CALIFORNIA JOINT REPLACEMENT REGISTRY

RISK-ADJUSTMENT FOR PATIENT REPORTED OUTCOMES OF TOTAL JOINT REPLACEMENT SURGERIES

California Joint Replacement Registry

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Background

The California Joint Replacement Registry (CJRR) plans to publicly report risk-adjusted patient reported outcomes (PRO) for joint replacement surgeries in CJRR-participating hospitals. Risk-adjustment controls for diseases and conditions and other patient characteristics that vary from hospital to hospital and may cause PROs to vary because of circumstances outside of a provider's control. These PRO results are based on data collected in CJRR about surgeries that occurred from April 1, 2011 through November 6, 2014. The calculations are current as of December 31, 2014.

Model Development

Patient Sample

Patients undergoing primary total[1] hip or primary total knee replacement (unilateral or bilateral) were included in the risk adjustment modeling and subsequent public reporting. Patients with pathological fractures or malignant neoplasms (primary or metastatic cancer) were excluded. See Table 1 in the Appendix for a list of excluded codes. A total of 5,780 eligible patients were registered by the CJRR during the study period beginning April 1, 2011 through November 6, 2014, at 14 participating hospital sites. Cases are eligible if at least one year has elapsed since the procedure occurred. Cases are complete if the patient has completed a pre-procedure PRO survey and also a one-year post-procedure PRO survey. There were 1,155 completed cases. The hospital response rate is the number of complete cases divided by the number of eligible cases. These PRO scores and performance outcome results are based on data collected in CJRR about surgeries that occurred from April 1, 2011 to November 6, 2014. The calculations are current as of December 31, 2014.

PRO Measure

CJRR collects PRO data using three distinct surveys: VR-12, Western Ontario and McMaster Universities Arthritis Index (WOMAC), and the UCLA Activity Index. The PRO measure that CJRR will report publicly at this time is the WOMAC, which is a condition-specific survey that asks patients about symptoms, pain, stiffness, and the patient's ability to perform various routine activities of daily life that are progressively more physically demanding.[2]

From the WOMAC data, the specific outcome measure to be reported is the percentage of WOMAC respondents that had Minimal Clinically Important Differences between pre- and post- WOMAC scores (MCID).[3] Survey responses sometimes have statistically significant differences that are associated with

[1] Partial procedures, resurfacings, and revisions were excluded

[2] http://www.womac.org/womac/index.htm

[3] Change in WOMAC Score between Pre-Op and 1-year Post-Op ≥ the Minimal Clinically Important Difference (0.5*standard deviation of mean change in scores)

small clinical changes. The MCID accounts for this, making sure that all patients who are counted as having positive post-procedure change have meaningful changes in their WOMAC scores.

Risk Adjustment Methods

The risk-adjustment approach used in CJRR compares the 95% confidence interval of each hospital's risk-adjusted PRO MCID rate (RAR) to all participating hospitals' overall PRO MCID rate to identify hospital performance "Better" or "Worse" outliers. The risk-adjusted PRO results represent what a hospital's PRO MCID rate would have been if the hospital had a patient case mix identical to the reference population. For CJRR the reference population is the patient population of all CJRR participating hospitals. A hospital's RACR is calculated by dividing the hospital's observed PRO MCID rate by the hospital's expected PRO MCID rate (obtained from the risk model calculation) to get the observed/expected (O/E) ratio. If the O/E ratio is greater than one, the hospital has a higher PRO MCID rate than expected given its patient mix. If the O/E ratio is less than one, the hospital has a lower PRO MCID rate than expected. The O/E ratio is then multiplied by the overall PRO MCID rate of all participating hospitals to obtain the hospital's risk-adjusted PRO MCID rate.

Statistical Analysis

All candidate risk factors were entered into a stepwise, backward-selection logistic regression model. Candidate risk factors included age, gender, race (Caucasian), ASA Class, ASA Class grouped, hip vs. knee procedure, multiple simultaneous procedures, diabetes, immunocompromised status, obese, hypertension history, MI history, CAD History, CLD history, VTE history, count of risk factors, surgery year, and median household income. These variables were collected from patient records where available and reported by participating hospitals. Patients with missing data for these variables were assigned a value not associated with MCIDs. For example, a patient with missing BMI would be assigned an obese score of "No."

