non-homeless Group	3,168 (1.3%)	---	---	---	---
Mechanical Complication					
Homeless Group	4 (0.9%)	2.29	0.85 – 6.14	1.73	0.102
Non-homeless Group	929 (0.4%)	---	---	---	---
Myocardial Infarction					
Homeless Group	1 (0.2%)	0.97	0.14 – 6.97	0.00	1.000
Non-homeless Group	541 (0.2%)	---	---	---	---
Pulmonary Embolism					
Homeless Group	11 (2.4%)	2.81	1.54 – 5.12	12.47	0.003
Non-homeless Group	2,103 (0.9%)	---	---	---	---
Periprosthetic Fracture					
Homeless Group	1 (0.2%)	0.95	0.13 – 6.77	0.00	1.000
Non-homeless Group	557 (0.2%)	---	---	---	---
Pneumonia					
Homeless Group	2 (0.4%)	0.68	0.17 – 2.73	0.07	1.000
Non-homeless Group	1,556 (0.4%)	---	---	---	---
Blood Transfusion					
Homeless Group	0	*	*	0.00	*
Non-homeless Group	135 (0.1%)	---	---	---	---

Surgical site infection, SSI; ventricular fibrillation, VF; deep venous thrombosis, DVT. Chi-square, X^2 analysis degrees of freedom=1. Young's Continuity Correction utilized when complication event number n< 10. Fischer's exact test utilized for p value when n < 5

Discussion

This study presents significant findings on the demographic disparities and postoperative complications between homeless and non-homeless patients undergoing TKA. Individuals experiencing homelessness face substantially higher rates of both perioperative and postoperative complications compared to their non-homeless counterparts. These findings underscore the profound health vulnerabilities of the homeless population, particularly in the context of major surgical interventions such as TKA.

Homeless patients were more likely to be older than 65, obese, diabetic, and smokers, which are all known risk factors for poor postoperative outcomes. These findings align with existing literature that documents the high prevalence of chronic diseases in homeless populations, particularly those living unsheltered.[21] The racial and ethnic composition differences observed between homeless and non-homeless groups, with a higher percentage of Black or African American and Native American patients in the homeless cohort, further emphasize the compounded challenges of racial health disparities within the homeless population.

In the retrospective review by Mahure et al, they determined that TKA patients with hepatitis C virus (HCV), human immunodeficiency virus (HIV), or both were more likely to be homeless. Additionally, they determined coinfection with HIV and HCV were independent risk factors for postoperative infections after TKA.[22] Our data is in accordance with the current literature and demonstrates homeless patients were more likely to have superficial SSI and PJI. Rates of postoperative ARF, blood loss anemia, and PE were also more frequent in the homeless group. These complications may be attributed to multiple factors such as inadequate preoperative optimization, poor nutrition, and higher baseline comorbidity burden observed in homeless patients.[21] The significantly higher rates of infections like SSIs and PJIs are concerning, as these complications often lead to prolonged hospital stays, increased healthcare costs, and further challenges in managing recovery.[15]

Interestingly, while some complications were more frequent among homeless patients, no cases of deep SSI, cardiac arrest, or the need for blood transfusion were observed in the homeless TKA group. This could be due to several factors, including the possibility of underreporting from HCOs or a smaller sample size in the homeless cohort. The lack of deep SSI cases in the homeless group, despite higher rates of superficial infections, warrants further investigation. Inadequate follow up could explain the differences in surgical site infections. Bennett et al published a case series in 2017 and demonstrated homeless patients in a Veteran's Affairs health care system high rates of orthopedic and radiographic follow-up at three and six months following TJA.[18] Deep SSIs occur within one year postoperatively; while superficial SSIs occur within 30 days.[24, 25] Lack of follow up outside of the window described by Bennett may partially explain our reported differences in deep SSI amongst homeless and non-homeless patients. Differences in diagnosis of postoperative infections may also explain the lack of deep SSIs reported in our results. Although guidelines for diagnosis of superficial SSI, deep SSI, and PJI indeed exist,[16,17] there is no single objective test or management approach established for the differentiation between a superficial SSI, deep SSI, and PJI.[26]

