HIDI HealthStats

Statistics and Analysis From the Hospital Industry Data Institute

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INCLUDING SOCIODEMOGRAPHIC FACTORS IN RISK-ADJUSTED READMISSION MEASURES

- A growing body of research is emerging around individual- and community-level social factors associated with hospital readmission risk.
- This issue of *HIDI HealthStats* suggests that hospitals with disproportionate shares of patients with complex sociodemographic status face disproportionately high penalties under the Hospital Readmission Reduction Program.
- This brief describes an alternative approach to risk adjustment for readmissions using the Centers for Medicare & Medicaid Services' methodology augmented with Medicaid status, poverty and community-based risk factors.
- Compared to the standard CMS models, the Missouri Hospital Association SDS-enriched models resulted in significantly less variation in the measured quality differences among Missouri hospitals.
- SDS-enriched readmission data will be available on MHA's new quality transparency website, Focus on Hospitals, beginning Feb. 3.

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Background

Risk adjustment for publicly-reported health outcome measures is intended to allow for meaningful comparisons of measured quality differences between hospitals that are attributable to characteristics of the hospitals, as opposed to differing characteristics of their patients or random variation.[1] Risk adjustment for patient-level clinical acuity and basic demographic factors, such as age and gender, are commonplace.[2-7] However, a growing body of research is emerging around individual- and community-level social factors associated with hospital readmission risk.[8-16] In August 2014, an expert panel convened by the National Quality Forum made recommendations to include social determinants in risk-adjustment models used for public reporting and other accountability applications.[17] On Feb. 3, the Missouri Hospital Association will launch Focus on Hospitals, a public transparency website that reports readmission rates for participating hospitals that are adjusted for patients' sociodemographic status. Specifically, the models include Medicaid status and the poverty rate of a patient's home census tract. The models also are designed to account for community-level risk factors by nesting the data at the census-tract level.

Inclusion of SDS Factors

Numerous SDS factors have been shown to influence patients' risk of readmission following an inpatient hospitalization.[8-13, 15] In light of the growing body of evidence, beginning in April 2015, the NQF enacted a two-year trial period to further evaluate risk adjustment for SDS factors in national quality reporting and incentive programs.[18] Measure developers now are required to test the effects of SDS factors in statistical models and provide a conceptual and empirical justification for the inclusion or exclusion of individual or contextual SDS factors. Conceptual evidence refers to the rationale and associated theory between the health outcome being measured and the patient's sociodemographic status or context. Empirical evidence refers to a known, observed and quantified statistical relationship between the measured outcome and SDS factor.[17] Table 1 includes the conceptual and empirical bases for the individual and contextual SDS factors included in the MHA/Hospital Industry Data Institute SDS-enriched readmission methods.

Table 1: Conceptual and Empirical Basis for Included SDS Factors

SDS Factor	Conceptual Basis	Empirical Basis
Medicaid Status (Individual)	Commonly used individual-level indicator of low SDS. Patients with Medicaid are by default below certain low-income eligibility thresholds; however, not all low-income patients qualify for Medicaid in Missouri (such as childless adults).[17]	Large and statistically-significant effects observed in the SDS-enriched models.
Census-Tract Poverty Rate (Contextual)	Socioeconomic status is a key driver of health outcomes. Income and associated poverty is a core dimension of SDS. In the absence of individual-level information, community-level proxy data are a tenable alternative. Census tracts are considered the preferred unit of geography in health outcomes modeling.[8, 17, 22]	Positive and predominantly significant observed association between poverty and readmission risk in the SDS-enriched models and existing literature.[8, 9, 20, 21]
Models Nested at Census-Tract (Contextual)	Intended to characterize the patient's environment and underlying risk associated with poverty and other community-based amenities, such as access to post-acute care, nutritious food and transportation to follow-up care.[9, 19-21]	Large reductions in measured quality differences (between-hospital variation) observed in census-tract nested models compared with hospital-nested models.

