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Decoding Social Determinants of Health

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> As the nation's health care system incorporated SDOH in care improvement strategies, clear definitions and a reliable measurement system with widely available data have been elusive. **This is beginning to change.**

Background

Good health outcomes rest not only on quality clinical care, but also on nonclinical factors that influence a patient's health. These factors, known as "social determinants of health," are a frame around the conditions a clinician identifies as the picture of a patient's health.

According to the World Health Organization, SDOH are "the conditions in which people are born, grow, live, work and age."[i] The multidimensional nature of SDOH reach far beyond poverty, requiring a systemic approach to effectively moderate their effects on health outcomes. The non-exhaustive list of SDOH include socioeconomic factors, such as income, education and employment; exposure to inequality arising from religion, race, ethnicity, gender identity and sexual orientation; access to health-enabling amenities such as food, water, transportation, recreation and health care; environmental context such as neighborhood characteristics, housing, air quality and crime; as well as psychosocial support structures such as family, childhood experiences and communal inclusivity.[ii, iii] The criteria used to identify SDOH include factors that have a defined association with health, exist before the delivery of care, are not determined by the quality of care received, and are not readily modifiable by health care providers.[iii]

Throughout a decade, SDOH have been increasingly recognized as a factor in delivery of, and payment for, patient-centered care. During this time, clinicians and community stakeholders have worked to understand the scope and influence of SDOH. For example, Google searches of "social determinants of health" increased 163 percent between 2008 and 2018.[iv] However, as the nation's health care system incorporated SDOH in care improvement strategies, clear definitions and a reliable measurement system with widely available data have been elusive. This is beginning to change.

Key Findings

The use of **diagnostic coding for social determinants of health carries beneficial implications for hospitals,** including potential future reimbursement, using SDOH in risk adjustment for incentive-based payments, identifying high-risk patients and informing community health needs assessments.

Comparing rates of SDOH coding to poverty at county and ZIP code levels suggests **inconsistent application of SDOH coding among Missouri hospitals** — two safety net hospitals accounted for 9 percent of total discharges and 32.4 percent of SDOH-coded claims during the first 30 months of ICD-10.

Despite suggestions of inconsistency, the frequency of **hospital patients diagnosed with social complexity has steadily increased in Missouri** since the conversion to ICD-10 in October 2015.

Compared to all hospital patients, individuals diagnosed with social complexity in Missouri **have significantly higher rates of hospital utilization and social, behavioral and clinical risk factors.**

The **most common ICD-10 SDOH code used in Missouri is homelessness** (Z590), with more than 34,000 diagnoses occurring for 17,068 unique patients between October 2015 and March 2018.

Even with potential inconsistencies in the use of SDOH codes, bivariate and multivariate testing suggests they **have significant predictive ability in health outcomes modeling,** such as hospital super-utilization.

The Affordable Care Act's emphasis on population health and value-based reimbursement is widely credited for inducing health care providers' paradigm shift toward allocating interventional resources to address SDOH.[ii] At the same time, the ACA's performance incentive payment mechanisms neglect to directly risk adjust or compensate for SDOH, despite a growing body of research supporting the association of upstream social factors and downstream health outcomes, including readmission and mortality.[v]

The conversion of diagnostic coding from the ninth to the 10th revision of the International Classification of Diseases in October 2015 created an opportunity for health care providers to identify, diagnose and document patients with social complexity in a uniform diagnostic and billing data system. Standardizing the practice of diagnosing patients with the included SDOH codes was made easier in February 2018 when provisions were made by the ICD-10 Cooperating Parties to enable nonphysician providers, such as nurses, social workers, case managers, community health workers and discharge planners, to diagnose social factors.[vi]

The effect of this policy change is observable in Missouri hospital discharge data with the presence of newly available SDOH codes, which experienced sharp increases during both February and March of 2018 (Figure 1). Since the implementation of ICD-10, the monthly frequency of SDOH-diagnosed patients in Missouri rose from 4,274 in October 2015 to 5,546 in March 2018 — a 30 percent increase. As a rate per 1,000 inpatient, outpatient and emergency department discharges, the frequency of SDOH coding grew from 3.7 to 4.9, signaling a 32.5 percent increase during the same period. It is assumed this observed increase is being driven more by awareness of the SDOH codes — as a function of added familiarity with the ICD-10 schema — than by actual differences in the sociodemographic status of the population in Missouri.

