

Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

eTable 1. Procedure Codes Used to Identify Revision TKR

Procedure Codes –used to identify TKR revision	
Variable	Procedure code
Revision of knee replacement, total (all components)	00.80
Revision of knee replacement, tibial component	
Replacement of tibial baseplate and tibial insert (liner)	00.81
Revision of knee replacement, femoral component	00.82
Revision of knee replacement, patellar component	00.83
Revision of total knee replacement, tibial insert	00.84
Revision of knee replacement, not otherwise specified	81.55
Removal of knee prosthesis without replacement	80.06

eTable 2. Reasons for Revision TKR: ICD-9-CM Codes

Reasons for revision	Diagnosis	ICD-9 codes
Mechanical/Aseptic	Osteoarthritis	715.X0; 715.X5; 715.X6; 715.X8;
Mechanical/Aseptic	Pathological dislocation	718.20; 718.25; 718.26; 718.28; 718.29
Mechanical/Aseptic	Recurrent dislocation of joint	718.30; 718.35; 718.36; 718.38; 718.39
Mechanical/Aseptic	Contracture of joint	718.40; 718.45; 718.46; 718.48; 718.49;
Mechanical/Aseptic	Ankylosis of joint	718.50; 718.55; 718.56; 718.58; 718.59
Mechanical/Aseptic	Other joint derangement not elsewhere classified	718.90; 718.95; 718.96; 718.98; 718.99
Mechanical/Aseptic	Other and unspecified disorders of bone and cartilage	733.90; 733.99
Mechanical/Aseptic	Other acquired deformities of knee	736.6
Mechanical/Aseptic	Mechanical complication of internal orthopedic device implant and graft	996.40-996.43; 996.45-996.49
Mechanical/Aseptic	Mechanical complication due to other implant and internal device, not elsewhere classified	996.59
Mechanical/Aseptic	Other complications due to internal prosthetic device, implant, and graft	996.70; 996.77; 996.78; 996.79
Septic	Pyogenic arthritis Unspecified infective arthritis Osteomyelitis	711.OX 711.9X 730.OX, 730.1X, 730.2X
Septic	Infection and inflammatory reaction due to internal prosthetic device implant and graft	996.60; 996.66; 996.67; 996.69
Septic	Infected postoperative seroma	998.51
Septic	Other postoperative infection	998.59
Fracture	Pathologic fracture	733.10; 733.14-733.19;
Fracture	Malunion and nonunion of fracture	733.8X;
Fracture	Other and unspecified disorders of bone and cartilage – stress fracture	733.93; 733.96-733.98
Fracture	Fracture of other and unspecified parts of femur	821.X
Fracture	Fracture of patella	822.X
Fracture	Fracture of tibia and fibula	823.X
Fracture	Other multiple and ill-defined fractures of lower limb	827.X

Reasons for revision	Diagnosis	ICD-9 codes
Other	Disruption of operation wound	998.3X
Other	Foreign body accidentally left during a procedure	998.4
Other	Persistent postoperative fistula	998.6
Other	Acute reaction to foreign substance accidentally left during a procedure	998.7
Other	Non-healing surgical wound	998.83
Other	Unspecified complication of procedure, not elsewhere classified	998.89; 998.9
Other	Revisions lacking any specific codes for infection, mechanical causes or fracture	

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

X = Indicates that the variable includes all codes starting with the numbers preceding the "X".

eTable 3. Comorbidities, Indication for TKR, Complications Index TKR: ICD-9-CM Codes

