

Latex Allergy as an Independent Risk Factor for Prosthetic Joint Infection

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abstract

In response to increasing rates of self-reported latex allergies, changes have been made to prevent anaphylaxis in the operating room, including the use of latex-free gloves. However, the impact of these changes on the risk of prosthetic joint infection (PJI) after arthroplasty is unclear. This study evaluated whether documented latex allergy is an independent risk factor for PJI and aseptic revision surgery after total hip arthroplasty (THA) and total knee arthroplasty (TKA). A retrospective matched cohort study was conducted with an administrative claims database. A total of 17,501 patients who underwent TKA and had documented latex allergy were matched 1:4 with 70,004 control subjects, and 8221 patients who underwent THA and had documented latex allergy were matched 1:4 with 32,884 control subjects. Multivariable logistic regression showed that patients who had TKA and had a latex allergy showed significantly higher risk of PJI at both 90 days (odds ratio [OR], 1.26) and 1 year (OR, 1.22) and significantly higher risk of aseptic revision TKA at 1 year (OR, 1.21) after surgery compared with control subjects. Patients who had THA and had a latex allergy had significantly higher risk of PJI at 1 year (OR, 1.19) compared with control subjects. Rates of aseptic revision THA were higher in the latex allergy cohort but statistically comparable ($P>.05$). Latex allergy was associated with significantly increased risk of PJI and aseptic revision after TKA and significantly increased risk of PJI after THA. More work is needed to determine whether these risks can be mitigated or if latex allergy is an inherent, nonmodifiable risk factor requiring modification to typical arthroplasty pathways. [Orthopedics. 202x;xx(x):xx-xx.]

the second leading cause of failure for total joints, accounting for 27.2% of all failures.³ To avoid increased morbidity to the patient and cost burden to payors, infection prevention is of utmost importance.

It is paramount to identify factors contributing to infection and failure. One identifiable cause for concern during pre-operative planning is a documented latex allergy. The incidence of latex allergy in the general population is between 0.99% and 3.2%,⁴ and the reported rate of hospital occupational allergy to natural rubber latex is documented at as high as 8% to 17%.⁵⁻⁷ With both health care workers and patients requiring the use of latex-free gloves, the integrity of these gloves has

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Total joint arthroplasty remains a highly successful procedure for treating end-stage osteoarthritis and has been associated with long-term survivorship rates ranging from 68.7% to 100% at 25 years for total hip arthroplasty (THA) and up to 92.4% for total knee arthroplasty (TKA).^{1,2} Infection is

been questioned. Edwards et al⁸ showed that Allergard (Johnson & Johnson Medical Inc) latex-free gloves were destroyed by contact with polymethyl methacrylate (PMMA), whereas other latex-free gloves tested did not show similar destruction. Further, the perforation rate of latex-free gloves is higher during total joint surgery: the reported incidence is as high as 21.6% for outer-layer and 5.7% for inner-layer latex-free gloves compared with 8.4% and 0% for outer-layer and inner-layer latex gloves, respectively.⁷ Thomas et al⁹ reached similar findings, with a greater than 200% increased chance of perforation seen for latex-free gloves vs latex gloves during arthroplasty.⁹

Given the increased rates of outer and inner latex-free glove perforation, potential loss of glove integrity as a result of PMMA interaction, and the possibility of latex allergy as an inherent independent risk factor for infection, this study used a large nationwide database to evaluate whether documented latex allergy was associated with higher rates of infection and revision after total joint arthroplasty.

MATERIALS AND METHODS

Patient records were obtained from the PearlDiver Mariner Database (PearlDiver Technologies), an administrative claims database that contains deidentified inpatient and outpatient data. The *International Classification of Diseases, Ninth Revision and Tenth Revision (ICD-9/ICD-10)* diagnosis codes and *Current Procedural Technology (CPT)* codes were used to identify patients and define outcomes. The PearlDiver database contains the medical records of approximately 144 million patients from across the United States from January 1, 2010, through September 30, 2020. All health insurance payors are represented. Institutional review board exemption was granted for this study, and the study was compliant with the Health Insurance Portability and Accountability Act (HIPAA). No outside funding was received for this study.

A retrospective matched cohort study was conducted to compare complication rates after primary elective TKA and THA for patients with vs without a documented latex allergy. For this study, TKA was defined with *CPT* 27447 and corresponding *ICD-9/ICD-10* procedural codes, and THA was defined with *CPT* 27130 and corresponding *ICD-9/ICD-10* procedural codes. To limit potential transfer bias, only patients with continuous database enrollment for at least 1 year before and 1 year after arthroplasty were included.