Methods

Using the hierarchical generalized logistic methods and measures used by the Centers for Medicare & Medicaid Services, MHA/HIDI developed a blended clinical and SDS-enriched methodology to report 30-day risk-standardized readmission rates and ratios for Missouri hospitals participating in the MHA quality transparency initiative. The measures are designed to account for patient-level risk associated with the clinical comorbidities employed by CMS, as well as the effects of select social determinants indicated by patient Medicaid status and the poverty rate of a patient's home census tract. The SDS-enriched models additionally control for clustering of patients at the census-tract level to help account for differences in access to post-acute care amenities in the patient's community, such as transitional care, nutritional food outlets and access to transportation for follow-up care.

Hierarchical logistic regression controls for naturally occurring data clustering — or correlation among records from groups of observations nested together in settings such as hospitals or geographic areas — by simultaneously modeling individual- and group-level effects that contribute to the probability the modeled outcome will occur. The SDS-enriched models employed draw from previous peer-reviewed work.[8] The SDS-enriched risk adjustment is designed to estimate and compare each hospital's performance while controlling for the predicted risk of its patients using the fixed effects (case mix) and the expected risk for patients from similar census tracts in terms of clinical acuity, Medicaid status and poverty rate using the random effects (community mix).

Data and Measures

Thirty-day risk standardized readmission rates and ratios for any cause are calculated for acute myocardial infarction, congestive heart failure, pneumonia, chronic obstructive pulmonary disease, total hip and/or total knee arthroplasty and hospital-wide readmissions. The readmission rates are based on patients ages 18 and older with any payer using the most recent 36 months of Missouri hospital inpatient discharge data. The results provided in this analysis represent inpatient discharges in Missouri occurring between June 1, 2012, and May 31, 2015. The same exclusion criteria defined by CMS are used to the extent possible. These include patient deaths, transfers, same day readmissions, patients who leave against medical advice, obstetric and non-acute patients, and readmissions flagged by the CMS Planned Readmission Algorithm.

Qualifying index admissions for the condition- and procedure-specific measures are identified using the ICD-9-CM based cohorts defined by CMS (Table 2). The HWR measure is

divided into five clinical subgroups of patients: medical, surgical/gynecological, cardiorespiratory, cardiovascular and neurological. The HWR method fits an individual model for each of the five clinical subgroups and uses a weighted geometric mean to derive overall, hospitalwide risk-adjusted performance metrics.

Results

Compared to the standard CMS approach, the SDS-enriched models produced significant reductions in the measured quality differences in each of the six measures evaluated for Missouri hospitals with 25 or more cases during the 36 months ending in May 2015. Table 3 shows the minimum and maximum assessments for each condition measured by both the CMS and SDS-enriched methodological approaches. The percent change in variance represents the relative difference in the range for each assessment method. At a 35 percent relative reduction, the AMI measure was least sensitive to the included SDS factors, while total hip and knee arthroplasty was most sensitive with a relative variance reduction of more than 80 percent.

Table 2: Model Cohorts Measure

ICD-9-CM Codes Used to Signal Index Admissions	
AMI	Any 410.xx, excluding 410.x2
CHF	40201, 40211, 40291, 40401, 40403, 40411, 40413, 40491, 40493 or 428.xx
PN	4800, 4801, 4802, 4803, 4808, 4809, 481, 4820, 4821, 4822, 48230, 48231, 48232, 48239, 48240, 48241, 48249, 48281, 48282, 48283, 48284, 48289, 4829, 4830, 4831, 4838, 485, 486, 4870, 48242 or 48811
COPD	49121, 49122, 4918, 4919, 4928, 49320, 49321, 49322, 496, or 51881, 51882, 51884 or 7991 and 49121, 49122, 49321 or 49322
THA/TKA	8151 or 8154
HWR	Medical, surgical/gynecological, cardiorespiratory, cardiovascular and neurological

Table 4 includes the distribution of impacted hospitals under each assessment method by the average poverty rate of patients' census tracts and the percentage of patients with Medicaid listed as primary payer on the discharge record. Hospitals with reduced (improved) assessments with the SDS-enriched models had higher rates of SDS-disadvantaged patients compared with hospitals receiving increased assessments. The relationship was more pronounced for hospitals with assessed risk-standardized readmission ratios (SRR) that were greater than one (higher than expected) under the CMS models to less than one (below expected) with SDS-enrichment.