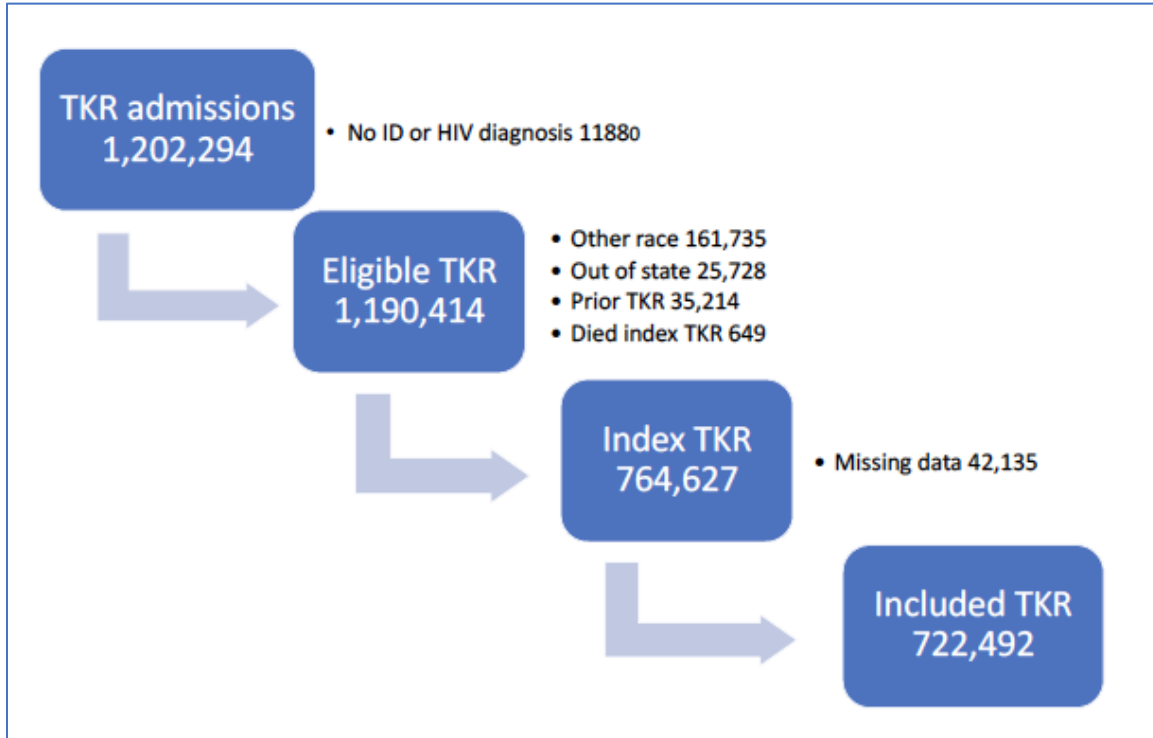
Comorbidities	Diagnosis	ICD-9 codes
Diabetes	Diabetes	250.X
Obesity	Obesity	278.0X
Renal disease	Renal disease	403.X; 581.X-583.X; 585.X-587.X
COPD	Chronic obstructive pulmonary disease	491.2X, 492.X

Indication for index TKR	Diagnosis	ICD-9 codes
Osteoarthritis	Osteoarthrosis	715.X0; 715.X5; 715.X6; 715.X8;
Osteonecrosis	Osteonecrosis	733.4X
Inflammatory arthritis	Rheumatoid arthritis	714.0
	Psoriatic arthritis	696.0
	Spondyloarthropathy	720.X; 099.3

Surgical complications index surgery	Diagnosis	ICD-9 codes
Surgical complications		
	Hemorrhage or hematoma complicating a procedure not elsewhere classified	998.1X
	Disruption of operation wound	998.3X
	Foreign body accidentally left during a procedure, Acute reaction to foreign substance accidentally left during a procedure	998.4; 998.7

Medical complications index surgery	Diagnosis	ICD-9 codes
Infection index surgery		
	Other infection due to medical care not elsewhere classified	999.3
	Pneumonia	480-486; 997.3X; 510.X
	Skin infection	035; 680-682; 684; 686.8; 686.9
	Bacterial infection in conditions classified elsewhere and of unspecified site	041.X
	Urinary tract infection, kidney infection	590.X; 597.X; 599.1; 599.9;
	Bacteremia/Sepsis	038.X; 790.7; 995.90; 995.91; 995.92; 998.02
	Upper respiratory tract infection	460-466; 471-476; 034.X
	Gastroenteritis	005.X; 008.X; 009.X;
	Postoperative infection not elsewhere classified	998.5X
	Diverticulitis, peritonitis	562.11; 567.X

eFigure. Flow Diagram Showing Patients Included and Excluded From the Study



eTable 4. Cox Multivariable Proportional Hazards Regression Modeling of Septic and Aseptic Revision TKR Risk in Black Patients Only