Consequently, only arthroplasty procedures performed between January 1, 2011, and September 30, 2019, were eligible for analysis. Pediatric patients, patients with previous knee or hip reconstruction or revision arthroplasty procedures, and patients with active joint infections during the index arthroplasty were excluded. In addition, patients with THA performed urgently for hip fractures were excluded to isolate elective THA. To ensure that queried complications tied to the index arthroplasty, patients who had contralateral partial or total joint arthroplasty during the 1-year follow-up period were excluded. Patients with a documented latex allergy were identified with diagnosis codes (*ICD-9* code V1507 and *ICD-10* code D-Z91040). Each population of patients who underwent TKA and THA was divided into 2 cohorts based on the presence or absence of a documented latex allergy. Codes used to define inclusion/exclusion criteria are shown in **Table A**, available in the online version of the article.

Baseline demographic and clinical characteristics were obtained for all patients, including age, sex, body mass index (BMI), mean Charlson Comorbidity Index (CCI) score, and rates of several comorbidities. Specific comorbidities queried included tobacco use, rheumatoid arthritis, liver disease, ischemic heart disease, alcohol abuse, preoperative iron deficiency anemia, anxiety disorders, diabetes mellitus, depression, and peripheral vascular disease (PVD). These various

comorbidities were defined by *ICD-9* and *ICD-10* diagnosis codes and were selected because they can be identified in claims data and were listed in the American Academy of Orthopaedic Surgeons 2019 clinical practice guidelines as risk factors for PJI.¹⁰

Length of stay was also obtained for patients with inpatient arthroplasty procedures with *ICD-9/ICD-10* procedural codes. Additionally, 90-day inpatient readmission rates were obtained for all included patients.

Rates of short-term joint complications, including periprosthetic joint infection (PJI) and aseptic revision arthroplasty were obtained at 90 days and 1 year after the index arthroplasty. The diagnosis of PJI was defined with diagnosis codes corresponding to infectious processes related to the hip or knee prosthesis. Aseptic revision arthroplasty included liner exchange, revision of the femoral and/or tibial components for TKA, revision of the femoral and/or acetabular components for THA, and removal of the prosthesis. Codes used to define these complications are shown in **Table A**.

Statistical Analysis

All statistical analyses were performed with R statistical software (version 4.1.0; R Project for Statistical Computing) integrated within the PearlDiver software with an alpha level set to 0.05. To reduce confounding bias, exact matching without replacement was used to match patients with a documented latex allergy with control subjects at a 1:4 ratio across the following variables: age, sex, and CCI score. Patients with missing data for any of these parameters were excluded.

Demographic and clinical characteristics were compared with chi-square analysis for categorical variables and with Welch's *t* test or the Mann-Whitney *U* test for parametrically and nonparametrically distributed continuous variables, respectively. Rates of PJI and aseptic revision were compared between (1) patients un-

dergoing TKA who had a documented latex allergy vs matched control subjects and (2) patients undergoing who had a documented latex allergy vs matched control subjects with multivariable logistic regression to adjust for residual confounding bias after matching. Odds ratio (OR) and corresponding 95% CI were calculated for each outcome at 90 days and 1 year postoperatively.

RESULTS

Study Populations

A total of 1,290,091 patients who underwent primary elective TKA were identified, including 17,511 (1.4%) patients with a documented latex allergy and 1,272,580 (98.6%) patients without a latex allergy. After 1:4 matching, 17,501 patients undergoing TKA were assigned to the latex allergy cohort and 70,004 patients undergoing TKA were assigned to the control cohort (**Figure 1**). The 2 cohorts were well matched across age, sex distribution, and mean CCI score, indicating successful matching (**Table 1**). Compared with control subjects, the TKA latex allergy cohort had significantly higher rates of tobacco use (46.7% vs 37.7%, $P<.001$), rheumatoid arthritis (10.5% vs 9.4%, $P<.001$), liver disease (13.3% vs 11.4%, $P<.001$), ischemic heart disease (28.2% vs 25.4%, $P<.001$), preoperative anemia (6.6% vs 5.7%, $P<.001$), anxiety disorders (51.4% vs 41.6%, $P<.001$), depression (55.2% vs 48.3%, $P<.001$), and PVD (30.7% vs 26.4%, $P<.001$). Only 50.7% of patients undergoing TKA had BMI data available in the database, and the distribution of BMI between the 2 cohorts was statistically comparable (all $P>.05$). For the subset of patients who had inpatient TKA procedures billed for using *ICD-9/ICD-10* procedural codes, length of stay was comparable between the 2 cohorts (2.75 vs 2.81 days, $P=.100$). Additionally, patients who underwent TKA and had a latex allergy had a significantly higher inpatient readmission rate within 90 days

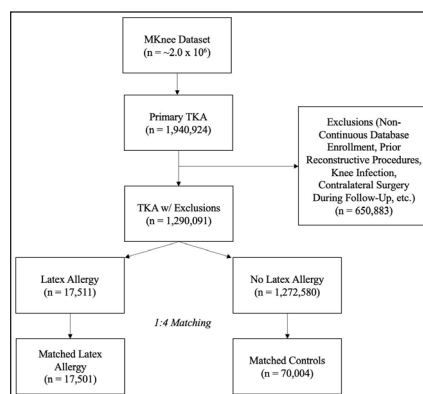


Figure 1: Flow diagram of patients included in the study. Abbreviations: MKnee, MKnee data set; TKA, total knee arthroplasty.

of the index TKA procedure (7.1% vs 5.7%, $P<.001$).