Table 3: Reduction in Between-Hospital Variation

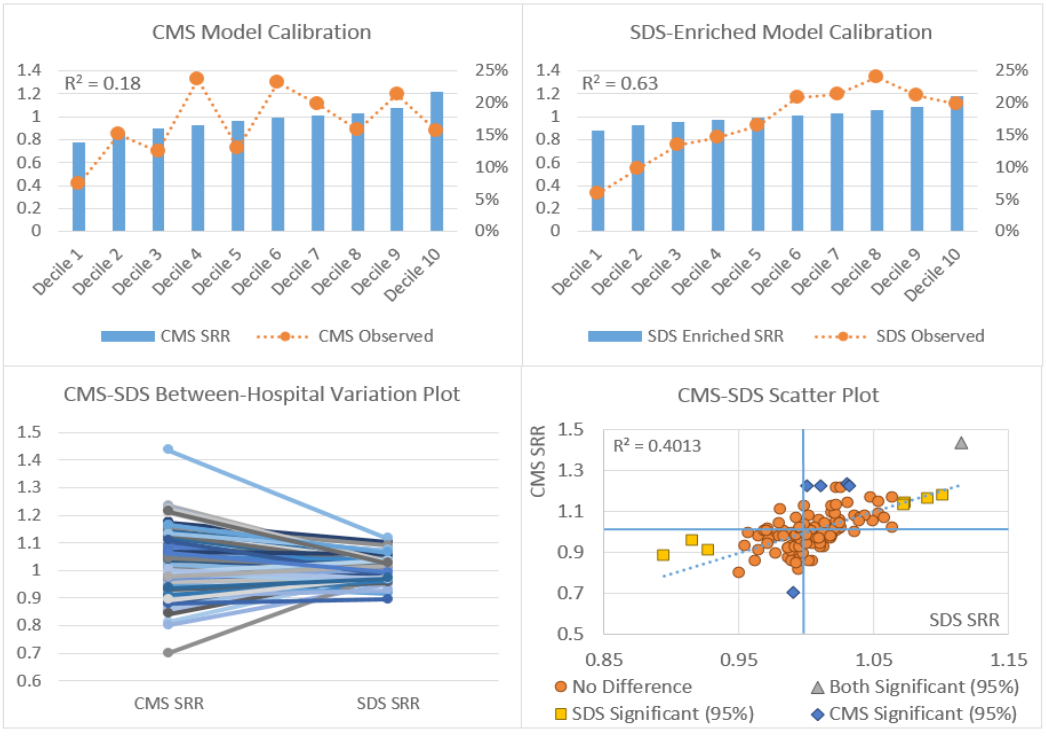
Model	Observations		CMS SRR			SDS-Enriched SRR			% Change in Variance
	Admissions	Hospitals	Min	Max	Range	Min	Max	Range	
AMI	35,741	57	0.7490	1.1667	0.4177	0.8897	1.1621	0.2724	-34.8%
HF	59,058	113	0.6998	1.4355	0.7357	0.8945	1.1157	0.2212	-69.9%
PN	62,127	118	0.7019	1.5584	0.8566	0.9422	1.2129	0.2707	-68.4%
COPD	58,554	117	0.7242	1.5573	0.8331	0.8383	1.2389	0.4007	-51.9%
TKA/ THA	73,418	81	0.6399	1.7917	1.1518	0.9457	1.1726	0.2269	-80.3%
HWR	1,322,483	125	0.7433	1.5717	0.8284	0.9202	1.2075	0.2873	-65.3%

Table 4: Impact by SDS Factors

	Hospitals With SRR Decrease With SDS-Enrichment (Improved Score)		Hospitals With SRR Increase With SDS-Enrichment (Worsened Score)		Hospitals Moving From Over Expected by CMS to Under Expected by SDS-Enriched	
	Average Census-Tract Poverty Rate	Percent Medicaid	Average Census-Tract Poverty Rate	Percent Medicaid	Average Census-Tract Poverty Rate	Percent Medicaid
AMI	10.9%	5.9%	10.6%	4.5%	11.5%	6.3%
HF	14.0%	6.9%	10.6%	4.7%	15.2%	8.5%
PN	12.1%	7.7%	12.0%	7.9%	11.9%	11.1%
COPD	13.3%	13.2%	11.6%	10.4%	14.0%	13.4%
TKA/THA	11.2%	6.9%	9.8%	3.9%	11.6%	8.5%
HWR	12.6%	12.0%	11.5%	9.6%	15.7%	11.0%

Medicaid status was a significant predictor of 30-day readmissions in each of the six measures evaluated. The poverty rate for families in the patient's census tract was positive in each model, while statistical significance was mixed. However, including census-tract poverty in the fixed effects side of the models may improve sensitivity of the expected rates by training the random effects on other provider's performance with patients from communities with similar levels of poverty.