Variable	Aseptic			Septic		
	HR	CI	P value	HR	CI	P value
Age (5yrs)	0.795	(0.78-0.81)	<.0001	0.824	(0.80-0.85)	<.0001
Sex - male	0.977	(0.89-1.08)	0.6296	1.635	(1.43-1.87)	<.0001
Insurance						
Medicaid	0.997	(0.85-1.18)	0.9743	0.909	(0.72-1.14)	0.4141
Other	0.830	(0.65-1.07)	0.1454	0.585	(0.40-0.86)	0.0071
Private	0.977	(0.88-1.09)	0.6717	0.676	(0.57-0.80)	<.0001
Workers compensation	1.487	(1.27-1.74)	<.0001	0.779	(0.59-1.03)	0.0797
Comorbidities						
Diabetes	1.057	(0.96-1.17)	0.2693	1.150	(1.00-1.33)	0.0555
Obesity	0.895	(0.81-0.99)	0.0254	1.036	(0.90-1.20)	0.6364
Renal disease	0.689	(0.54-0.88)	0.0032	1.393	(1.09-1.78)	0.0086
COPD	1.086	(0.92-1.28)	0.3177	1.206	(0.97-1.50)	0.0883
Inflammatory arthritis*	0.626	(0.49-0.80)	0.0002	1.259	(0.95-1.66)	0.1038
Index TKR surgery						
Surgical Complication**	1.333	(0.95-1.86)	0.0919	1.750	(1.15-2.67)	0.0096
Census tract variables						
CT % no college	0.822	(0.57-1.18)	0.2846	0.706	(0.41-1.21)	0.2057
CT % poverty	0.969	(0.87-1.08)	0.5647	1.055	(0.90-1.24)	0.5178
Hospital annual TKR volume (reference 645+)						
236-644	0.851	(0.75-0.97)	0.0143	1.119	(0.89-1.40)	0.3265
90-235	0.859	(0.75-0.99)	0.0306	1.349	(1.07-1.70)	0.0113
<=89	0.873	(0.74-1.03)	0.1001	1.754	(1.36-2.26)	<.0001
Hospital bed size						
200-399 beds	0.961	(0.86-1.07)	0.4636	1.110	(0.95-1.30)	0.2016
6-199 beds	1.066	(0.94-1.21)	0.3213	1.080	(0.88-1.32)	0.4514
Hospital type						
Government, non-federal	0.901	(0.78-1.05)	0.1720	1.142	(0.93-1.40)	0.1943
Investor-owned (for-profit)	1.003	(0.87-1.15)	0.9678	1.081	(0.88-1.34)	0.4691
Rural	1.144	(0.78-1.69)	0.4978	1.167	(0.65-2.10)	0.6053
Teaching hospital	0.902	(0.81-1.00)	0.0499	1.242	(1.06-1.46)	0.0077
State						
California	1.265	(1.13-1.42)	<.0001	1.256	(1.06-1.49)	0.0080
Florida	1.062	(0.94-1.20)	0.3310	0.951	(0.79-1.14)	0.5936
Year	1.020	(1.00-1.04)	0.0242	1.009	(0.98-1.03)	0.4863

*Rheumatoid arthritis, psoriatic arthritis, spondyloarthropathy

**Hemorrhage, wound disruption, retained foreign body

TKR = Total Knee Replacement

eTable 5. Cox Multivariable Proportional Hazards Regression Modeling of Septic and Aseptic Revision TKR Risk in White Patients Only