As mentioned previously, unaddressed socioeconomic issues often contraindicate TKA in homeless patients. However, in the case series by Bennett et al, 73% of homeless patients were permanently housed at final follow-up.[18] Additionally, the Bennet et al case series concluded that the employment status of homeless patients increased from 9% before surgery to 27% after joint arthroplasty, suggesting the potential improvement in quality of life and socioeconomic status secondary to surgery. Therefore the patient health and socioeconomic benefit of TKA may outweigh the theoretical risks associated with homelessness.[24] Given the increasing number of homeless individuals across the United States and the growing aging population within this group, healthcare providers must consider patient comorbidities for patients undergoing major procedures such as TKA. Comprehensive preoperative optimization, including addressing social determinants of health, may be key to improving outcomes for this vulnerable population. The role of safety net hospitals and VA systems in providing TKA to homeless individuals further highlights the importance of tailored approaches to care in these settings.

Limitations

This study is not without limitations. TriNetX database participation is voluntary, and selection bias may be present. Overrepresentation by academic institutions and variability in HCO reporting of codes may cloud our results. As mentioned earlier, the homeless cohort represents a small percentage of the overall patient population, and the lack of a representative sample may affect the generalizability of our findings. The retrospective nature of our study relies on the reporting of other individuals, therefore variability in data entry or reporting may influence our results/analysis. Additionally, the use of ICD-9 and ICD-10 coding for homelessness may not capture all patients experiencing homelessness, particularly those with temporary housing or shelter situations. The strengths of this study include the use of a large multicenter database, which offers robust data on a nationally representative population. The number of patients in homeless group is small compared to the non-homeless group and this could affect our ability to detect statistical significance. However, the large true number of patients in our two groups helps to enhance the predictive power of our study.

Conclusion

Patients experiencing homelessness face significantly higher risks of postoperative complications following TKA compared to non-homeless patients. These disparities highlight the need for targeted interventions aimed at optimizing the perioperative health of homeless individuals and ensuring appropriate postoperative care. Addressing the unique challenges faced by this vulnerable population will be essential as the demand for TKA continues to grow in the coming decades.