The aim of this policy brief is threefold. First, the brief evaluates the frequency and consistency of SDOH coding for Missouri patients. Second, it identifies the types of SDOH codes being used and the characteristics of socially complex patients compared to the larger population. And third, it characterizes the predictive properties of the SDOH codes in standard risk-adjustment models of hospital super-utilization in Missouri during 2017.

Figure 1: Monthly Frequency of ICD-10-CM SDOH Code Use for Missouri Residents, October 2015 - March 2018 (n=140,417)

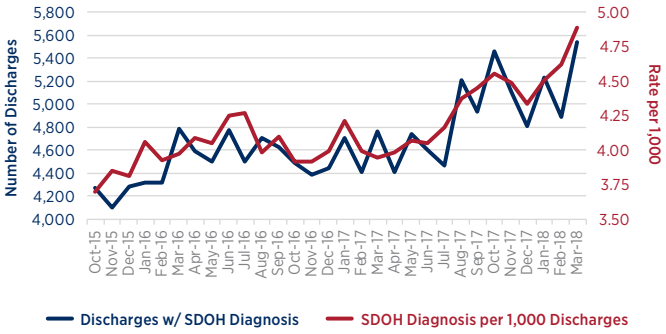


Table 1: Demographic and Utilization Characteristics of Missouri Patients Diagnosed With SDOH During 2017

					SDOH CATEGORIES*				
		Non-SDOH	Any SDOH dx	Percent Difference	Employment	Family	Housing	Psychosocial	SES
DEMOGRAPHIC	Unique Patients	1,880,866	32,470	1.7% of total	5,733	13,416	9,178	4,636	8,325
	Percent Male	44.7%	50.0%	12%	56.5%	41.9%	65.2%	43.4%	49.4%
	Mean Age	37.7	34.9	-7%	39.2	27.5	41.5	32.3	39.5
	Percent Race White	75.4%	72.3%	-4%	71.8%	76.8%	68.5%	79.1%	68.8%
	Percent Race Black or African American	18.0%	23.1%	29%	23.8%	18.5%	28.4%	16.7%	26.3%
	Percent Race Other	6.7%	4.8%	-27%	4.7%	5.2%	3.5%	4.5%	5.1%
	Mean Number of Residential ZIP Codes	1.04	1.37	31%	1.45	1.30	1.76	1.36	1.34
UTILIZATION	Mean Inpatient & ED Visits	1.84	4.90	167%	6.03	4.31	7.47	4.91	5.05
	Range	*1 to 219*	*1 to 477*	*118%*	*1 to 254*	*1 to 173*	*1 to 477*	*1 to 216*	*1 to 245*
	Mean ED Visits	1.64	4.16	154%	5.07	3.43	6.72	4.28	4.34
	Mean Inpatient Stays	0.39	1.65	317%	1.97	1.61	2.14	1.78	1.80
	Mean Charges	$19,812	$52,009	163%	$51,562	$46,230	$65,637	$44,572	$59,058
	Range	*$0 to $6.2m*	*$0 to $19.8m*	*219%*	*$0 to $1.1m*	*$0 to $19.8m*	*$0 to $2.2m*	*$0 to $1.5m*	*$0 to $2.4m*
	Mean Number of Hospitals Visited	1.20	2.00	66%	2.23	1.97	2.47	2.02	1.94
	Range	*1 to 54*	*1 to 27*	*-50%*	*1 to 27*	*1 to 20*	*1 to 20*	*1 to 20*	*1 to 20*
	Percent Super-Utilizers (10+ Visits)	0.8%	11.3%	1250%	16.2%	9.3%	21.7%	11.4%	11.3%
	Mean Inpatient & ED Visits in 2016	1.01	3.14	213%	4.04	2.61	5.14	3.10	3.16