Variable	Aseptic			Septic		
	HR	CI	P value	HR	CI	P value
Age (5yrs)	0.779	(0.77-0.79)	<.0001	0.849	(0.84-0.86)	<.0001
Sex- male	1.041	(1.01-1.08)	0.0177	1.609	(1.54-1.68)	<.0001
Insurance						
Medicaid	0.937	(0.84-1.05)	0.2458	1.255	(1.10-1.44)	0.0011
Other	0.942	(0.85-1.05)	0.2821	0.997	(0.86-1.16)	0.9712
Private	0.899	(0.86-0.94)	<.0001	0.773	(0.73-0.82)	<.0001
Workers compensation	1.624	(1.51-1.74)	<.0001	0.978	(0.87-1.10)	0.7040
Comorbidities						
Diabetes	1.017	(0.97-1.06)	0.4401	1.247	(1.18-1.32)	<.0001
Obesity	0.785	(0.75-0.82)	<.0001	1.147	(1.08-1.21)	<.0001
Renal disease	0.897	(0.80-1.00)	0.0578	1.426	(1.28-1.59)	<.0001
COPD	1.040	(0.99-1.10)	0.1525	1.221	(1.15-1.30)	<.0001
Inflammatory arthritis	0.789	(0.71-0.87)	<.0001	1.574	(1.42-1.75)	<.0001
Index TKR surgery						
Surgical complication	1.112	(0.93-1.32)	0.2313	2.277	(1.92-2.69)	<.0001
Census tracts						
CT % no college	0.901	(0.80-1.02)	0.1004	1.186	(1.00-1.41)	0.0543
CT % poverty	0.998	(0.94-1.06)	0.9551	1.021	(0.94-1.11)	0.6277
Hospital annual TKR volume (reference 645+)						
236-644	1.052	(1.00-1.10)	0.0354	1.138	(1.06-1.22)	0.0002
90-235	1.079	(1.02-1.14)	0.0041	1.324	(1.23-1.42)	<.0001
<=89	1.204	(1.13-1.29)	<.0001	1.498	(1.36-1.65)	<.0001
Hospital bed size						
200-399	1.048	(1.00-1.09)	0.0389	0.973	(0.92-1.03)	0.3799
6-199	1.020	(0.97-1.07)	0.4333	0.997	(0.93-1.07)	0.9320
Hospital type						
Government, non-federal	1.060	(1.00-1.12)	0.0348	1.067	(0.99-1.15)	0.0955
Investor-owned (for-profit)	1.118	(1.07-1.17)	<.0001	1.125	(1.05-1.20)	0.0006
rural	0.969	(0.90-1.04)	0.4070	0.854	(0.77-0.95)	0.0042
Teaching hospital	0.944	(0.91-0.98)	0.0050	1.125	(1.06-1.19)	<.0001
State						
California	1.103	(1.06-1.15)	<.0001	1.152	(1.08-1.22)	<.0001
Florida	1.058	(1.01-1.11)	0.0209	0.915	(0.86-0.98)	0.0087
Year	1.021	(1.01-1.03)	<.0001	1.028	(1.02-1.04)	<.0001

*Rheumatoid arthritis, psoriatic arthritis, spondyloarthropathy

**Hemorrhage, wound disruption, retained foreign body

TKR = Total Knee Replacement

eTable 6. Marginal Cox Proportional Hazards Regression Model, Cox Proportional Hazards Regression Model Stratified by State, and Cox Proportional Hazards Regression Model With a Frailty Term for Risk of Aseptic Revision TKR

