

Patient-Reported Outcomes

Table 2: PRO Completion Rates

Hospital Name	Patients Completing All 3 Surveys Pre-op [N]	Pre-op and 1 Year Opportunities [N]	Pre-op and 1 Year Completed [N]	Pre-op and 1 Year Completed [%]
Alta Bates Summit Medical Center - Bates Campus	401	299	136	45.5%
Alta Bates Summit Medical Center - Summit Campus	375	336	163	48.51%
California Pacific Medical Center	308	111	49	44.1%
Cedars-Sinai Medical Center	340	973	402	41.3%
Dameron Hospital	43	245	67	27.3%
Eisenhower Medical Center	915	640	505	78.9%
Hoag Orthopaedic Institute*	0	6,712	0	11.7%*
John Muir Medical Center, Concord	273	540	248	45.9%
John Muir Medical Center, Walnut Creek	625	1,215	480	39.5%
Lodi Memorial Hospital	172	133	64	48.1%
Long Beach Memorial	138	221	94	42.5%
Memorial Medical Center	171	63	51	81.0%
Methodist Hospital of Sacramento	412	283	109	38.5%
Mills-Peninsula Medical Center	431	395	246	62.3%
Novato Community Hospital	136	83	35	42.2%
Orange Coast Memorial	115	311	94	30.2%
PIH Health Hospital - Whittier	398	805	147	18.3%
Saddleback Memorial	301	379	120	31.7%
Scripps Green Hospital	511	274	129	47.1%
St. Bernardine Medical Center	17	14	10	71.4%
St. Joseph Hospital	234	334	192	57.5%
St. Jude Medical Center	222	298	122	40.9%
Stanford Healthcare	789	1,493	503	33.7%
Sutter Medical Center, Sacramento	32	111	71	64.0%
Tahoe Forest Hospital District	8	26	0	0.0%
Tri-City Medical Center	304	202	146	72.3%
UCSF Medical Center	1,660	1,818	984	54.1%

* Hoag Orthopaedic Institute collects the 12-Item Short Form Survey (SF-12) instead of The Veterans Rand 12 Item Health Survey (VR-12). They had 11.7% of their eligible patients complete all three surveys pre-operatively and at one year post-operatively.

CJRR collects information directly from patients, using several standardized surveys.

- The Western Ontario & McMaster Universities Osteoarthritis Index (WOMAC) assesses a patient’s hip and knee pain and function on a scale of 0 to 100, with 100 being maximum function and minimum pain, by asking questions related to a patient’s activities such as:

- “How much pain do you have when walking on a flat surface?” “...or sitting?”
- “How severe is your stiffness when you first wake up in the morning?”
- “How much difficulty do you have when getting up from a sitting position?”

- The Veterans Rand 12-Item Health Survey (VR-12) assesses a patient’s general quality of life. As with the WOMAC, the VR-12 has a scale of 0 to 100, with 100 indicating a maximum positive score.

- The UCLA Activity Score surveys a patient’s hip and knee pain and function on a 10-point scale from a 1 – “wholly inactive: dependent upon others; cannot leave residence,” to a 5 – “sometimes participate in moderate activities,” to a 10 – “regularly participate in impact sports, such as jogging, tennis, skiing, acrobatics, ballet, heavy labor, or backpacking.”

CJRR offers multiple options for PRO survey completion. Patients can complete their PRO surveys online using a secure CJRR web-based interface (on a phone, computer, or tablet) or in a paper form that can be sent directly to CJRR via secure electronic fax. This reduces the administrative burden on surgeons and staff and ensures that PRO collection is uniform and complete.

PRO Results

Figure 3: WOMAC Hip and Knee Mean Scores Pre-Surgery and One Year Post-Surgery (N=17,080)