For primary elective THA, a total of 686,202 patients who met all inclusion criteria were identified: 8228 (1.2%) patients with a documented latex allergy and 677,974 (98.8%) patients without a latex allergy. After 1:4 matching, 8221 patients who underwent THA and had a latex allergy were matched with 32,884 control subjects (**Figure 2**). The 2 cohorts were statistically comparable across age, sex distribution, and mean CCI score, indicating successful matching (**Table 2**). Compared with control subjects, the THA latex allergy cohort had significantly higher rates of tobacco use (51.0% vs 41.6%, $P<.001$), rheumatoid arthritis (9.4% vs 8.1%, $P<.001$), liver disease (12.2% vs 10.2%, $P<.001$), ischemic heart disease (26.5% vs 23.7%, $P<.001$), diabetes (44.0% vs 41.3%, $P<.001$), anxiety disorders (49.4% vs 39.7%, $P<.001$), depression (50.4% vs 44.6%, $P<.001$), and PVD (30.0% vs 25.8%, $P<.001$). Among the 65.6% of patients who underwent THA and had BMI data available in the database, the control cohort had a significantly greater proportion of patients with BMI less than 30 kg/m² (27.2% vs 30.5%, $P<.001$), and the latex allergy cohort had significantly more patients with BMI of 30 to 35 kg/m² (28.8% vs 27.6%, $P=.044$) and BMI of 36 to 40 kg/m² (24.0% vs 21.6%, $P<.001$). For the subset of patients with inpatient THA billed for using *ICD-9/ICD-10* proce-

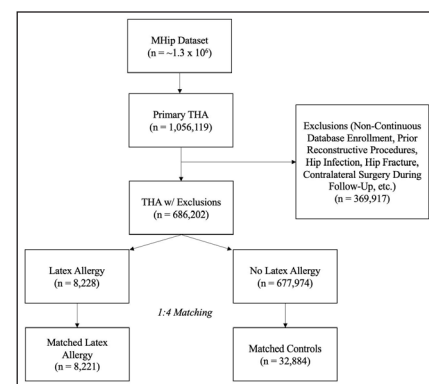


Figure 2: Flow diagram of patients included in the study. Abbreviations: FX's, fractures; MHip, MHip data set; THA, total hip arthroplasty.

dural codes, length of stay was comparable between the 2 cohorts (2.74 vs 2.71 days, $P=.499$). Within 90 days of the index THA procedure, patients who had a latex allergy had a significantly higher rate of inpatient readmission (7.8% vs 6.2%, $P<.001$).

Complications

Patients with a documented latex allergy who underwent TKA exhibited significantly higher risk of PJI compared with control subjects at both 90 days (1.6% vs 1.2%; OR, 1.26; 95% CI, 1.10-1.45) and 1 year (2.3% vs 1.7%; OR, 1.22; 95% CI, 1.08-1.36) postoperatively (**Table 3**).

Additionally, patients in the latex allergy cohort exhibited significantly higher risk of aseptic revision TKA at 1 year after the index TKA (1.6% vs 1.2%; OR, 1.21; 95% CI, 1.06-1.39).

Among patients who underwent primary elective THA, the latex allergy cohort had a significantly higher risk of PJI at 1 year postoperatively (3.0% vs 2.2%; OR, 1.19; 95% CI, 1.02-1.38). Rates of aseptic revision THA were higher in the latex allergy cohort at both 90 days and 1 year after the index THA, but neither difference achieved statistical significance (both $P>.05$).

DISCUSSION

Identification and mitigation of infection risk factors is essential for the long-term success of patients undergoing