Variable	Marginal Cox Model			Stratified by State			Frailty Model		
	HR	CI	P value	HR	CI	P value	HR	CI	P value
Age (5yrs)	0.782	(0.77-0.79)	<.0001	0.782	(0.77-0.79)	<.0001	0.782	(0.77-0.79)	<.0001
Race-Black	1.387	(1.36-1.41)	<.0001	1.391	(1.32-1.46)	<.0001	1.391	(1.32-1.46)	<.0001
Sex - Male	1.034	(1.02-1.05)	<.0001	1.032	(1.00-1.06)	0.0455	1.032	(1.00-1.06)	0.0444
Insurance									
Medicaid	0.943	(0.89-1.00)	0.0503	0.941	(0.86-1.03)	0.1860	0.939	(0.86-1.03)	0.1691
Other	0.913	(0.82-1.02)	0.1006	0.917	(0.83-1.01)	0.0873	0.917	(0.83-1.01)	0.0885
Private	0.914	(0.88-0.95)	<.0001	0.913	(0.88-0.95)	<.0001	0.913	(0.88-0.95)	<.0001
Workers Compensation	1.629	(1.57-1.69)	<.0001	1.614	(1.51-1.72)	<.0001	1.610	(1.51-1.72)	<.0001
Comorbidities									
Diabetes	1.021	(0.96-1.08)	0.4981	1.024	(0.98-1.07)	0.2428	1.024	(0.98-1.07)	0.2410
Obesity	0.809	(0.79-0.83)	<.0001	0.806	(0.77-0.84)	<.0001	0.805	(0.77-0.84)	<.0001
Renal disease	0.859	(0.80-0.92)	<.0001	0.854	(0.77-0.95)	0.0025	0.855	(0.77-0.95)	0.0027
COPD	1.039	(1.00-1.08)	0.0580	1.045	(0.99-1.10)	0.0850	1.045	(0.99-1.10)	0.0884
Inflammatory arthritis*	0.762	(0.64-0.90)	0.0017	0.763	(0.70-0.84)	<.0001	0.763	(0.70-0.84)	<.0001
Index TKR									
Surgical Complication**	1.157	(1.05-1.28)	0.0048	1.152	(0.99-1.34)	0.0717	1.152	(0.99-1.34)	0.0722
Census tracts									
% no college	0.822	(0.69-0.98)	0.0272	0.910	(0.81-1.02)	0.1130	0.904	(0.80-1.02)	0.0893
% below poverty	1.007	(0.93-1.09)	0.8574	0.981	(0.93-1.03)	0.4787	0.982	(0.93-1.04)	0.5083
Hospital annual TKR volume									
236 to 644	1.043	(0.88-1.24)	0.6326	1.025	(0.98-1.07)	0.2746	1.028	(0.98-1.07)	0.2168
90 to 235	1.057	(0.83-1.34)	0.6439	1.046	(1.00-1.10)	0.0697	1.049	(1.00-1.10)	0.0538
<=89	1.153	(0.89-1.50)	0.2869	1.140	(1.07-1.21)	<.0001	1.143	(1.07-1.22)	<.0001
Hospital bed size									
200-399	1.055	(0.94-1.19)	0.3657	1.038	(1.00-1.08)	0.0755	1.039	(1.00-1.08)	0.0623
6-199	1.049	(0.92-1.20)	0.4792	1.028	(0.98-1.08)	0.2413	1.030	(0.98-1.08)	0.2135
Hospital Type									
Government, non-federal	1.035	(0.94-1.14)	0.4705	1.032	(0.98-1.09)	0.2270	1.034	(0.98-1.09)	0.1977
Investor-owned (for-profit)	1.090	(1.05-1.14)	<.0001	1.101	(1.05-1.15)	<.0001	1.102	(1.05-1.15)	<.0001
Rural	0.968	(0.93-1.01)	0.1648	0.975	(0.91-1.05)	0.4996	0.975	(0.91-1.05)	0.4931
Teaching hospital	0.932	(0.89-0.98)	0.0033	0.938	(0.90-0.97)	0.0008	0.938	(0.90-0.97)	0.0008
Calendar year	1.021	(0.99-1.05)	0.1341	1.021	(1.01-1.03)	<.0001	1.021	(1.01-1.03)	<.0001

*Rheumatoid arthritis, psoriatic arthritis, spondyloarthropathy; **Hemorrhage, wound disruption, retained foreign body
TKR = Total Knee Replacement

eTable 7. Marginal Cox Proportional Hazards Regression Model, Cox Proportional Hazards Regression Model Stratified by State, and Cox Proportional Hazards Regression Model With a Frailty Term for Risk of Septic Revision TKR

