

Appendix

TABLE E-1 Prediction Models for Inpatient Mortality in the Developmental Database for Total Hip and Knee Replacement in Medicare Patients

Risk Factor Description	Total Hip Replacement*	Total Knee Replacement*
Male sex	2.188 (1.659 to 2.887)	1.875 (1.563 to 2.249)
Age of 75 to 84 years	1.919 (1.413 to 2.606)	1.996 (1.643 to 2.426)
Age of ≥85 years	3.724 (2.472 to 5.611)	3.270 (2.409 to 4.439)
Pulmonary hypertension	5.050 (2.669 to 9.556)	3.078 (1.957 to 4.839)
Evidence of recent injury	7.379 (4.610 to 11.812)	8.199 (5.892 to 11.410)
Heart failure	8.184 (3.177 to 21.083)	2.939 (2.222 to 3.887)
No systemic hypertension	2.022 (1.502 to 2.721)	1.929 (1.581 to 2.354)
Malnutrition	7.342 (2.923 to 18.442)	5.582 (2.767 to 11.260)
Chronic renal failure	3.287 (2.235 to 4.833)	7.179 (4.721 to 10.918)
Orthopaedic complications	5.895 (2.683 to 12.954)	Not significant
Gastrointestinal bleeding	Not significant	13.942 (4.943 to 39.320)
Arterial disease	Not significant	2.229 (1.575 to 3.155)
Intestinal inflammation	Not significant	21.175 (6.612 to 67.806)
Other renal disorders	Not significant	6.439 (2.724 to 15.221)

*The values are given as the odds ratio, with the 95% confidence interval in parentheses. Unless designated as not significant, the values were significant at $p < 0.001$.

TABLE E-2 Prediction Models for Prolonged Length of Stay in the Developmental Database for Total Hip and Knee Replacement in Medicare Patients