Table 1

Demographic Data for TKA Cohorts^a

Characteristic	TKA with latex allergy (n=17,501)	TKA with no latex allergy (n=70,004)	P
Sex, No. (%)			
Female	14,926 (85.3)	59,707 (85.3)	.998
Male	2575 (14.7)	10,297 (14.7)	.998
Age, mean±SD, y	64.24±9.42	62.29±9.41	.497
Age, No. (%)			
<65 y	8340 (47.7)	33,364 (47.7)	.996
≥65 y	9161 (52.3)	36,640 (52.3)	.996
Body mass index, No. (%) ^b			
<30 kg/m ²	1827 (17.3)	6058 (17.9)	.108
30-35 kg/m ²	2708 (25.6)	8501 (25.2)	.405
36-40 kg/m ²	2728 (25.8)	8472 (25.1)	.161
>40 kg/m ²	3319 (31.4)	10,720 (31.8)	.443
Charlson Comorbidity Index, mean±SD	2.13±2.30	2.13±2.29	.991
Length of stay, mean±SD, d ^c	2.75±1.31	2.81±1.48	.100
90-day readmission rate, No. (%)	1238 (7.1)	3973 (5.7)	<.001
Comorbidity, No. (%)			
Tobacco use	8177 (46.7)	26,362 (37.7)	<.001
Rheumatoid arthritis	1845 (10.5)	6578 (9.4)	<.001
Liver disease	2321 (13.3)	8001 (11.4)	<.001
Ischemic heart disease	4928 (28.2)	17,791 (25.4)	<.001
Alcohol abuse	947 (5.4)	3587 (5.1)	.125
Preoperative anemia	1160 (6.6)	4021 (5.7)	<.001
Anxiety disorder	8994 (51.4)	29,098 (41.6)	<.001
Diabetes mellitus	9075 (51.9)	35,781 (51.1)	.081
Depression	9659 (55.2)	33,814 (48.3)	<.001
Peripheral vascular disease	5375 (30.7)	18,469 (26.4)	<.001

Abbreviation: TKA, total knee arthroplasty.

^aMatched 1:4.

^bBody mass index data were available for 60.3% of patients in the latex allergy cohort and 48.2% of patients in the cohort with no latex allergy. The percentages of patients in each body mass index range were calculated based only on patients with available body mass index data.

^cBecause Current Procedural Technology codes do not contain temporal data and are used in both inpatient and outpatient settings, length of stay data reflect only the 45.4% of patients in the latex allergy cohort and 37.1% of patients in the cohort with no latex allergy where the TKA procedure was billed for using International Classification of Diseases, Ninth Revision or Tenth Revision, procedural codes on inpatient claims.

With a concerted effort of the Association of periOperative Registered Nurses and the American College of Surgeons to move toward the use of all latex-free and synthetic gloves to prevent patient reactions and decrease medical staff sensitization,¹¹ many institutions have ceased using latex gloves, drapes, dressings, and urinary catheters over the past several years. Because of these incremental and asynchronous changes, it is not possible to detect whether these equipment changes influenced the rates of PJI for patients with a documented latex allergy during the study period. However, the use of a large national database minimizes a disproportionate impact of this trend on either cohort.¹²

Patients who are sensitized by proteins contained in natural rubber latex undergo an immunoglobulin E-mediated response that leads to symptoms that can be as mild as local histamine release and itching or as serious as anaphylaxis.¹³ The clinical diagnosis is variable and can be based on a patient-reported history of allergic symptoms on natural rubber latex exposure, a positive result on skin prick test, component-resolved diagnosis, and the results of basophil activation testing.¹³⁻¹⁵ However, even when recognized, it is unlikely that the local immunoglobulin E response is the sole contributor to the increase in odds risk of infection among patients with a documented latex allergy.

A possible hypothesis to explain the relationship between latex allergy and increased rates of PJI may be related to the pathophysiology of an allergic reaction. Although it is commonly understood that anaphylaxis is mediated via an immunoglobulin E-dependent pathway,^{16,17} research has shown other biologic factors, such as platelet-activating factor (PAF), also contributing to the development of anaphylaxis. The potent phospholipid-derived mediator PAF is involved in platelet aggregation and has been implicated in a variety of immune and inflammatory re-

TKA and THA. This study showed that a documented latex allergy was independently associated with increased odds of PJI at 90 days and 1 year after surgery for patients who underwent TKA and at

1 year after surgery for patients who underwent THA. Patients undergoing TKA with a documented latex allergy also had increased odds of revision at 1 year after surgery.

sponses; for example, PAF is a key mediator of the systemic inflammatory response leading to sepsis.¹⁸ Activation of PAF induces increased vascular permeability, hypotension, and cytokine production, which may contribute to increased general infection risk. The role of PAF in mediating systemic inflammatory responses is being further investigated in human trials,¹⁸ and it is being studied for its potential role in increasing the risk of PJI.

In addition to showing higher odds of PJI after TKA, patients with a documented latex allergy also exhibited significantly higher odds of prosthetic revision at 1 year (OR, 1.21; 95% CI, 1.06-1.39) after surgery. It is possible that the observed revision rates are partly a result of elevated PJI rates because PJI has been shown to lead to early failure in 25% of TKA procedures.¹⁹⁻²¹ Other contributors to failure and the need for revision arthroplasty include aseptic loosening, polyethylene wear, instability, and malalignment.^{22,23} Because PMMA is widely used in TKA and much less so in THA,²⁴ it is possible that cement use has a role in the increased rate of revision among patients with a documented latex allergy.