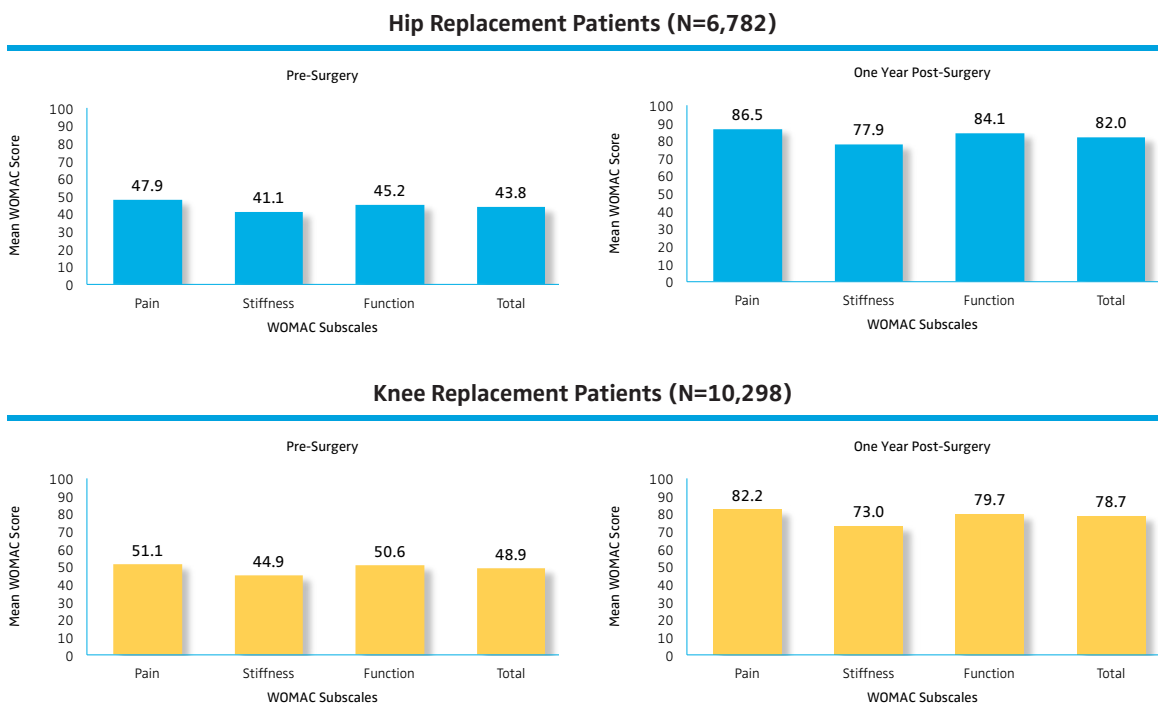


Table 3: Change in WOMAC Scores Pre-Surgery and One Year Post-Surgery, by Hospital*

Hospital Code	Count of Patients That Had Orthopedic Surgery, N	Count of Patients That Had Orthopedic Surgery and Completed a Survey about Their Physical Health before and after Surgery, N	Response Rate - Percentage of Patients Who Completed Pre-op and 1-Year WOMAC Total Score, %	Percent of Patients That Reported Meaningful Improvement in Their WOMAC Total Score after Surgery - Adjusted for Difference in Patient Health, %	Performance Rating
Overall	21,167	3,513	16.6		
Alta Bates Summit Medical Center - Bates Campus	327	80	24.5	81.1	★★★★★
Alta Bates Summit Medical Center - Summit Campus	428	88	20.6	86.4	★★★★★
California Pacific Medical Center	316	35	11.1	91.6	★★★★★
Cedars-Sinai Medical Center	879	122	13.9	86.8	★★★★★
Eisenhower Medical Center	1,091	420	38.5	90.9	★★★★★
Hoag Orthopedic Institute	7,205	635	8.8	90.0	★★★★★
John Muir Medical Center, Concord	808	93	11.5	90.5	★★★★★
John Muir Medical Center, Walnut Creek	1,569	184	11.7	88.7	★★★★★
Lodi Memorial Hospital	185	48	25.9	81.2	★★★★★
Long Beach Memorial	453	58	12.8	91.7	★★★★★
Memorial Medical Center	195	45	23.1	86.9	★★★★★
Methodist Hospital of Sacramento	369	95	25.7	87.3	★★★★★
Mills-Peninsula Medical Center	640	172	26.9	80.1	★★★★★
Orange Coast Memorial	562	31	5.5	81.6	★★★★★
PIH Health Hospital - Whittier	942	78	8.3	89.0	★★★★★
Saddleback Memorial	776	80	10.3	87.9	★★★★★
Scripps Green Hospital	294	93	31.6	90.1	★★★★★
St. Joseph Hospital	381	111	29.1	89.8	★★★★★
St. Jude Medical Center	328	85	25.9	89.5	★★★★★
Stanford Healthcare	1,259	181	14.4	87.4	★★★★★
Tri-City Medical Center	339	113	33.3	86.3	★★★★★
UCSF Medical Center	1,231	608	49.4	88.5	★★★★★

*For hospitals with >30 eligible patients who completed both pre-surgical and 1 year post-surgical PROs.