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Appendix A. Complications and Corresponding ICD 9 and 10 codes	
stroke	436, 4370, 4371, 4380, 43810, 43811, 43812, 43813, 43814, 43819, 43820, 43821, 43822, 43830, 43831, 43832, 43840, 43841, 43842, 43850, 43851, 43852, 43853, 4386, 4387, 43881, 43882, 43883, 43884, 43885, 43889, 4389, V1254, Z8673, G450, G451, G452, G453, G454, G458, G459, G460, G462, G463, G464, G465, G466, G467, G468, I6300, I63011, I63012, I63013, I63019, I6302, I63031, I63032, I63033, I63039, I6309, I6310, I63111, I63112, I63113, I63119, I6312, I63131, I63132, I63133, I63139, I6319, I6320, I63211, I63212, I63213, I63219, I6322, I63231, I63232, I63233, I63239, I6329, I6330, I63311, I63312, I63313, I63319, I63321, I63322, I63323, I63329, I63331, I63332, I63333, I63339, I63341, I63342, I63343, I63349, I6339, I6340, I63411, I63412, I63413, I63419, I63421, I63422, I63423, I63429, I63431, I63432, I63433, I63439, I63441, I63442, I63443, I63449, I6349, I6350, I63511, I63512, I63513, I63519, I63521, I63522, I63523, I63529, I63531, I63532, I63533, I63539, I63541, I63542, I63543, I63549, I6359, I636, I638, I6381, I6389, I639, I6930, I6931, I69310, I69311, I69312, I69313, I69314, I69315, I69318, I69319, I69320, I69321, I69322, I69323, I69328, I69331, I69332, I69333, I69334, I69339, I69341, I69342, I69343, I69344, I69349, I69351, I69352, I69353, I69354, I69359, I69361, I69362, I69363, I69364, I69365, I69369, I69390, I69391, I69392, I69393, I69398, I6980, I6981, I69810, I69811, I69812, I69813, I69814, I69815, I69818, I69819, I69820, I69821, I69822, I69823, I69828, I69831, I69832, I69833, I69834, I69839, I69841, I69842, I69843, I69844, I69849, I69851, I69852, I69853, I69854, I69859, I69861, I69862, I69863, I69864, I69865, I69869, I69890, I69891, I69892, I69893, I69898, I6990, I6991, I69910, I69911, I69912, I69913, I69914, I69915, I69918, I69919, I69920, I69921, I69922, I69923, I69928, I69931, I69932, I69933, I69934, I69939, I69941, I69942, I69943, I69944, I69949, I69951, I69952, I69953, I69954, I69959, I69961, I69962, I69963, I69964, I69965, I69969, I69990, I69991, I69992, I69993, I69998
Cardiac Arrest and VF	I4901, 4275, 42741
Heart Failure	I509, 428, 4281, 4282, 42821, 42822, 42823, 4283, 42831, 42832, 42833, 4284, 42841, 42842, 42843, 4289, 40201, 40211, 40291, 40401, 40403, 40411, 40413, 40491, 40493
Cardiac Arrythmia	I49, 4279, 42789, 4269, 42760, 9971, 3062, 7802
Acute Renal Failure	N170, N171, N172, N178, N179, 584, 5945, 5946, 5847, 5848, 5849
Myocardial Infarction	I2101, I2102, I2111, I2113, I2114, I2119, I2121, I2129, I21A1, 410, 4100, 41000, 41001, 41002, 4101, 41010, 41011, 41012, 4102, 41020, 41021, 41022, 4103, 41030, 41031, 41032, 4104, 41040, 41041, 41042, 4105, 41050, 41051, 41052, 4106, 41060, 41061, 41062, 4107, 41070, 41071, 41072, 4108, 41080, 41081, 41082, 4109, 41090, 41091, 41092
Blood Loss Anemia	D62, 2800, 2878, 2879
Pneumonia	J189, J159, J22, 486, 481, 485, 4870, 4871, 4878, 480, 4800, 4801, 4802, 4803, 4808, 4809, 482, 4820, 4821, 4822, 4823, 48230, 48231, 48232, 48239, 4824, 48240, 48241, 48242, 48249, 4828, 48281, 48282, 48283, 48284, 48289, 4829, 483, 4830, 4831, 4838, 484, 4841, 4843, 4845, 4846, 4847, 4848, 488, 4880, 48801, 48802, 48809, 4881, 48811, 48812, 48819, 4888, 48881, 48882, 48889
Blood Transfusion	30233N1, 990, 9900, 9901, 9902, 9903, 9904, 9905, 9906, 9907, 9908, 9909
Pulmonary Embolism	I2602, I2609, I2692, I2699, 4151, 41511, 41512, 41513, 41519
Deep Vein Thrombosis	I82401, I82402, I82403, I82409, I82411, I82412, I82413, I82419, I82421, I82422, I82423, I82429, I82431, I82432, I82433, I82439, I82441, I82442, I82443, I82491, I82492, I82493, I82499, I824Y1, I824Y2, I824Y3, I824Y9, I824Z1, I824Z2, I824Z3, I824Z4, 451, 4510, 4511, 45111, 45119, 4512, 4518, 45181, 45182, 45183, 45184, 45189, 4519