Limitations

There are several limitations of this study. An inherent limitation of an administrative claims database study is the potential for coding bias secondary to reliance on manual medical billing input, which is subject to human error. However, the Centers for Medicare & Medicaid Services showed that such instances are rare and accounted for only 1.0% of payments in 2019.²⁵ An additional source of coding bias is the use of both *ICD-9* and *ICD-10* codes. With the introduction of *ICD-10* codes during the study period in 2015, both *ICD-9* and *ICD-10* codes were used to query the database. Because billing codes do not tie exactly between *ICD-9* and *ICD-10*, a coding coupler and consensus review of inclusion and exclusion criteria were used

Characteristic	THA with latex allergy (n=8221)	THA with no latex allergy (n=32,884)	P
Sex, No. (%)			
Female	6730 (81.9)	26,916 (81.9)	.992
Male	1491 (18.1)	5968 (18.1)	.992
Age, mean±SD, y	64.46±10.55	64.52±10.53	.651
Age, No. (%)			
<65 y	3673 (44.7)	14,688 (44.7)	.994
≥65 y	4548 (55.3)	18,196 (55.3)	.994
Body mass index, No. (%) ^b			
<30 kg/m ²	1808 (27.2)	6233 (30.5)	<.001
30-35 kg/m ²	1920 (28.8)	5630 (27.6)	.044
36-40 kg/m ²	1595 (24.0)	4420 (21.6)	<.001
>40 kg/m ²	1332 (20.0)	4134 (20.3)	.681
Charlson Comorbidity Index, mean±SD	1.99±2.25	1.99±2.24	.975
Length of stay, mean±SD, d ^c	2.74±1.86	2.71±1.68	.499
90-day readmission rate, No. (%)	641 (7.8)	2031 (6.2)	<.001
Comorbidity, No. (%)			
Tobacco use	4189 (51.0)	13,693 (41.6)	<.001
Rheumatoid arthritis	775 (9.4)	2669 (8.1)	<.001
Liver disease	1005 (12.2)	3351 (10.2)	<.001
Ischemic heart disease	2180 (26.5)	7805 (23.7)	<.001
Alcohol abuse	576 (7.0)	2161 (6.6)	.165
Preoperative anemia	479 (5.8)	1741 (5.3)	.060
Anxiety disorder	4065 (49.4)	13,042 (39.7)	<.001
Diabetes mellitus	3620 (44.0)	13,585 (41.3)	<.001
Depression	4146 (50.4)	14,658 (44.6)	<.001
Peripheral vascular disease	2468 (30.0)	8481 (25.8)	<.001

Abbreviation: THA, total hip arthroplasty.
^aMatched 1:4.
^bBody mass index data were available for 81.0% of the latex allergy cohort and 62.1% of the patients in the cohort without latex allergy. The percentages of patients in each body mass index range were calculated based only on patients with available body mass index data.
^cBecause Current Procedural Technology codes do not contain temporal data and are used in both inpatient and outpatient settings, length of stay data reflect only the 49.4% of patients in the latex allergy cohort and 40.1% of patients in the cohort without latex allergy where the THA procedure was billed for using International Classification of Diseases, Ninth Revision or Tenth Revision, procedural codes on inpatient claims.

to ensure that all relevant *ICD-9* and *ICD-10* codes were included. The database is limited to administrative claims; therefore, the use of the Musculoskeletal Infection Society criteria to define infection was not

possible. Similar to earlier studies, PJI was defined with diagnosis codes pertaining to infectious processes related to the hip or knee prosthesis. A recent validation study by Kandel et al²⁸ reported that this method

Table 3

Rates of Prosthetic Joint Infection and Revision for TKA and THA Cohorts

Complication	TKA			THA		
	No. (%)			No. (%)		
	Latex allergy (n=17,501)	No latex allergy (n=70,004)	Odds ratio (95% CI)	Latex allergy (n=8221)	No latex allergy (n=32,884)	Odds ratio (95% CI)
Prosthetic joint infection						
90 d	287 (1.6)	809 (1.2)	1.26 (1.10-1.45)	175 (2.1)	536 (1.6)	1.14 (0.95-1.35)
1 y	401 (2.3)	1192 (1.7)	1.22 (1.08-1.36)	248 (3.0)	725 (2.2)	1.19 (1.02-1.38)
Aseptic revision						
90 d	111 (0.6)	345 (0.5)	1.15 (0.92-1.43)	106 (1.3)	387 (1.2)	1.01 (0.80-1.24)
1 y	284 (1.6)	843 (1.2)	1.21 (1.06-1.39)	180 (2.2)	570 (1.7)	1.15 (0.96-1.36)

Abbreviations: THA, total hip arthroplasty; TKA, total knee arthroplasty.