Risk Factor Description	Total Hip Replacement*	Total Knee Replacement*
Male sex	1.192 (1.141 to 1.245)	1.246 (1.211 to 1.281)
Age of 75 to 84 years	1.414 (1.362 to 1.478)	1.340 (1.299 to 1.374)
Age of ≥85 years	1.726 (1.606 to 1.855)	1.650 (1.566 to 1.749)
Heart valve disease	1.461 (1.358 to 1.572)	1.291 (1.225 to 1.362)
Pulmonary hypertension	1.814 (1.586 to 2.075)	2.123 (1.945 to 2.317)
No systemic hypertension	1.146 (1.094 to 1.201)	1.127 (1.092 to 1.163)
Coronary atherosclerosis	Not significant	1.647 (1.421 to 1.909)
Hypertensive heart disease	Not significant	1.468 (1.313 to 1.641)
Rheumatic heart disease	Not significant	1.507 (1.381 to 1.645)
Prior myocardial infarction	Not significant	1.207 (1.168 to 1.247)
Prior heart transplant	Not significant	3.806 (2.193 to 6.604)
Other myocardial disease	1.372 (1.307 to 1.441)	Not significant
Aortic aneurysm	Not significant	6.376 (2.798 to 14.528)
Cardiac dysrhythmia	1.515 (1.428 to 1.607)	1.444 (1.388 to 1.502)
Conduction disturbance	Not significant	1.171 (1.085 to 1.264)
Lower-extremity venous insufficiency	7.520 (3.451 to 16.382)	5.289 (3.072 to 9.104)
Pericardial disease	Not significant	3.864 (2.516 to 5.934)
Systolic heart failure	19.070 (12.112 to 30.025)	13.461 (10.259 to 17.663)
Other heart failure	1.761 (1.623 to 1.910)	1.668 (1.575 to 1.766)
Complications of cardiovascular device	6.625 (2.932 to 14.966)	3.547 (1.901 to 6.619)
Miscellaneous cardiac conditions	Not significant	2.079 (1.539 to 2.810)
Systemic hypotension	Not significant	1.557 (1.310 to 1.851)
Peripheral arterial disease	Not significant	1.185 (1.105 to 1.270)
Varicose veins	1.365 (1.171 to 1.590)	Not significant
Diabetes	1.113 (1.055 to 1.175)	1.090 (1.056 to 1.126)
Complications of diabetes	1.500 (1.259 to 1.788)	1.430 (1.301 to 1.573)
Overweight	1.635 (1.490 to 1.794)	1.547 (1.471 to 1.626)
Severe malnutrition	4.078 (3.349 to 4.964)	Not significant
Mild malnutrition	Not significant	1.594 (1.357 to 1.872)
Metabolic, immunologic, or deficiency disorders	1.940 (1.440 to 2.613)	2.373 (1.971 to 2.857)
Mineral metabolism disorders	Not significant	1.511 (1.290 to 1.769)
Neuroadrenal disorder	3.540 (2.587 to 4.844)	4.547 (3.687 to 5.606)
Esophageal ulcer	Not significant	3.952 (2.675 to 5.840)
Reflux esophagitis	1.406 (1.176 to 1.680)	1.533 (1.370 to 1.716)
Gastrointestinal bleeding	6.429 (3.926 to 10.527)	7.031 (5.197 to 9.513)
Severe gastric ulcer or gastritis	2.896 (1.968 to 4.261)	3.344 (2.613 to 4.279)
Mild gastric ulcer	Not significant	1.371 (1.215 to 1.546)
Constipation	Not significant	1.249 (1.148 to 1.359)
Other upper gastrointestinal disorders	2.782 (1.841 to 4.203)	1.646 (1.358 to 1.994)
Intestinal obstruction	18.475 (9.027 to 37.810)	17.046 (10.773 to 26.970)
Abnormal abdominal findings	Not significant	1.965 (1.590 to 2.428)
Miscellaneous gastrointestinal conditions	9.843 (4.525 to 21.412)	5.757 (3.512 to 9.436)
Gastrointestinal bleeding	Not significant	7.031 (5.197 to 9.513)
Intestinal inflammation	9.082 (4.910 to 16.799)	4.776 (3.114 to 7.327)
Pancreatic disease	Not significant	1.946 (1.356 to 2.791)
End-stage renal disease	Not significant	4.661 (2.478 to 8.767)
Chronic renal failure	Not significant	1.687 (1.516 to 1.878)
Other renal disorders	1.865 (1.740 to 1.998)	1.810 (1.729 to 1.895)
Urinary tract obstruction	1.493 (1.323 to 1.684)	1.480 (1.369 to 1.611)
Urinary tract infection or inflammation	Not significant	1.429 (1.307 to 1.564)
Urinary tract abnormality	Not significant	1.787 (1.398 to 2.283)