**SDOH categories do not sum to total due to overlap between categories.*

Do hospitals have a vested interest in using SDOH codes?
While incentives for the wider adoption of standardized coding for SDOH by hospitals and health systems currently are nebulous, several recent policy developments signal the eventuality of direct returns on the investment:

- Under the provisions of the Improving Medicare Post-Acute Care Transformation Act of 2014, Congress required the Department of Health and Human Services to evaluate the linkages of SDOH to performance differentials in federal reimbursement systems. The IMPACT Act resulted in two significant bodies of work. The first was a report by the Office of the Assistant Secretary for Planning and Evaluation that was delivered to Congress in December 2016.[vii] The second was an ASPE-commissioned report from the National Academies of Sciences, Engineering, and Medicine that was published in January 2017.[viii] **Both of the reports contained strong recommendations to Congress and policymakers for expanded availability and use of SDOH data, and more importantly, to incentivize the provision of care for socially-disadvantaged populations.**[iii, ix]
- The 21st Century Cures Act of 2016 requires the Centers for Medicare & Medicaid Services to stratify assessments made by the Hospital Readmissions Reduction Program by hospitals' proportion of dual-eligible patients. Beginning in federal fiscal year 2019, this requirement will benchmark hospitals for readmission performance against peers within the same quintile of patients dually eligible for both Medicare and Medicaid. While early analysis points to limited financial impact, the 21st Century Cures Act also calls for the Secretary of HHS to take into account the reports generated under the IMPACT Act, which opens the possibility of direct risk adjustment in addition to, or in place of, stratification. **The ICD-10 SDOH codes could serve as a rich data source for this type of eventual risk adjustment in the HRRP.**
- In February 2018, CMS announced a major policy shift, enabling added flexibility for Medicare Advantage that enables "supplemental benefits if they compensate for physical impairments, diminish the impact of injuries or health conditions, and/or reduce avoidable emergency room utilization."[x] Previously, the allowable supplemental benefits were constrained to direct patient care around preventing, limiting or curing illnesses. **The policy shift allows reimbursement for nontraditional goods and services for socially complex MA enrollees, such as transportation for follow-up care, groceries, wheelchair ramps and air conditioning.**[xi]
- In addition, ICD-10-coded SDOH data can be used to inform hospital community health needs assessments, to identify populations and geographic areas with targeted

> "Social determinants influence health outcomes just as powerfully as medical conditions, but can be hard to measure. I'm very encouraged by these data showing that clinicians are beginning to capture them in billing codes, which will help policymakers develop better risk adjustment and payment models, and will help clinical leaders develop more targeted interventions."
>
> *Karen Joynt-Maddox, M.D., MPH, Assistant Professor of Medicine at Washington University School of Medicine in St. Louis, and Co-Investigator in ASPE's 2016 Report to Congress.*

Figure 2: Frequency of ICD-10-CM SDOH Code Use for Missouri Residents by Category and Two Most Frequent Diagnoses, October 2015 - March 2018 (n=140,417)