Periprosthetic Fracture	T84010A, T84011A, T84012A, T84013A, T84018A, T84019A, M9665, M96661, M96662, M96669, M96671, M96672, M96679, M9669, M9701XA, M9702XA, M9711XA, M9712XA, 99644
Periprosthetic Dislocation	T84020A, T84021A, T84022A, T84023A, T84028A, T84029A, 99642
Periprosthetic Mechanical Complication	T84090A, T84091A, T84092A, T84093A, T84098A, T84099A, 99639, 9964, 99640, 99641, 99643, 99645, 99646, 99647, 99649
Periproesthic infection	T8450XA, T8451XA, T8452XA, T8453XA, T8459XA, T8454XA, 99666, 99667, 99669
Superficial SSI	T8141XA
Deep SSI	T8142XA
Wound Dehiscence	T8130XA, T8131XA, T8132XA, 99831, 99832
Comorbidities and Corresponding ICD 9 and 10 Codes	
Stroke	430, 431, 4320, 4321, 4329, 43301, 43311, 43321, 43331, 43381, 43391, 43401, 43411, 43491, 4350, 4351, 4352, 4353, 4358, 4359, 436, 4370, 4371, 4372, 4373, 4374, 4375, 4376, 4377, 4378, 4379, I60, I600, I6000, I6001, I6002, I6009, I601, I6010, I6011, I6012, I6019, I602, I6020, I6021, I6022, I6029, I603, I6030, I6031, I6032, I6039, I604, I6040, I6041, I6042, I6049, I605, I6050, I6051, I6052, I6059, I606, I6060, I6061, I6062, I6069, I607, I6070, I6071, I6072, I6079, I608, I6080, I6081, I6082, I6089, I609, I6090, I6091, I6092, I6099, I61, I610, I611, I612, I613, I614, I615, I616, I618, I619, I620, I6200, I6201, I6202, I6203, I6209, I621, I6210, I6211, I6212, I6213, I6219, I629, I63, I630, I6300, I6301, I6302, I6303, I6309, I631, I6310, I6311, I6312, I6313, I6319, I632, I6320, I6321, I6322, I6323, I6329, I633, I6330, I6331, I6332, I6333, I6339, I634, I6340, I6341, I6342, I6343, I6349, I635, I6350, I6351, I6352, I6353, I6359, I636, I638, I6381, I6382, I6389, I639, I64, I650, I651, I652, I653, I658, I659, I66, I660, I661, I662, I663, I668, I669, I67, I670, I671, I672, I673, I674, I675, I676, I677, I678, I679, I688, I698, I699, I700, I701, I702, I703, I708, I709, I72, I720, I721, I722, I728, I729, I73, I730, I731, I732, I733, I738, I739, I74, I740, I741, I742, I743, I744, I745, I748, I749, I75, I750, I751, I752, I753, I758, I759, I76, I77, I770, I771, I772, I773, I774, I775, I776, I777, I778, I779, I78, I780, I781, I782, I783, I784, I785, I786, I787, I788, I789, I79, I790, I791, I792, I793, I794, I795, I796, I797, I798, I799
Smoking	3051, 30510, 30511, 30512, 30513, 30514, 30515, 30516, 30517, 30518, 30519, 64900, 64901, 64902, 64903, 64904, 98984, F17200, F17201, F17203, F17208, F17209, F17210, F17211, F17213, F17218, F17219, F17220, F17221, F17223, F17228, F17229, F17290, F17291, F17293, F17298, F17299, O99330, O99331, O99332, O99333, O99334, O99335, O99336, Z720, Z87791
