IMPACT OF RACE/ETHNICITY AND SOCIOECONOMIC STATUS ON RISK-ADJUSTED HOSPITAL READMISSION RATES FOLLOWING HIP AND KNEE ARTHROPLASTY http://dx.doi.org/10.2106/JBJS.15.00884

Page 1

Appendix

TABLE E-1 CMS Criteria for Calculating Risk-Standardized Readmission Rates and Modifications for This Study

CMS Criteria and Definitions (Verbatim ¹⁹)	Study Modification
Readmission measure inclusion criteria, index event	
1. Enrolled in Medicare FFS	We did not limit patients on the basis of insurance enrollment. For the all-payer analysis, we examined all insurance types and the uninsured. For the Medicare analysis, we examined all patients with an expected primary payer of Medicare. This included both fee-for- service (FFS) and managed-care stays
2. Aged 65 or older	We included ages of 18 years and older for the all-payer analysis and ages of 65 years and older for the Medicare analysis
3. Discharged from non-federal acute care hospitals alive	We included community hospitals that were not rehabilitation or long-term acute-care hospitals
4. Enrolled in Part A and Part B Medicare for the 12 months prior to the date of admission, and enrolled in Part A during the index admission	We did not limit patients on the basis of insurance enrollment
 5. Having a qualifying elective primary THA/TKA procedure using the following ICD-9-CM procedure codes: 81.51 Total Hip Arthroplasty 81.54 Total Knee Arthroplasty Elective primary THA/TKA procedures are defined as those procedures not having any of the following: Femur, hip, or pelvic fracture coded in the principal or secondary discharge diagnosis fields of the index admission Partial hip arthroplasty (PHA) procedures with a concurrent THA/TKA; ICD9 codes do not distinguish partial knee arthroplasty procedures, which are captured by the THA/TKA measure Revision procedures with a concurrent THA/TKA Mechanical complication coded in the principal discharge diagnosis field Malignant neoplasm of the pelvis, sacrum, coccyx, lower limbs, or bone/bone marrow or a disseminated malignant neoplasm coded in the principal discharge diagnosis field Removal of implanted devices/prostheses Transfer from another acute care facility for the THA/TKA 	None
the following criteria)	We did not limit natients on the basis of
Medicare	insurance enrollment
2. Discharged against medical advice (AMA)	None
3. Admitted for the index procedure and subsequently transferred to another acute care facility	None
4. With more than two THA/TKA procedure codes during the index hospitalization	None
5. Admissions within 30 days of discharge from an index admission are not considered index admissions. Thus, no hospitalization will be counted as both a readmission and an index admission within the same measure	None

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Page 2

Definition of all-cause unplanned readmissions measure	
The CMS THA/TKA readmission measure counts unplanned	None
readmissions within a 30-day period from the date of discharge from	
an index admission. If a patient has more than one unplanned	
admission within 30 days of discharge from the index admission, only	
the first is counted as a readmission. The measure looks for a	
dichotomous yes or no outcome of whether each admitted patient has	
an unplanned readmission within 30 days. However, if the first	
readmission after discharge is planned, any subsequent unplanned	
readmission is not counted as an outcome for that index admission	
because the unplanned readmission could be related to care provided	
during the intervening planned readmission rather than during the	
index admission	
Definition of risk factors	
For each patient, risk-adjustment variables are obtained from	Because the HCUP SID used for this study do
inpatient, outpatient, and provider Medicare administrative claims	not provide the ability to follow a patient
data extending 12 months prior to, and including, the index admission	across data years, we limited the study to
	information on comorbidities at the time of the
	inpatient index event. Outpatient data were not
	included
Definition of risk adjustment (paraphrased ¹⁹)	
The CMS methodology for developing risk-standardized readmission	There were no changes to the CMS
rates involves 3 key steps:	methodology. We based risk-adjustment
1. Run a hierarchical linear regression that includes individual	models on our analysis file.
hospital effects (that is, an intercept for each hospital) and risk	To be consistent with the CMS methodology,
adjusts for individual patient age, sex, and comorbidities. Obtain	we used the following procedures to derive the
predicted rates from the regression	risk-standardized readmission rates. First, we
2. Run a hierarchical linear regression that includes average hospital	used our analysis file to generate a set of
effects (that is, 1 intercept across all hospitals for the average effect)	regression parameters (including the hospital-
and risk adjusts as above. Obtain <i>expected</i> rates from the regression	specific intercepts) for a probability of
3. Calculate the risk-standardized rate for an individual hospital as	readmission for each patient specific to a
the following:	hospital. We applied these regression
(predicted rate/expected rate) × national observed rate	parameters back to the records in the analysis
This calculation gives the ratio of the risk-adjusted hospital-specific	file to obtain the predicted probability on each
readmission rate to the risk-adjusted average hospital readmission	record. The sum of these predicted
rate multiplied by a standard readmission rate	probabilities within a hospital was the
	predicted number of readmissions at that
	hospital. Next we used our analysis file to
	generate similar regression parameters, except
	with a single (average) intercept across
	hospitals. We applied this second set of
	regression parameters back to the analysis file
	to obtain the expected number of readmissions
	for each hospital. The predicted divided by the
	expected number of readmissions was
	multiplied by the overall observed rate of
	readmissions from our analysis file