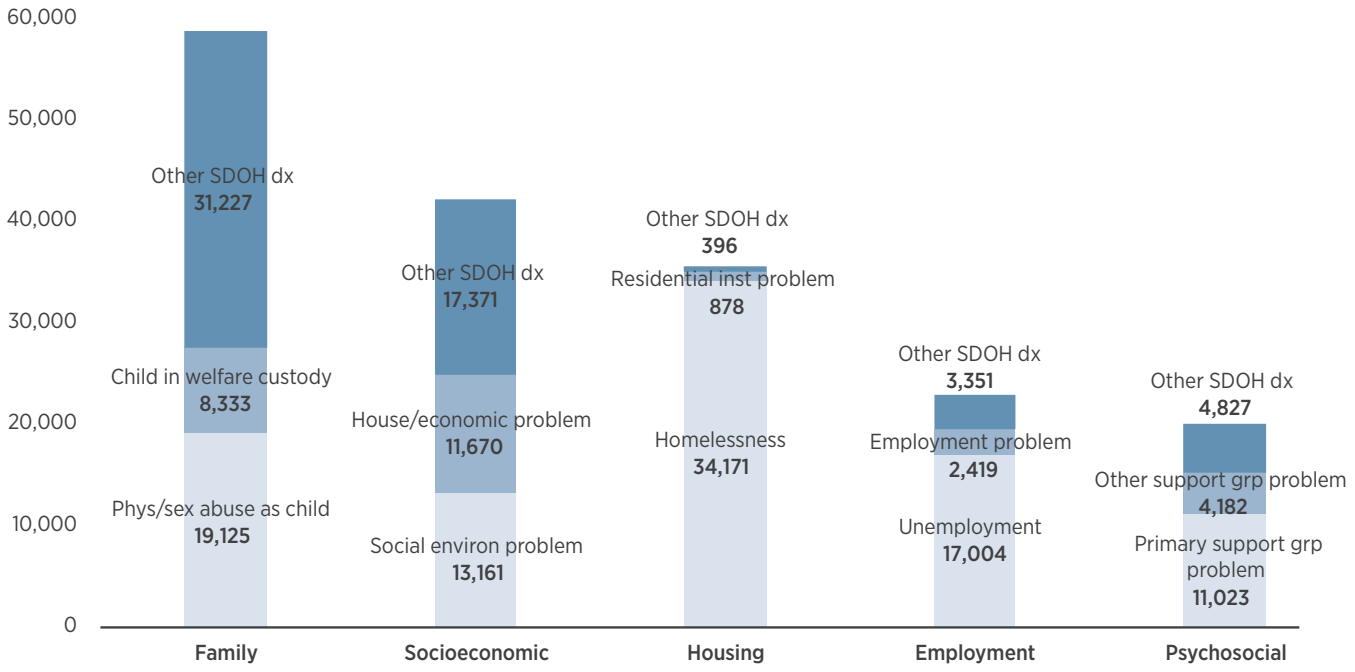
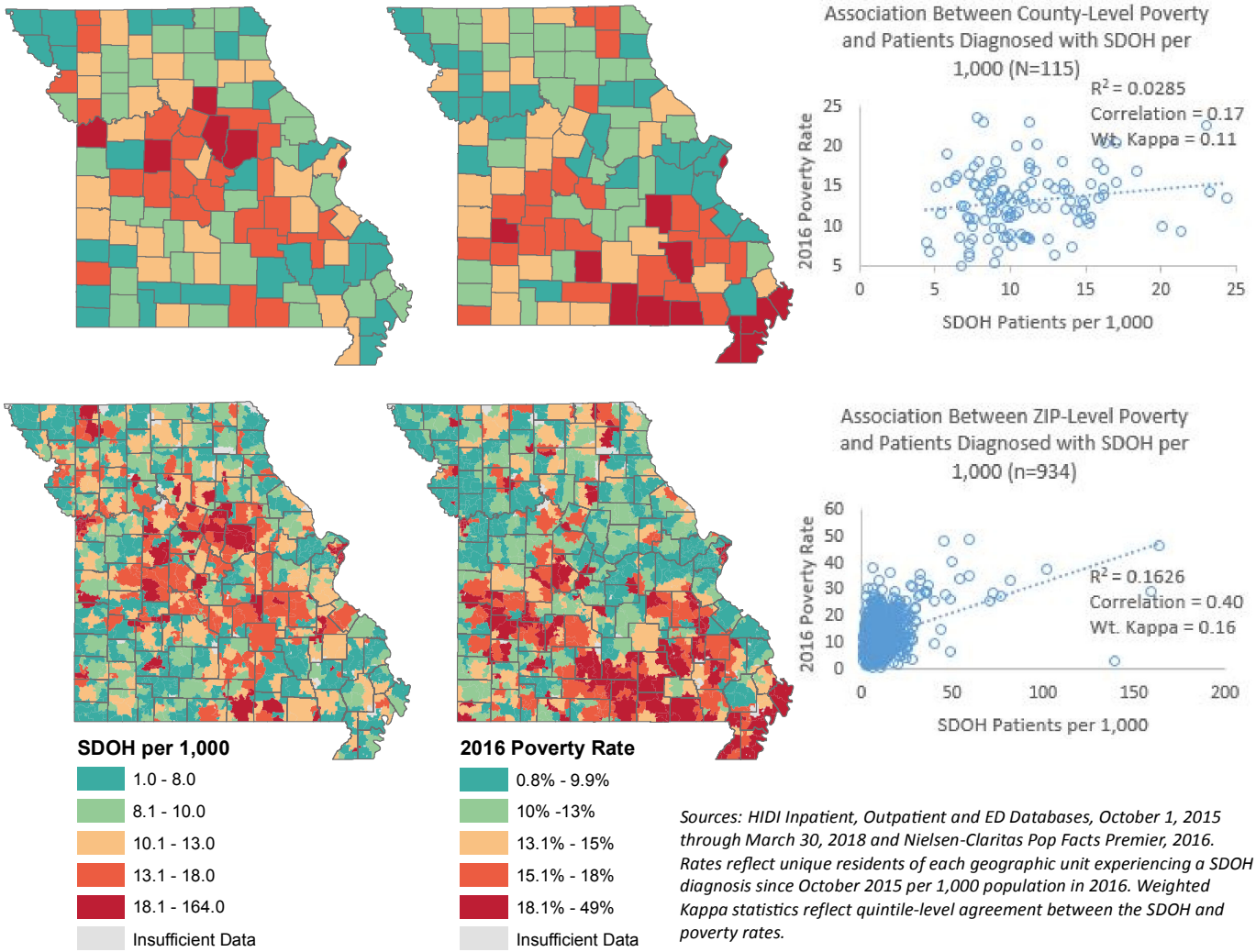