Male genital conditions or symptoms	3.048 (1.947 to 4.771)	2.665 (1.722 to 4.123)
Miscellaneous hematologic conditions	Not significant	1.772 (1.481 to 2.121)
Anemia, iron deficiency	1.382 (1.190 to 1.605)	1.122 (1.058 to 1.191)
Clotting disorders	3.181 (2.369 to 4.272)	Not significant
Skeletal deformities	1.257 (1.132 to 1.396)	Not significant
Orthopaedic brace	1.942 (1.424 to 2.647)	Not significant
Muscle and tendon disorders	2.628 (1.653 to 4.178)	Not significant
Alzheimer disease or dementia	4.628 (2.137 to 10.026)	5.109 (3.027 to 8.625)
Other psychiatric disorders	1.199 (1.097 to 1.311)	Not significant
Chronic bronchitis or asthma	5.217 (3.418 to 7.963)	4.978 (3.923 to 6.316)
Other chronic obstructive lung disease	1.267 (1.189 to 1.349)	1.272 (1.218 to 1.328)
Upper respiratory conditions	3.469 (1.769 to 6.804)	Not significant
Malignant neoplasm	4.512 (2.027 to 10.043)	3.022 (1.949 to 4.684)
Benign neoplasm	2.615 (1.631 to 4.193)	2.310 (1.819 to 2.942)
Metastatic cancer	Not significant	3.565 (1.919 to 6.626)
Hematopoietic malignancy	Not significant	1.317 (1.146 to 1.514)
Neoplasm of uncertain behavior	Not significant	1.600 (1.335 to 1.913)
Drug toxicity or reactions	3.548 (3.128 to 4.023)	3.427 (3.176 to 3.697)
Seizure disorder	Not significant	1.269 (1.116 to 1.444)
Miscellaneous infection	Not significant	1.357 (1.225 to 1.503)
Miscellaneous gastrointestinal or abdominal symptoms	2.022 (1.640 to 2.493)	Not significant
Cirrhosis or portal hypertension	Not significant	4.529 (2.643 to 7.761)
Other chronic liver disease	1.645 (1.334 to 2.029)	1.269 (1.122 to 1.437)
Biliary disease, cholecystitis	26.565 (12.859 to 54.882)	10.297 (6.229 to 17.024)
Other biliary disease	Not significant	3.442 (2.636 to 4.495)
Anal or rectal disorders	2.036 (1.465 to 2.829)	3.246 (2.350 to 4.485)
Urinary tract infection or inflammation	1.732 (1.532 to 1.958)	Not significant
Anemia, not specified	1.723 (1.490 to 1.994)	1.510 (1.405 to 1.622)
Clotting disorders	1.599 (1.400 to 1.827)	1.364 (1.252 to 1.485)
Skin gangrene or ulcer	2.287 (1.692 to 3.091)	2.464 (1.958 to 3.102)
Orthopaedic complications	5.153 (3.324 to 7.988)	Not significant
Cerebrovascular disease	1.571 (1.375 to 1.795)	1.332 (1.211 to 1.465)
Paralysis	Not significant	1.947 (1.586 to 2.391)
Miscellaneous neurological conditions	3.427 (1.999 to 5.874)	1.782 (1.411 to 2.249)
Cerebral disorders	1.502 (1.256 to 1.796)	Not significant
Speech disturbances	1.184 (1.098 to 1.276)	1.150 (1.099 to 1.203)
Psychiatric disorders	1.781 (1.577 to 2.012)	1.877 (1.726 to 2.042)
Mental retardation	Not significant	1.119 (1.056 to 1.186)
Depressive mood disorders, not defined	Not significant	1.133 (1.085 to 1.183)
Minor depressive mood disorder	1.526 (1.241 to 1.876)	1.544 (1.364 to 1.748)
Major depressive mood disorder	Not significant	4.730 (2.923 to 7.653)
Major dependence disorder	4.536 (3.547 to 5.801)	4.521 (3.782 to 5.404)
Drug abuse	Not significant	1.756 (1.318 to 2.338)
Minor dependence disorder	Not significant	1.526 (1.296 to 1.798)
Wheezing	1.553 (1.347 to 1.790)	1.502 (1.213 to 1.861)
Extrinsic alveolitis	Not significant	1.844 (1.397 to 2.434)
Dyspnea	3.655 (2.109 to 6.336)	2.802 (1.942 to 4.044)
Minor chest issues	Not significant	1.355 (1.230 to 1.493)
Chronic ventilator dependency	Not significant	60.123 (23.592 to 153.225)
Injury present on admission	4.764 (4.300 to 5.278)	6.159 (5.748 to 6.599)
History of major injury	1.974 (1.518 to 2.569)	2.790 (1.689 to 4.624)
Procedure not occurring in 2012	1.104 (1.055 to 1.154)	3.070 (1.857 to 5.075)
Revision procedure	1.580 (1.308 to 1.909)	Not significant
Refused transfusion	Not significant	2.991 (1.882 to 4.753)

Procedure conversion	Not significant	8.644 (3.675 to 20.333)
Not computer-assisted surgery	Not significant	1.250 (1.151 to 1.353)

*The values are given as the odds ratio, with the 95% confidence interval in parentheses. Unless designated as not significant, the values were significant at $p < 0.001$.