showed sensitivity of 0.88 (95% CI, 0.85-0.92) and positive predictive value of 0.78 (95% CI, 0.74-0.82) for detecting cases of PJI confirmed via chart review. Therefore, it is possible that rates of PJI are underestimated. Another limitation is that the database does not contain information on the type of gloves used in each procedure (ie, latex or non-latex). With documented rates of occupational latex allergies of as high as 17%⁵ and the trend of health care facilities moving toward non-latex supplies, it is reasonable to assume that a large proportion of included patients were operated on with non-latex gloves and drapes. Consequently, with use of a large database, intraoperative latex exposure is likely evenly distributed in each cohort. Further, patient exposure to latex is not exclusively through gloves worn by the health care team. Latex exposure may also occur with many unlisted Food and Drug Administration–approved products that contain latex, so contact with latex allergens outside of the surgical procedure is likely.¹²

CONCLUSION

Documented latex allergy was associated with significantly increased risk of PJI

and aseptic revision after TKA and PJI after THA. Further study is warranted to identify whether these risks can be mitigated by improvement of operative gloves with latex-free specifications or if this allergy represents an inherent, nonmodifiable factor because of an intrinsic mechanism within the patient that might prompt modification to typical arthroplasty pathways.

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Table A: Codes used to define study cohorts, PJI, and Prosthetic Revision

Latex Allergy			
ICD-9-D- V1507	ICD-10-D-Z91040		
Immunocompromised			
Status			
USC-86100	USC-86230	USC-30990	USC-3523
USC-86210	USC-86290	USC-35930	
USC-86220	USC-30210	USC-30940	
Primary THA Codes			
ICD-9-P-8151	ICD-10-P-0SRA039	ICD-10-P-0SRB0KZ	ICD-10-P-0SRS019
ICD-10-P-0SR9019	ICD-10-P-0SRA03A	ICD-10-P-0SRE009	ICD-10-P-0SRS01A
ICD-10-P-0SR901A	ICD-10-P-0SRA03Z	ICD-10-P-0SRE00A	ICD-10-P-0SRS01Z
ICD-10-P-0SR901Z	ICD-10-P-0SRA07Z	ICD-10-P-0SRE00Z	ICD-10-P-0SRS039
ICD-10-P-0SR9029	ICD-10-P-0SRA0J9	ICD-10-P-0SRE019	ICD-10-P-0SRS03A
ICD-10-P-0SR902A	ICD-10-P-0SRA0JA	ICD-10-P-0SRE01A	ICD-10-P-0SRS03Z
ICD-10-P-0SR902Z	ICD-10-P-0SRA0JZ	ICD-10-P-0SRE01Z	ICD-10-P-0SRS0J9
ICD-10-P-0SR9039	ICD-10-P-0SRA0KZ	ICD-10-P-0SRE039	ICD-10-P-0SRS0JA
ICD-10-P-0SR903A	ICD-10-P-0SRB019	ICD-10-P-0SRE03A	ICD-10-P-0SRS0JZ
ICD-10-P-0SR903Z	ICD-10-P-0SRB01A	ICD-10-P-0SRE03Z	ICD-10-P-0SRS0KZ
ICD-10-P-0SR9049	ICD-10-P-0SRB01Z	ICD-10-P-0SRE0J9	
ICD-10-P-0SR904A	ICD-10-P-0SRB029	ICD-10-P-0SRE0JA	
ICD-10-P-0SR904Z	ICD-10-P-0SRB02A	ICD-10-P-0SRE0JZ	
ICD-10-P-0SR907Z	ICD-10-P-0SRB02Z	ICD-10-P-0SRR019	
ICD-10-P-0SR90J9	ICD-10-P-0SRB039	ICD-10-P-0SRR01A	
ICD-10-P-0SR90JA	ICD-10-P-0SRB03A	ICD-10-P-0SRR01Z	

ICD-10-P-0SR90JZ	ICD-10-P-0SRB03Z	ICD-10-P-0SRR039
ICD-10-P-0SR90KZ	ICD-10-P-0SRB049	ICD-10-P-0SRR03A
ICD-10-P-0SRA009	ICD-10-P-0SRB04A	ICD-10-P-0SRR03Z
ICD-10-P-0SRA00A	ICD-10-P-0SRB04Z	ICD-10-P-0SRR07Z
ICD-10-P-0SRA00Z	ICD-10-P-0SRB07Z	ICD-10-P-0SRR0J9
ICD-10-P-0SRA019	ICD-10-P-0SRB0J9	ICD-10-P-0SRR0JA
ICD-10-P-0SRA01A	ICD-10-P-0SRB0JA	ICD-10-P-0SRR0JZ
ICD-10-P-0SRA01Z	ICD-10-P-0SRB0JZ	ICD-10-P-0SRR0KZ