The variable selection method required an individual predictor to be associated with PRO MCID at the 0.05 level of significance to be retained. Predictor variables that did not meet this level of significance were dropped. A final risk model was specified by keeping all predictor variables that met the 0.05 level of significance in the automated selection method, and by adding additional variables that were not statistically significant but were clinically meaningful.

The CJRR Reporting Subcommittee determined that the resulting risk adjustment model had adequate fit (Hosmer-Lemesow lack-of-fit chi-square = 0.299, n.s.), and that it was adequately predictive (c=0.78).

Final Risk Adjustment Variables

The final risk adjustment regression model included several patient-level variables known to be associated with improved patient-reported outcomes:

- Preoperative WOMAC score
- Age: Patient age in years at the time of surgery
- Gender: Male / Female
- Race: Caucasian / Other

- ASA Physical Status Classification System score: (3 or 4) / (1 or 2)
- Obese: Body Mass Index (BMI) score of 30 greater
- Diabetes: Yes / No
- Hypertension History: Yes / No
- Chronic Lung Disease History: Yes / No
- Hip vs. Knee Procedure

Calculation of Hospital Risk-Adjusted MCID Outcome

The risk-adjustment regression model was used to calculate expected MCIDs for each hospital using patient-level data. The expected PRO MCID rate was the number of expected MCIDs as predicted by the risk-adjustment model, divided by the total number of actual, eligible joint replacement surgery cases, multiplied by 100. The expected event rate is adjusted for the severity of the hospital's case mix. The observed PRO MCID rate was the number of observed MCIDs divided by the total number of eligible joint replacement surgery cases, multiplied by 100.

The risk-adjusted MCID rate (RAR) was obtained by multiplying the population observed MCID rate (87.1%) by the hospital's Observed / Expected ratio. The risk-adjusted event rate reflects the best estimate of what a provider's MCID rate would have been if the provider had a patient case mix identical to the overall CJRR average. This rate is comparable among providers because it accounts for the differences in patient severity-of-illness.

Each provider's performance rating was based on a comparison of the 95% confidence interval (CI) of each provider's RAR to the population average MCID rate (87.1%). The Poisson exact probability method was used for computing the 95% CI for the RAR.

Hospital risk-adjusted[4] PRO scores and performance outcome results (Worse Than Expected / As Expected / Better Than Expected) for CJRR participating hospitals appear in Table 2 in the Appendix. Appendix Table 3 shows an example of how results will be reported to the public. Results are included for all hospitals with at least 30 eligible cases during the reporting period (April 1, 2011 to November 6, 2014).

[4] Risk-adjustment controls for diseases and conditions that existed in patients at the time the procedures occurred, and other patient characteristics that are different from hospital to hospital. These differences may cause PRO scores to vary because of circumstances outside of a provider's control.

APPENDIX

Table 1: Exclusion Codes used in CJRR PRO Measure		
Exclusions	170.6	MALIGNANT NEOPLASM OF PELVIC BONES SACRUM AND COCCYX
	170.7	MALIGNANT NEOPLASM OF LONG BONES OF LOWER LIMB
	170.9	MALIGNANT NEOPLASM OF SHORT BONES OF LOWER LIMB
	195.3	MALIGNANT NEOPLASM OF PELVIS
	195.5	MALIGNANT NEOPLASM OF LOWER LIMB
	198.5	SECONDARY MALIGNANT NEOPLASM OF BONE AND BONE MARROW
	199.0	DISSEMINATED MALIGNANT NEOPLASM
	733.10	PATHOLOGICAL FRACTURE UNSPECIFIED SITE
	733.14	PATHOLOGICAL FRACTURE OF NECK OF FEMUR
	733.15	PATHOLOGICAL FRACTURE OF OTHER SPECIFIED PART OF FEMUR
	733.19	Pathological fracture of other specified site
	733.8	Malunion and nonunion of fracture
	733.81	Malunion of fracture
	733.82	Nonunion of fracture
	733.95	Stress fracture of other bone
	733.96	Stress fracture of femoral neck
	733.97	Stress fracture of shaft of femur
	808.0	Closed fracture of acetabulum
	808.1	Open fracture of acetabulum
	808.2	Closed fracture of pubis
	808.3	Open fracture of pubis
	808.41	Closed fracture of ilium
	808.42	Closed fracture of ischium
	808.43	Multiple closed pelvic fractures with disruption of pelvic circle
	808.44	Multiple closed pelvic fractures without disruption of pelvic circle
	808.49	Closed fracture of other specified part of pelvis
	808.50	Open fracture of other specified part of pelvis
	808.51	Open fracture of ilium
	808.52	Open fracture of ischium
	808.53	Multiple open pelvic fractures with disruption of pelvic circle
	808.54	Multiple open pelvic fractures without disruption of pelvic circle
	808.8	Unspecified closed fracture of pelvis
	820	Fracture of neck of femur
	820.0	Transcervical fracture closed
	820.00	Fracture of unspecified intracapsular section of neck of femur closed
	820.01	Fracture of epiphysis (separation) (upper) of neck of femur closed
	820.02	Fracture of midcervical section of femur closed
	820.03	Fracture of base of neck of femur closed
	820.09	Other transcervical fracture of femur closed
	820.1	Transcervical fracture open
	820.10	Fracture of unspecified intracapsular section of neck of femur open
	820.11	Fracture of epiphysis (separation) (upper) of neck of femur open