TABLE E-3 Prediction Models for 90-Day Post-Discharge Deaths without Readmission in the Developmental Database for Total Hip and Knee Replacement in Medicare Patients

Risk Factor Description	Total Hip Replacement*	Total Knee Replacement*
Male sex	1.687 (1.354 to 2.103)	1.608 (1.377 to 1.877)
Age of 75 to 84 years	Not significant	1.950 (1.652 to 2.300)
Age of ≥85 years	3.290 (2.504 to 4.324)	3.683 (2.850 to 4.758)
Psychiatric disorders	4.388 (2.831 to 6.802)	Not significant
Heart failure	4.131 (3.009 to 5.670)	2.370 (1.821 to 3.084)
Cardiac dysrhythmia	Not significant	1.648 (1.337 to 2.032)
Renal disorders	2.105 (1.572 to 2.817)	1.850 (1.474 to 2.320)
Metastatic cancer	40.213 (17.839 to 90.651)	17.814 (7.574 to 41.902)
Injury present on admission	2.515 (1.662 to 3.806)	Not significant
Revision total joint replacement	4.397 (2.441 to 7.921)	Not significant
Prolonged risk-adjusted length of stay	5.049 (3.829 to 6.657)	5.183 (4.276 to 6.283)

*The values are given as the odds ratio, with the 95% confidence interval in parentheses. Unless designated as not significant, the values were significant at $p < 0.001$.

TABLE E-4 Prediction Models for 90-Day Readmissions in the Developmental Database for Total Hip and Knee Replacement in Medicare Patients

Risk Factor Description	Total Hip Replacement*	Total Knee Replacement*
Male sex	Not significant	1.075 (1.050 to 1.099)
Age of 75 to 84 years	1.436 (1.388 to 1.485)	1.434 (1.403 to 1.466)
Age of ≥85 years	2.011 (1.907 to 2.122)	2.072 (1.987 to 2.159)
Heart valve disease	Not significant	1.104 (1.056 to 1.154)
Systolic heart failure	Not significant	3.515 (2.324 to 5.315)
Other heart failure	1.424 (1.329 to 1.526)	1.454 (1.388 to 1.523)
Other myocardial disease	1.290 (1.244 to 1.340)	1.330 (1.297 to 1.364)
Pulmonary hypertension	Not significant	1.241 (1.140 to 1.350)
Miscellaneous cardiac conditions	1.288 (1.194 to 1.389)	Not significant
Cardiac dysrhythmia	1.410 (1.344 to 1.479)	1.410 (1.365 to 1.456)
Venous disease	1.330 (1.238 to 1.429)	1.266 (1.206 to 1.329)
Miscellaneous cardiovascular disease	Not significant	1.278 (1.225 to 1.333)
Diabetes with renal manifestations	Not significant	1.286 (1.187 to 1.395)
Diabetes without complications	1.194 (1.148 to 1.242)	1.157 (1.128 to 1.186)
Diabetes with insulin pump	Not significant	1.228 (1.153 to 1.309)
Gout	Not significant	1.126 (1.072 to 1.182)
Overweight	1.487 (1.384 to 1.538)	1.332 (1.279 to 1.387)
Abnormal weight gain	1.106 (1.049 to 1.167)	Not significant
Neuroadrenal disorder	1.418 (1.232 to 1.632)	1.329 (1.192 to 1.483)
Reflux esophagitis	1.070 (1.032 to 1.109)	Not significant
Chronic liver disease	1.551 (1.302 to 1.847)	2.106 (1.698 to 2.611)
Hypertensive renal disease	1.935 (1.687 to 2.220)	1.862 (1.688 to 2.055)
Renal dialysis status	Not significant	1.937 (1.507 to 2.490)
Other kidney disease	Not significant	1.326 (1.275 to 1.378)
Renal glomerulonephritis or nephrosis	1.317 (1.246 to 1.393)	Not significant
End-stage kidney disease	Not significant	1.182 (1.092 to 1.280)
Skeletal disorders	1.307 (1.208 to 1.415)	Not significant
Urinary tract obstruction	Not significant	1.172 (1.086 to 1.264)
Urinary tract infection or inflammation	Not significant	1.304 (1.213 to 1.401)
Miscellaneous hematologic conditions	Not significant	1.369 (1.170 to 1.601)
Neuropathy	Not significant	1.218 (1.138 to 1.304)
Seizure disorder	1.482 (1.274 to 1.724)	1.334 (1.208 to 1.474)
Cerebrovascular disease	1.636 (1.344 to 1.990)	Not significant
Autonomic or spinal nerve disorders	1.326 (1.213 to 1.449)	1.271 (1.193 to 1.354)
Cerebral disorders	1.224 (1.105 to 1.356)	1.216 (1.176 to 1.256)
Minor cerebral disorders	1.587 (1.379 to 1.826)	1.567 (1.439 to 1.707)
Cranial or peripheral nerve disorders	Not significant	1.190 (1.095 to 1.293)
Schizophrenic disorders	Not significant	1.392 (1.301 to 1.490)
Anxiety disorders	1.205 (1.138 to 1.277)	Not significant
Depression or mood disorder	Not significant	1.562 (1.415 to 1.724)
Depression or mood disorder, not classified	1.299 (1.237 to 1.363)	1.216 (1.176 to 1.266)
Obstructive or parenchymal lung disease	1.479 (1.411 to 1.551)	1.478 (1.430 to 1.527)
Minor obstructive or parenchymal lung disease	1.174 (1.098 to 1.256)	1.134 (1.087 to 1.182)
Miscellaneous pulmonary symptoms	Not significant	2.171 (1.515 to 3.111)
Metastatic cancer	1.991 (1.392 to 2.848)	3.521 (2.367 to 5.238)
Hematopoietic malignancy	Not significant	1.307 (1.169 to 1.462)
Malignant neoplasm	2.097 (1.408 to 3.121)	2.206 (1.484 to 3.278)
Neoplasm of uncertain behavior	Not significant	1.652 (1.430 to 1.909)
Drug toxicity or reaction	Not significant	1.224 (1.128 to 1.328)
Systemic hypertension	1.095 (1.056 to 1.136)	1.089 (1.062 to 1.117)
Miscellaneous cardiac conditions	1.184 (1.109 to 1.265)	1.137 (1.079 to 1.196)