Primary TKA Codes

ICD-9-P-8154	ICD-10-P-0SRD0JA	ICD-10-P-0SRU0JA	ICD-10-P-0SRW0KZ
ICD-10-P-0SRC07Z	ICD-10-P-0SRD0JZ	ICD-10-P-0SRU0JZ	
ICD-10-P-0SRC0J9	ICD-10-P-0SRD0KZ	ICD-10-P-0SRU0KZ	
ICD-10-P-0SRC0JA	ICD-10-P-0SRD0L9	ICD-10-P-0SRV0J9	
ICD-10-P-0SRC0JZ	ICD-10-P-0SRD0LZ	ICD-10-P-0SRV0JA	
ICD-10-P-0SRC0KZ	ICD-10-P-0SRT0J9	ICD-10-P-0SRV0JZ	
ICD-10-P-0SRC0L9	ICD-10-P-0SRT0JA	ICD-10-P-0SRW0J9	
ICD-10-P-0SRC0LZ	ICD-10-P-0SRT0JZ	ICD-10-P-0SRW0JA	
ICD-10-P-0SRD0J9	ICD-10-P-0SRU0J9	ICD-10-P-0SRW0JZ	

Exclusion Codes for Hip

ICD-9-D-82021	ICD-10-D-S72141C	ICD-10-D-S72001B	ICD-10-D-M84559A
ICD-9-D-82011	ICD-10-D-S72064A	ICD-10-D-S72146B	ICD-10-D-M84559D
ICD-9-D-82020	ICD-10-D-S72043C	ICD-10-D-S72012B	ICD-10-D-M84559G
ICD-9-D-8209	ICD-10-D-S72142B	ICD-10-D-S72002B	ICD-10-D-M84559K
ICD-9-D-82031	ICD-10-D-S72051B	ICD-10-D-S72101E	ICD-10-D-M84559S
ICD-9-D-82013	ICD-10-D-S72044B	ICD-10-D-S72012C	ICD-10-D-M84659A

ICD-9-D-82030	ICD-10-D-S72142C	ICD-10-D-S72009B	ICD-10-D-M84659D
ICD-9-D-82010	ICD-10-D-S72052B	ICD-10-D-S72051A	ICD-10-D-M84659G
ICD-9-D-82019	ICD-10-D-S72046B	ICD-10-D-S72019B	ICD-10-D-M84659K
ICD-9-D-82012	ICD-10-D-S72143B	ICD-10-D-S72002C	ICD-10-D-M84659P
ICD-9-D-82032	ICD-10-D-S72061B	ICD-10-D-S72101J	ICD-10-D-M84659S
ICD-9-D-73314	ICD-10-D-S72091B	ICD-10-D-S72052A	
ICD-10-D-S72009C	ICD-10-D-S72143C	ICD-10-D-S72001C	
ICD-10-D-S72062A	ICD-10-D-S72063A	ICD-10-D-S72102B	
ICD-10-D-S72041B	ICD-10-D-S72091C	ICD-10-D-S72061A	
ICD-10-D-S72109B	ICD-10-D-S72144B	ICD-10-D-M84459A	
ICD-10-D-S72059A	ICD-10-D-S72092B	ICD-10-D-M84459D	
ICD-10-D-S72042B	ICD-10-D-S72066A	ICD-10-D-M84459G	
ICD-10-D-S72141B	ICD-10-D-S72101B	ICD-10-D-M84459K	
ICD-10-D-S72065A	ICD-10-D-S72145B	ICD-10-D-M84459P	
ICD-10-D-S72043B	ICD-10-D-S72011B	ICD-10-D-M84459S	

Exclusion codes for knee

ICD-9-D-73315	ICD-9-D-82382	ICD-10-D-S72456A	ICD-10-D-S82401A
ICD-9-D-73397	ICD-9-D-82390	ICD-10-D-S72499A	ICD-10-D-S82202A
ICD-9-D-82100	ICD-9-D-82392	ICD-10-D-S72409B	ICD-10-D-S82402A
ICD-9-D-82110	ICD-9-P-0080	ICD-10-D-S72453B	ICD-10-D-S82201B
ICD-9-D-82120	ICD-9-P-0081	ICD-10-D-M84469A	ICD-10-D-S82201C
ICD-9-D-82123	ICD-9-P-0082	ICD-10-D-M84369A	ICD-10-D-S82401B
ICD-9-D-82129	ICD-9-P-0083	ICD-10-D-S82109A	ICD-10-D-S82202B
ICD-9-D-82130	ICD-9-P-0084	ICD-10-D-S82101A	ICD-10-D-S82402B
ICD-9-D-82132	ICD-9-P-8155	ICD-10-D-S82831A	ICD-10-P-0SPC0JZ