Panel 1: CHF Model Comparison



Compared to the CMS models, the SDS-enriched models yielded enhanced calibration, or ability to correctly predict which patients have a higher risk of readmission as measured by observed readmission rates. The calibration charts in Panel 1 indicate patient SRR deciles for CHF patients under each assessment method compared to their observed readmission rates. The CMS model estimated risk explained just 18 percent of the variation in the actual patient risk as measured by the observed readmission rate. By comparison, the SDS-enriched model

estimated risk explained 63 percent of the actual risk for CHF patients. Improved calibration was induced by SDS enrichment in all conditions evaluated.

The bottom-left quadrant of Panel 1 graphically displays the reduction in between-hospital variation induced by the SDS-enriched CHF model. The SRR range under the CMS assessment for Missouri hospitals was 0.70 to 1.44, or 74 points. After controlling for Medicaid status, census-tract poverty and where patients live, the range shrank toward the mean to 22 points for a relative reduction of 70 percent (Table 3).

A common concern surrounding the inclusion of SDS factors in risk-adjustment models is that doing so may mask actual variation in quality. To the contrary, SDS-enriched models produced more statistically-significant assessments at the hospital level — high or low — than the CMS models in each of the six measures evaluated. The scatter plot in Panel 1 indicates that for the CHF cohort, six hospitals had statistically significant assessments under the CMS approach (five higher than expected and one lower), while seven hospitals had significant differences under the SDS-enriched model (four higher than expected and three lower).

These results suggest that controlling for nonclinical SDS factors produces models that are comparatively more adept at predicting which patients actually will experience a readmission within 30 days of an acute hospitalization. This approach also subscribes to the recommendations put forth by NQF in terms of the conceptual and empirical constructs of sociodemographic determinants of 30-day hospital readmissions for each measure evaluated.

Participating hospital-level results of the SDS-enriched readmission measures will be available on Focus on Hospitals, beginning Wednesday, Feb. 3, as well as a detailed description of the methodology.

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[1] Krumholz, H., et al. (2016, January 24). *Standards for statistical models used for public reporting of health outcomes.* An American Heart Association scientific statement from the quality of care and outcomes research interdisciplinary writing group. Cosponsored by the council on epidemiology and prevention and the stroke council. Endorsed by the American College of Cardiology Foundation. Circulation. January 24, 2006, 113(3), 456-462.

[2] Krumholz, H., Normand, S., Keenan, P., Lin, Z., Drye, E., Bhat, K., et al. (2008, April). (Yale University/Yale-New Haven Hospital Center for Outcomes Research and Evaluation, New Haven, CT). *Hospital 30-day heart failure readmission measure*. Baltimore (MD): Centers for Medicare & Medicaid Services.

[3] Krumholz, H., Normand, S., Keenan, P., Desai, M., Lin, Z., Drye, E., et al. (2008, June). (Yale University/Yale-New Haven Hospital Center for Outcomes Research and Evaluation, New Haven, CT). *Hospital 30-day acute myocardial infarction readmission measure*. Baltimore (MD): Centers for Medicare & Medicaid Services.

[4] Krumholz, H., Normand, S., Keenan, P., Desai, M., Lin, Z., Drye, E., et al. (2008, June). (Yale University/Yale-New Haven Hospital Center for Outcomes Research and Evaluation, New Haven, CT). *Hospital 30-day pneumonia readmission measure*. Baltimore (MD): Centers for Medicare & Medicaid Services.

[5] Grosso, L., Lindenauer, P., Wang, C., Savage, S., Potteiger, J., Abedin, Z., et al. (2011, September). (Yale University/Yale-New Haven Hospital Center for Outcomes Research and Evaluation, New Haven, CT). *Hospital-level 30-day readmissions following admission for an acute exacerbation of chronic obstructive pulmonary disease*. Baltimore (MD): Centers for Medicare & Medicaid Services.