Peripheral arterial disease	1.229 (1.137 to 1.327)	1.229 (1.163 to 1.297)
Biliary disease or cholecystitis	Not significant	1.683 (1.314 to 2.156)
Other anemias	1.473 (1.298 to 1.671)	1.245 (1.137 to 1.363)
Deficiency anemia	1.129 (1.060 to 1.202)	Not significant
Clotting disorders	Not significant	1.206 (1.138 to 1.277)
Orthopaedic complications	Not significant	1.483 (1.235 to 1.781)
Skin gangrene or ulcer	1.829 (1.484 to 2.253)	Not significant
Skeletal disorders	1.482 (1.244 to 1.765)	1.702 (1.411 to 2.052)
Generalized musculoskeletal disorder	1.259 (1.169 to 1.357)	1.236 (1.177 to 1.298)
Muscle and tendon disorders	Not significant	1.149 (1.090 to 1.211)
Paralysis	Not significant	1.683 (1.411 to 2.007)
Miscellaneous pulmonary or chest conditions	1.276 (1.142 to 1.426)	1.269 (1.175 to 1.372)
Injury present on admission	1.375 (1.233 to 1.533)	1.479 (1.368 to 1.600)
Procedure occurring in 2010	1.330 (1.279 to 1.383)	1.277 (1.244 to 1.311)
Procedure occurring in 2011	1.229 (1.182 to 1.277)	1.165 (1.135 to 1.195)
Revision procedure	2.395 (2.067 to 2.774)	1.635 (1.433 to 1.865)
Prolonged risk-adjusted length of stay	1.991 (1.883 to 2.105)	1.957 (1.886 to 2.031)

*The values are given as the odds ratio, with the 95% confidence interval in parentheses. Unless designated as not significant, the values were significant at $p < 0.001$.