Variable	Marginal Cox Model			Stratified by State			Frailty		
	HR	CI	P value	HR	CI	P value	HR	CI	P value
Age (5yrs)	0.845	(0.83-0.86)	<.0001	0.845	(0.83-0.86)	<.0001	0.845	(0.83-0.86)	<.0001
Race-Black	1.105	(1.05-1.17)	0.0004	1.113	(1.03-1.20)	0.0041	1.113	(1.03-1.20)	0.0041
Sex - Male	1.619	(1.53-1.71)	<.0001	1.614	(1.55-1.68)	<.0001	1.613	(1.55-1.68)	<.0001
Insurance									
Medicaid	1.176	(1.14-1.22)	<.0001	1.168	(1.04-1.31)	0.0086	1.167	(1.04-1.31)	0.0090
Other	0.920	(0.88-0.97)	0.0009	0.929	(0.81-1.07)	0.2974	0.929	(0.81-1.07)	0.2985
Private	0.761	(0.69-0.84)	<.0001	0.759	(0.72-0.80)	<.0001	0.758	(0.72-0.80)	<.0001
Workers Compensation	0.972	(0.89-1.07)	0.5484	0.950	(0.85-1.06)	0.3495	0.950	(0.85-1.06)	0.3416
Comorbidities									
Diabetes	1.227	(1.20-1.25)	<.0001	1.235	(1.17-1.30)	<.0001	1.236	(1.17-1.30)	<.0001
Obesity	1.145	(1.10-1.19)	<.0001	1.132	(1.07-1.19)	<.0001	1.132	(1.07-1.19)	<.0001
Renal disease	1.440	(1.38-1.50)	<.0001	1.424	(1.29-1.57)	<.0001	1.425	(1.29-1.57)	<.0001
COPD	1.207	(1.16-1.26)	<.0001	1.222	(1.15-1.30)	<.0001	1.221	(1.15-1.30)	<.0001
Inflammatory arthritis*	1.526	(1.38-1.69)	<.0001	1.531	(1.39-1.69)	<.0001	1.530	(1.39-1.69)	<.0001
Index TKR									
Surgical Complication**	2.212	(1.89-2.60)	<.0001	2.191	(1.87-2.56)	<.0001	2.191	(1.87-2.56)	<.0001
Census tracts									
% no college	0.917	(0.82-1.02)	0.1072	1.145	(0.97-1.35)	0.1081	1.136	(0.96-1.34)	0.1297
% below poverty	1.074	(1.04-1.10)	<.0001	1.012	(0.94-1.09)	0.7450	1.014	(0.94-1.09)	0.7025
Hospital annual TKR volume									
236 to 644	1.177	(1.01-1.37)	0.0351	1.132	(1.06-1.21)	0.0001	1.135	(1.06-1.21)	0.0001
90 to 235	1.356	(1.19-1.55)	<.0001	1.322	(1.23-1.42)	<.0001	1.327	(1.24-1.42)	<.0001
<=89	1.576	(1.44-1.72)	<.0001	1.535	(1.41-1.68)	<.0001	1.540	(1.41-1.68)	<.0001
Hospital bed size									
200-399	1.029	(0.96-1.10)	0.3949	0.990	(0.94-1.05)	0.7316	0.992	(0.94-1.05)	0.7849
6-199	1.058	(1.00-1.12)	0.0688	1.009	(0.94-1.08)	0.7970	1.011	(0.95-1.08)	0.7488
Hospital Type									
Government, non-federal	1.080	(0.95-1.23)	0.2421	1.076	(1.00-1.15)	0.0437	1.077	(1.00-1.16)	0.0407
Investor-owned (for-profit)	1.093	(1.03-1.16)	0.0022	1.121	(1.05-1.20)	0.0005	1.120	(1.05-1.19)	0.0005
Rural	0.842	(0.83-0.85)	<.0001	0.860	(0.77-0.96)	0.0052	0.859	(0.77-0.96)	0.0050
Teaching hospital	1.125	(1.04-1.22)	0.0046	1.138	(1.08-1.20)	<.0001	1.140	(1.08-1.20)	<.0001
Calendar year	1.025	(1.00-1.05)	0.0152	1.026	(1.02-1.03)	<.0001	1.026	(1.02-1.03)	<.0001

*Rheumatoid arthritis, psoriatic arthritis, spondyloarthropathy; **Hemorrhage, wound disruption, retained foreign body
TKR = Total Knee Replacement