[6] Grosso, L., Curtis, J., Lin, Z., Geary, L., Vellanky, S., Oladele, C., Ott, L., et al. (2012, June). (Yale University/Yale-New Haven Hospital Center for Outcomes Research and Evaluation, New Haven, CT). *Hospital-level 30-day all-cause risk-standardized readmission rate following elective primary total hip arthroplasty (THA) and/or total knee arthroplasty (TKA)*. Baltimore (MD): Centers for Medicare & Medicaid Services.

[7] Horwitz, L., Partovian, C., Lin, Z., Herrin, J., Grady, J., Conover, M., Montague, J., et al. (2012, July). (Yale University/Yale-New Haven Hospital Center for Outcomes Research and Evaluation, New Haven, CT). *Hospital-wide all-cause unplanned readmission measure*. Baltimore (MD): Centers for Medicare & Medicaid Services.

[8] Nagasako, E., Reidhead, M., Waterman, B. & Dunagan, W. (2014). *Adding socioeconomic data to hospital readmissions calculations may produce more useful results*. Health Affairs, 33(5), 786-791.

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[9] Hu, J., Gonsahn, M. & Nerenz, D. (2014). *Socioeconomic status and readmissions: Evidence from an urban teaching hospital.* Health Affairs, 33(5).

[10] Joynt, K., Orav, E. & Jha, A. (2011). *Thirty-day readmission rates for Medicare beneficiaries by race and site of care.* JAMA, 305(7), 675-681.

[11] Bernheim, S., Spertus, J., Reid, K., Bradley, E., Desai, R., Peterson, E., et al. (2007). *Socioeconomic disparities in outcomes after acute myocardial infarction.* Am Heart J, 153(2), 313-319.

[12] Calvillo-King, L., Arnold, D., Eubank, K., Lo, M., Yunyongying, P., Stieglitz, H., et al. (2013). *Impact of social factors on risk of readmission or mortality in pneumonia and heart failure: Systematic review.* J Gen Intern Med, 28(2), 269-282.

[13] McGregor, M., Reid, R., Schulzer, M., Fitzgerald, J., Levy, A. & Cox, M. (2006). *Socioeconomic status and hospital utilization among younger adult pneumonia admissions at a Canadian hospital.* BMC Health Serv Res. 6, 152.

[14] Berenson, J. & Shih, A. (2012, December). *Higher readmissions at safety-net hospitals and potential policy solutions.* New York: Commonwealth Fund.

[15] Joynt, K. & Jha, A. (2011). *Who has higher readmission rates for heart failure, and why? Implications for efforts to improve care using financial incentives.* Circ Cardiovasc Qual Outcomes, 4(1), 53-59.

[16] Joynt, K. & Jha, A. (2013). *Characteristics of hospitals receiving penalties under the hospital readmissions reduction program.* JAMA, 309(4), 342-343.

[17] National Quality Forum. (2014, August 15). *Technical report: Risk adjustment for socioeconomic status or other sociodemographic factors.* Retrieved from http://www.qualityforum.org/Publications/2014/08/Risk_Adjustment_for_Socioeconomic_Status_or_Other_Sociodemographic_Factors.aspx

[18] Burstin, H., Amin, T. & Isijola, W. National Quality Forum. (2015, April 7). *Memorandum to the consensus standards approval committee regarding risk adjustment for sociodemographic (SDS) trial period.*

[19] Herrin, J., St. Andre, J., Kenward, K., Joshi, M., Audet, A. & Hines, S. (2015). *Community factors and hospital readmission rates.* Health Services Research, 50, 20-39. doi: 10.1111/1475-6773.12177.

[20] Krieger, N., Chen, J., Waterman, P., et al. (2002). *Geocoding and monitoring of US socioeconomic inequalities in mortality and cancer incidence: Does the choice of area-based measure and geographic level matter? The public health disparities geocoding project.* Am J Epidemiol., 156(5), 471-482.

[21] Beck, A., Florin, T., Campanella, S. & Shah, S. (2015). *Geographic variation in hospitalizations for lower respiratory tract infections across one county.* JAMA Pediatr., 169(9), 846-854.

[22] Link, B. & Phelan, J. (1995). *Social conditions as fundamental causes of disease.* J Health Soc Behav., Spec No: 80-94.

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