Figure 4: VR-12 Hip and Knee Scores for Physical and Mental Function, Pre-Surgery and One Year Post-Surgery for Hip and Knee Replacement Patients (N=19,106)

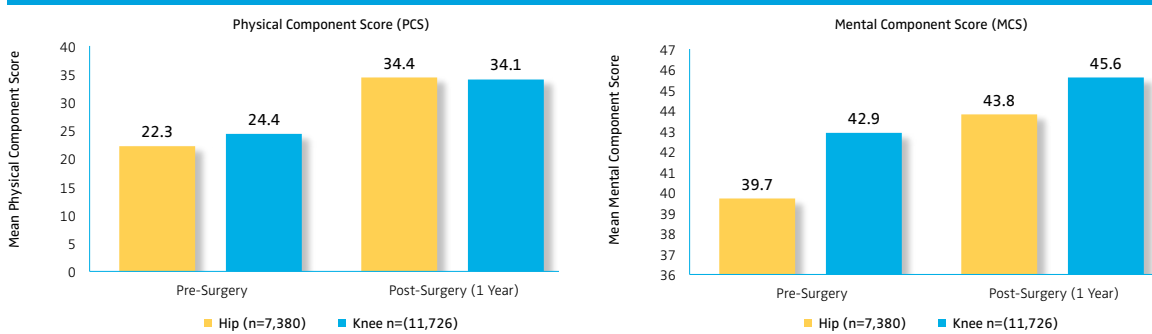


Table 4a: Change in VR-12 Physical Component Score*

Hospital Code	Count of Patients That Had Orthopedic Surgery, N	Count of Patients That Had Orthopedic Surgery and Completed a Survey about Their Physical Health before and after Surgery, N	Response Rate - Percentage of Patients Who Completed Pre-op and 1-Year VR-12 Physical Health Subscale Score, %	Percent of Patients That Reported Meaningful Improvement in Their Physical Health Score after Surgery - Adjusted for Difference in Patient Health, %	Performance Rating
Overall	13,962	2,922	20.9		
Alta Bates Summit Medical Center-Bates Campus	327	90	27.5	62.9	★★★★★
Alta Bates Summit Medical Center-Summit Campus	428	103	24.1	76.0	★★★★★
California Pacific Medical Center	316	35	11.1	71.8	★★★★★
Cedars-Sinai Medical Center	879	122	13.9	74.2	★★★★★
Eisenhower Medical Center	1,091	422	38.7	79.1	★★★★★
John Muir Medical Center, Concord	808	91	11.3	79.0	★★★★★
John Muir Medical Center, Walnut Creek	1,569	195	12.4	80.2	★★★★★
Lodi Memorial Hospital	185	48	25.9	76.2	★★★★★
Long Beach Memorial	453	55	12.1	85.3	★★★★★
Memorial Medical Center	195	44	22.6	66.6	★★★★★
Methodist Hospital of Sacramento	369	94	25.5	78.5	★★★★★
Mills-Peninsula Medical Center	640	166	25.9	66.9	★★★★★
PIH Health Hospital-Whittier	942	77	8.2	73.5	★★★★★
Saddleback Memorial	776	79	10.2	81.5	★★★★★
Scripps Green Hospital	294	90	30.6	84.7	★★★★★
St. Joseph Hospital	381	112	29.4	76.1	★★★★★
St. Jude Medical Center	328	90	27.4	74.5	★★★★★
Stanford Healthcare	1,259	185	14.7	72.2	★★★★★
Tri-City Medical Center	339	113	33.3	74.6	★★★★★
UCSF Medical Center	1,231	621	50.4	70.9	★★★★★

*For hospitals with >30 eligible patients who completed both pre-surgical and 1 year post-surgical PROs.

Table 4b: Change in VR-12 Mental Component Score*

Hospital Code	Count of Patients That Had Orthopedic Surgery, N	Count of Patients That Had Orthopedic Surgery and Completed a Survey about Their Physical Health before and after Surgery, N	Response Rate - Percentage of Patients Who Completed Pre-op and 1-Year VR-12 Mental Health Subscale, %	Percent of Patients That Reported Meaningful Improvement in Their Mental Health Score after Surgery - Adjusted for Difference in Patient Health, %	Performance Rating
Overall	13,962	2,922	20.9		
Alta Bates Summit Medical Center-Bates Campus	327	90	27.5	31.0	★★★★★
Alta Bates Summit Medical Center-Summit Campus	428	103	24.1	32.9	★★★★★
California Pacific Medical Center	316	35	11.1	30.1	★★★★★
Cedars-Sinai Medical Center	879	122	13.9	39.5	★★★★★
Eisenhower Medical Center	1,091	422	38.7	43.4	★★★★★
John Muir Medical Center, Concord	808	91	11.3	38.2	★★★★★
John Muir Medical Center, Walnut Creek	1,569	195	12.4	39.6	★★★★★
Lodi Memorial Hospital	185	48	25.9	27.7	★★★★★
Long Beach Memorial	453	55	12.1	48.0	★★★★★
Memorial Medical Center	195	44	22.6	49.2	★★★★★
Methodist Hospital of Sacramento	369	94	25.5	41.3	★★★★★
Mills-Peninsula Medical Center	640	166	25.9	35.3	★★★★★
PIH Health Hospital-Whittier	942	77	8.2	44.3	★★★★★
Saddleback Memorial	776	79	10.2	45.2	★★★★★
Scripps Green Hospital	294	90	30.6	37.6	★★★★★
St. Joseph Hospital	381	112	29.4	45.1	★★★★★
St. Jude Medical Center	328	90	27.4	38.2	★★★★★
Stanford Healthcare	1,259	185	14.7	42.0	★★★★★
Tri-City Medical Center	339	113	33.3	38.5	★★★★★
UCSF Medical Center	1,231	621	50.4	36.8	★★★★★

*For hospitals with >30 eligible patients who completed both pre-surgical and 1 year post-surgical PROs.