ICD-9-D-82133	ICD-9-P-8006	ICD-10-D-S82102A	ICD-10-P-0SPD0JZ
ICD-9-D-82139	ICD-10-D-M84453A	ICD-10-D-S82832A	
ICD-9-D-73316	ICD-10-D-M84750A	ICD-10-D-S82109B	
ICD-9-D-73393	ICD-10-D-M84353A	ICD-10-D-S82109C	
ICD-9-D-82300	ICD-10-D-S7290XA	ICD-10-D-S82101B	
ICD-9-D-82302	ICD-10-D-S7290XB	ICD-10-D-S82831B	
ICD-9-D-82310	ICD-10-D-S7290XC	ICD-10-D-S82102B	
ICD-9-D-82312	ICD-10-D-S72409A	ICD-10-D-S82832B	
ICD-9-D-82380	ICD-10-D-S72453A	ICD-10-D-S82201A	

TKA Joint Infection

ICD-9-D-99666	ICD-10-D-T8453XA	ICD-10-D-T8453XS	ICD-10-D-T8454XD
ICD-9-D-99667	ICD-10-D-T8453XD	ICD-10-D-T8454XA	ICD-10-T8454XS

THA Joint Infection

ICD-9-D-99667	ICD-10-D-T8451XS	ICD-10-D-T8453XA	ICD-10-D-T8454XD
ICD-9-D-99666	ICD-10-D-T8452XA	ICD-10-D-T8453XD	ICD-10-D-T8454XS
ICD-10-D-T8451XA	ICD-10-D-T8452XD	ICD-10-D-T8453XS	
ICD-10-D-T8451XD	ICD-10-D-T8452XS	ICD-10-D-T8454XA	

TKA Prosthetic Revision

ICD-9-P-0080	ICD-10-P-0QPF0JZ	ICD-10-P-0SPD08Z	ICD-10-P-0SRC06A
ICD-9-P-0081	ICD-10-P-0QRF3JZ	ICD-10-P-0SRU0JA	ICD-10-P-0SRC06Z
ICD-9-P-0082	ICD-10-P-0SUD09C	ICD-10-P-0SRU0JZ	ICD-10-P-0SRC0J9
ICD-9-P-0083	ICD-10-P-0QPF3JZ	ICD-10-P-0SPD48Z	ICD-10-P-0SRC0JA
ICD-9-P-0084	ICD-10-P-0QRF4JZ	ICD-10-P-0SPD4JZ	ICD-10-P-0SRC0JZ
ICD-10-P-0SPC09Z	ICD-10-P-0QUF0JZ	ICD-10-P-0SPW0JZ	ICD-10-P-0SPC4JZ
ICD-10-P-0SUV09Z	ICD-10-P-0QUF4JZ	ICD-10-P-0SRV0J9	ICD-10-P-0SPC0JZ

ICD-10-P-0SUW09Z	ICD-10-P-0SRT0J9	ICD-10-P-0SRV0JA	ICD-10-P-0SRD069
ICD-10-P-0SPD09Z	ICD-10-P-0SPC08Z	ICD-10-P-0SRV0JZ	ICD-10-P-0SRD0JA
ICD-10-P-0QRD0JZ	ICD-10-P-0SRT0JA	ICD-10-P-0SPT0JZ	ICD-10-P-0SRD0JZ
ICD-10-P-0QPD0JZ	ICD-10-P-0SRT0JZ	ICD-10-P-0SRW0J9	ICD-10-P-0SRD0J9
ICD-10-P-0QRD3JZ	ICD-10-P-0SPC48Z	ICD-10-P-0SRW0JA	ICD-10-P-0SRD06A
ICD-10-P-0QUD0JZ	ICD-10-P-0SPC4JZ	ICD-10-P-0SRW0JZ	ICD-10-P-0SRD06Z
ICD-10-P-0SUC09C	ICD-10-P-0SPV0JZ	ICD-10-P-0SPU0JZ	ICD-10-P-0SPD0JZ
ICD-10-P-0QRF0JZ	ICD-10-P-0SRU0J9	ICD-10-P-0SRC069	

THA Prosthetic Revision

ICD-9-P-0070	ICD-10-P-0SW909Z	ICD-10-P-0SWA0JZ	ICD-10-P-0SWB3JZ
ICD-9-P-0071	ICD-10-P-0SW90BZ	ICD-10-P-0SWAXJZ	ICD-10-P-0SWBXJZ
ICD-9-P-0072	ICD-10-P-0SW90JZ	ICD-10-P-0SWB04Z	
ICD-9-P-0073	ICD-10-P-0SW93JZ	ICD-10-P-0SWB08Z	
ICD-10-P-0SW904Z	ICD-10-P-0SW9X8Z	ICD-10-P-0SWB09Z	
ICD-10-P-0SW908Z	ICD-10-P-0SW9XJZ	ICD-10-P-0SWB0JZ	

THA, Total Hip Arthroplasty; TKA, Total Knee Arthroplasty; ICD-9, International Classification of Disease 9th Revision; ICD-10, International Classification of Disease 10th Revision

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