Diabetes	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, E0800, E0801, E0802, E0803, E0804, E0805, E0806, E0807, E0808, E0809, E0810, E0811, E0812, E0813, E0814, E0815, E0816, E0817, E0818, E0819, E0820, E0821, E0822, E0823, E0824, E0825, E0826, E0827, E0828, E0829, E0830, E0831, E0832, E0833, E0834, E0835, E0836, E0837, E0838, E0839, E0840, E0841, E0842, E0843, E0844, E0845, E0846, E0847, E0848, E0849, E0850, E0851, E0852, E0853, E0854, E0855, E0856, E0857, E0858, E0859, E0860, E0861, E0862, E0863, E0864, E0865, E0866, E0867, E0868, E0869, E0870, E0871, E0872, E0873, E0874, E0875, E0876, E0877, E0878, E0879, E0880, E0881, E0882, E0883, E0884, E0885, E0886, E0887, E0888, E0889, E089, E0900, E0901, E0902, E0903, E0904, E0905, E0906, E0907, E0908, E0909, E0910, E0911, E0912, E0913, E0914, E0915, E0916, E0917, E0918, E0919, E0920, E0921, E0922, E0923, E0924, E0925, E0926, E0927, E0928, E0929, E0930, E0931, E0932, E0933, E0934, E0935, E0936, E0937, E0938, E0939, E0940, E0941, E0942, E0943, E0944, E0945, E0946, E0947, E0948, E0949, E0950, E0951, E0952, E0953, E0954, E0955, E0956, E0957, E0958, E0959, E0960, E0961, E0962, E0963, E0964, E0965, E0966, E0967, E0968, E0969, E0970, E0971, E0972, E0973, E0974, E0975, E0976, E0977, E0978, E0979, E0980, E0981, E0982, E0983, E0984, E0985, E0986, E0987, E0988, E0989, E0990, E0991, E0992, E0993, E0994, E0995, E0996, E0997, E0998, E0999, E1000, E1001, E1002, E1003, E1004, E1005, E1006, E1007, E1008, E1009, E1010, E1011, E1012, E1013, E1014, E1015, E1016, E1017, E1018, E1019, E1020, E1021, E1022, E1023, E1024, E1025, E1026, E1027, E1028, E1029, E1030, E1031, E1032, E1033, E1034, E1035, E1036, E1037, E1038, E1039, E1040, E1041, E1042, E1043, E1044, E1045, E1046, E1047, E1048, E1049, E1050, E1051, E1052, E1053, E1054, E1055, E1056, E1057, E1058, E1059, E1060, E1061, E1062, E1063, E1064, E1065, E1066, E1067, E1068, E1069, E1070, E1071, E1072, E1073, E1074, E1075, E1076, E1077, E1078, E1079, E1080, E1081, E1082, E1083, E1084, E1085, E1086, E1087, E1088, E1089, E1090, E1091, E1092, E1093, E1094, E1095, E1096, E1097, E1098, E1099, E1100, E1101, E1102, E1103, E1104, E1105, E1106, E1107, E1108, E1109, E1110, E1111, E1112, E1113, E1114, E1115, E1116, E1117, E1118, E1119, E1120, E1121, E1122, E1123, E1124, E1125, E1126, E1127, E1128, E1129, E1130, E1131, E1132, E1133, E1134, E1135, E1136, E1137, E1138, E1139, E1140, E1141, E1142, E1143, E1144, E1145, E1146, E1147,

	E1148, E1149, E1150, E1151, E1152, E1153, E1154, E1155, E1156, E1157, E1158, E1159, E1160, E1161, E1162, E1163, E1164, E1165, E1166, E1167, E1168, E1169, E1170, E1171, E1172, E1173, E1174, E1175, E1176, E1177, E1178, E1179, E1180, E1181, E1182, E1183, E1184, E1185, E1186, E1187, E1188, E1189, E1190, E1191, E1192, E1193, E1194, E1195, E1196, E1197, E1198, E1199
Obesity	E660, E6601, E6609, E661, E662, E668, E669, Z6830, Z6831, Z6832, Z6833, Z6834, Z6835, Z6836, Z6837, Z6838, Z6839, Z6841, Z6842, Z6843, Z6844, Z6845, 278, 2780, 27800, 27801, 27802, 27803
Procedure and Corresponding CPT Code	
Primary Total Knee Arthroplasty	27447

*International Classification of Diseases, ICD; ventricular fibrillation, VF; surgical site infection, SSI; Current Procedural Terminology, CPT