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Page 3

 TABLE E-2 Definitions of Select Hospital Characteristics

Term	Definition	
Teaching hospital	A hospital that has an American Medical Association (AMA)-approved residency program,	
	is a member of the Council of Teaching Hospitals and Health Systems (COTH), or has a	
	ratio of full-time-equivalent interns and residents to beds of $\geq 0.25^*$	
Critical access hospital	Any hospital characterized by CMS as a "critical access hospital"*	
Safety-net hospital	Any hospital in top quartile (>75th percentile) for proportion of Medicaid and uninsured	
	discharges	
Bed size	Number of acute-care beds*, with the categorization of small, medium, and large varying	
	by Census region, location (urban/rural), and teaching category for urban areas such that	
	approximately 1/3 of all hospitals in the region are allocated to each category†	

*Based on data from the American Hospital Association (AHA) Annual Survey of Hospitals. †See http://www.hcup-us.ahrq.gov/db/vars/hosp_bedsize/nisnote.jsp.

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Page 4

Sensitivity Analysis Based on Hospitals with at Least 25 THAs and/or TKAs

CMS does not categorize hospitals as above or below the mean readmission rate if they did not perform least 25 surgical procedures. In order to confirm the robustness of our estimates, we repeated our original analyses while limiting the data to hospitals that had performed at least 25 THAs and TKAs combined. This reduced the sample size by 17%, from 1,194 to 987 hospitals, for all payers and by 28%, from 1,163 to 843 hospitals, for Medicare. The sensitivity analysis produced results similar in magnitude to the original results (Tables E-3 and E-4). When the readmission rate was calculated with and without race/ethnicity and socioeconomic status added to the risk-adjustment algorithm, the proportion of hospitals in the reduced sample that did not have a change in the designation of the readmission rate relative to the population mean was >99% for all payers and for Medicare alone. Similarly, the proportion of hospitals in the reduced sample that did not have a change in the excess readmission ratio was >98% for all payers and for Medicare alone.

TABLE E-3 Effect on Designation of Hospital Readmission Rates Following THA and TKA After Adjustment for	r
Race/Ethnicity and Socioeconomic Status at Hospitals with at Least 25 TKAs and/or THAs*	

	No. (%)		
		Favorable	Unfavorable
	No Change	Change ⁺	Change‡
All payers	981 (99.4)	3 (0.3)	3 (0.3)
Medicare	842 (99.9)	0 (0.0)	1 (0.1)

*The data, which are for THA and TKA combined, are from the AHRQ Center for Delivery, Organization, and Markets (CDOM) HCUP SID from 16 states, 2011. †Changed from performing no differently from to performing better than the population mean or changed from performing worse than to performing no differently from or better than the population mean. ‡Changed from performing no differently from to performing worse than the population mean or changed from performing better than to performing no differently from or worse than the population mean.

TABLE E-4 Effect on Hospital Excess Readmission Ratio Following THA and TKA After Adjustment for Race/Ethnicity and Socioeconomic Status at Hospitals with at Least 25 TKAs and/or THAs*

	No. (%)		
		Favorable	Unfavorable
	No Change	Change+	Change‡
All payers	968 (98.1)	10 (1.0)	9 (0.9)
Medicare	833 (98.8)	4 (0.5)	6 (0.7)

*The data, which are for THA and TKA combined, are from the AHRQ Center for Delivery, Organization, and Markets (CDOM), HCUP SID from 16 states, 2011. †Changed from an excess readmission ratio of >1 to an excess readmission ratio of ≤ 1 . ‡Changed from an excess readmission ratio of >1.