Table 1: Exclusion Codes used in CJRR PRO Measure		
Exclusions	820.12	Fracture of midcervical section of femur open
	820.13	Fracture of base of neck of femur open
	820.19	Other transcervical fracture of femur open
	820.2	Pertrochanteric fracture of femur closed
	820.20	Fracture of unspecified trochanteric section of femur closed
	820.21	Fracture of intertrochanteric section of femur closed
	820.22	Fracture of subtrochanteric section of femur closed
	820.3	Pertrochanteric fracture of femur open
	820.30	Fracture of unspecified trochanteric section of femur open
	820.31	Fracture of intertrochanteric section of femur open
	820.32	Fracture of subtrochanteric section of femur open
	820.8	Fracture of unspecified part of neck of femur closed
	820.9	Fracture of unspecified part of neck of femur open
	821	Fracture of other and unspecified parts of femur
	821.0	Fracture of shaft or unspecified part of femur closed
	821.00	Fracture of unspecified part of femur closed
	821.01	Fracture of shaft of femur closed
	821.1	Fracture of shaft or unspecified part of femur open
	821.10	Fracture of unspecified part of femur open
	821.11	Fracture of shaft of femur open
	821.2	Fracture of lower end of femur closed
	821.20	Fracture of lower end of femur unspecified part closed
	821.21	Fracture of femoral condyle closed
	821.22	Fracture of lower epiphysis of femur closed
	821.23	Supracondylar fracture of femur closed
	821.29	Other fracture of lower end of femur closed
	821.3	Fracture of lower end of femur open
	821.30	Fracture of lower end of femur unspecified part open
	821.31	Fracture of femoral condyle open
	821.32	Fracture of lower epiphysis of femur open
	821.33	Supracondylar fracture of femur open
	821.39	Other fracture of lower end of femur open
	996.4	Mechanical complication of internal orthopedic device implant and graft
	996.40	Unspecified mechanical complication of internal orthopedic device, implant and graft
	996.41	Mechanical loosening of prosthetic joint
	996.42	Dislocation of prosthetic joint
	996.43	Broken prosthetic joint implant
	996.44	Peri prosthetic fracture around prosthetic joint
	996.45	Peri prosthetic osteolysis
	996.46	Articular bearing surface wear of prosthetic joint
	996.47	Other mechanical complication of prosthetic joint implant
	996.49	Other mechanical complication of other internal orthopedic device, implant, and graft
	996.77	Other complications due to internal joint prosthesis
	996.78	Other complications due to other internal orthopedic device implant and graft
	78.65	Removal of implanted devices from femur
	78.66	Removal of implanted devices from bone; patella
	78.67	Removal of implanted devices from bone; tibia and fibula
	80.05	Arthrotomy for removal of prosthesis - femur
	80.06	Arthrotomy for removal of prosthesis without replacement, knee
	80.09	Arthrotomy For Removal Of Prosthesis Without Replacement, Other Specified Sites

Table 2. Hospital Casemix-Adjusted Rate of Meaningful Improvement in Physical Functioning[1] After Hip and Knee Joint Replacement Surgery