Figure 5: UCLA Hip and Knee Mean Scores Pre-Surgery and One Year Post-Surgery (N=15,188)

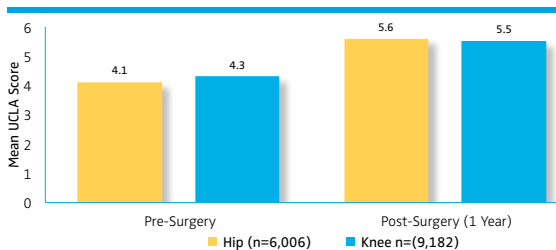


Table 5: Change in UCLA Score Pre-Surgery and One Year Post-Surgery, by Hospital*

Hospital Code	Count of Patients That Had Orthopedic Surgery, N	Count of Patients That Had Orthopedic Surgery and Completed a Survey about Their Physical Health before and after Surgery, N	Response Rate - Percentage of Patients Who Completed Pre-op and 1-Year UCLA Activity Score, %	Percent of Patients That Reported Meaningful Improvement in Their UCLA Activity Score after Surgery - Adjusted for Difference in Patient Health, %	Performance Rating
Overall	21,167	3,546	16.7		
Alta Bates Summit Medical Center - Bates Campus	327	92	28.1	58.2	★★★★★
Alta Bates Summit Medical Center - Summit Campus	428	103	24.1	50.5	★★★★★
California Pacific Medical Center	316	35	11.1	64.8	★★★★★
Cedars-Sinai Medical Center	879	115	13.1	64.5	★★★★★
Eisenhower Medical Center	1,091	422	38.7	43.4	★★★★★
Hoag Orthopedic Institute	7,205	616	8.5	71.2	★★★★★
John Muir Medical Center, Concord	808	91	11.3	62.1	★★★★★
John Muir Medical Center, Walnut Creek	1,569	192	12.2	59.4	★★★★★
Lodi Memorial Hospital	185	51	27.6	60.0	★★★★★
Long Beach Memorial	453	55	12.1	54.2	★★★★★
Memorial Medical Center	195	45	23.1	62.7	★★★★★
Methodist Hospital of Sacramento	369	96	26.0	71.8	★★★★★
Mills-Peninsula Medical Center	640	170	26.6	54.4	★★★★★
PIH Health Hospital - Whittier	942	75	8.0	62.9	★★★★★
Saddleback Memorial	776	77	9.9	60.4	★★★★★
Scripps Green Hospital	294	89	30.3	66.1	★★★★★
St. Joseph Hospital	381	111	29.1	66.0	★★★★★
St. Jude Medical Center	328	97	29.6	52.9	★★★★★
Stanford Healthcare	1,259	189	15.0	67.7	★★★★★
Tri-City Medical Center	339	113	33.3	58.9	★★★★★
UCSF Medical Center	1,231	620	50.4	65.2	★★★★★

*For hospitals with >30 eligible patients who completed both pre-surgical and 1 year post-surgical PROs.

Appendix A:

CJRR Methodology for Reporting Meaningful Change in Risk-Adjusted Patient-Reported Outcomes

Background

The California Joint Replacement Registry (CJRR) publicly reports 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.

Model Development

Patient Sample

Patients undergoing primary total 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. Cases are eligible if at least one year has elapsed since the procedure occurred. Cases are complete if the patient has finished a pre-procedure PRO survey and also a one-year post-procedure PRO survey. The hospital response rate is the number of complete cases divided by the number of eligible cases.

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

¹ Partial procedures, resurfacings, and revisions were excluded

² <http://www.womac.org/womac/index.htm>

³ Change in Score between Pre-Op and 1-year Post-Op \geq the Minimal Clinically Important Difference ($0.5 \times$ standard deviation of mean change in scores)

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 versus 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 = 0.10-0.27), and that it was adequately predictive (c=0.70-0.86).

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 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 versus 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 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. The Poisson exact probability method was used for computing the 95% CI for the RAR.

Exclusion Codes Used in CJRR PRO Measure

- 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 specific 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 fractures with disruption of pelvic circle
- 808.54 Multiple open fractures without disruption of pelvic circle
- 808.8 Unspecified closed fracture of pelvis
- 820 Fracture of neck of femur