Hospital Code	Number of Eligible Patients (At least one year post-procedure) N	Number of Eligible Patients That Completed both Pre-Op and 1-Year Post-Op Survey N (%)	Number of Eligible Patients That Completed both Pre-Op and 1-Year Post-Op Survey (Response Rate)	Number of Patients with Meaningful[1] Change in Survey Score N	Observed Percent of Patients with Meaningful[1] Change in Survey Score %	Expected Percent of Patients with Meaningful[1] Change in Survey Score[b] %	Casemix-Adjusted Percent of Patients with Meaningful[1] Change in Survey Score (CMAPR) %	Upper and Lower Confidence Limits for CMAPR (LCL, UCL)	Casemix-Adjusted Performance Rating
Overall	5,396	1,155	20.0%	856	87.1%[a]				
University of California, San Francisco	793	554	69.9%	494	89.2%	88.2%	88.0%	(80.4%, 96.1%)	As Expected
Stanford Hospitals and Clinics	327	66	20.2%	59	89.4%	89.5%	87.0%	(66.2%, 100%)	As Expected
Hoag Orthopedic Institute	3,078	199	6.5%	168	84.4%	84.9%	86.6%	(74.0%, 100%)	As Expected
St. Joseph Hospital of Orange	128	45	35.2%	40	88.9%	89.4%	86.6%	(61.9%, 100%)	As Expected
John Muir Medical Center, Walnut Creek	224	42	18.8%	34	81.0%	81.7%	86.3%	(59.8%, 100%)	As Expected
Cedars-Sinai Medical Center	499	72	14.4%	61	84.7%	88.5%	83.4%	(63.8%, 100%)	As Expected
Alta Bates Summit Medical Center - Alta Bates campus	Declined to Report								
Alta Bates Summit Medical Center - Summit campus	Declined to Report								
Eisenhower Medical Center	8	1	12.5%	Insufficient Data Available					
John Muir Medical Center, Concord	93	27	29.0%	Insufficient Data Available					
PIH Health	172	24	14.0%	Insufficient Data Available					
Scripps Green Hospital	19	9	47.4%	Insufficient Data Available					
St. Bernardine Medical Center	2	1	50.0%	Insufficient Data Available					
St. Jude Medical Center	53	15	28.3%	Insufficient Data Available					

[1]Change in WOMAC Score between Pre-Op and 1-year Post-Op ≥ the Minimal Important Difference (0.5*standard deviation of mean change in scores), data entered in registry as of 11/06/2014

[a]All-Hospital Observed Meaningful Change Rate (72.24%) is calculated on all of the 2,699 eligible cases in the 13 participating hospitals during the 33 month study period

[b]Expected Good Meaningful Change Rate is the number of complications predicted for that hospital by the risk adjustment model divided by the hospital's surgical volume

[c]Risk-Adjusted Complication Rate is (Hospital Observed Complication Rate/Hospital Expected Complication Rate)*All-Hospital Observed Complication Rate (9.74%)

[d]Calculated using the Poisson Exact method

Table 3. Percent of Patients That reported a Meaningful Improvement in Their Physicial Abilities After Hip and Knee Joint Replacement Surgery, by Hospital

Hospital Code	Count of Patients That Had Orthopedic Surgery	Count of Patients That Had Orthopedic Surgery and Completed a Survey About How Their Physicial Abilities Changed After Surgery	Percent of All Patients That Had Surgery and Completed a Survey (Response Rate)	Percent of Patients That Reported Meaningful Improvement in Their Physicial Abilities After Surgery - Adjusted for Differences in Patient Health	Rating
University of California, San Francisco	793	554	69.9%	88.0%	★★★
Stanford Hospitals and Clinics	327	66	20.2%	87.0%	★★★
Hoag Orthopedic Institute	3,078	199	6.5%	86.6%	★★★
St. Joseph Hospital of Orange	128	45	35.2%	86.6%	★★★
John Muir Medical Center, Walnut Creek	224	42	18.8%	86.3%	★★★
Cedars-Sinai Medical Center	499	72	14.4%	83.4%	★★★
Alta Bates Summit Medical Center - Alta Bates campus	Declined to Report				
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Eisenhower Medical Center	8	1	12.5%	Insufficient Data Available	
John Muir Medical Center, Concord	93	27	29.0%	Insufficient Data Available	
PIH Health	172	24	14.0%	Insufficient Data Available	
Scripps Green Hospital	19	9	47.4%	Insufficient Data Available	
St. Bernardine Medical Center	2	1	50.0%	Insufficient Data Available	
St. Jude Medical Center	53	15	28.3%	Insufficient Data Available	