Figure 3: County and ZIP Code-Level Association Between Unique Patients Diagnosed With SDOH Since October 2015 and the 2016 Povery Rate



Sources: HIDI Inpatient, Outpatient and ED Databases, October 1, 2015 through March 30, 2018 and Nielsen-Claritas Pop Facts Premier, 2016. Rates reflect unique residents of each geographic unit experiencing a SDOH diagnosis since October 2015 per 1,000 population in 2016. Weighted Kappa statistics reflect quintile-level agreement between the SDOH and poverty rates.

social complexities in isolation, or in addition to targeted clinical comorbidities for community health improvement interventions. **Recent research has found that lagged investments in social conditions and programming has a larger positive effect on County Health Rankings than similar investments in traditional health care.**[xii]

What types of SDOH codes are being diagnosed in Missouri? During the first 30 months of ICD-10 implementation, codes included in the SDOH array of diagnoses (Z55-Z65) were identified in 140,417 inpatient, outpatient and ED claims for 78,800 individual Missouri residents. The most frequently used SDOH code for Missouri patients between October 2015 and March 2018 was homelessness (Z590), which was identified in 34,171 claims and accounted for 19.1 percent of all SDOH codes detected. Homelessness was followed by codes indicating a history of physical and sexual abuse in childhood (Z62810), which was diagnosed 19,125 times (10.5 percent), and unemployment, which was identified on 17,004 individual claims (9.5 percent).

Figure 2 contains the distribution of SDOH codes diagnosed in Missouri for five generalized categories that were developed for this analysis to evaluate the impact various social dimensions have on hospital utilization and their association with comorbid risk factors. A detailed list of the SDOH categories, codes and frequencies used to inform this analysis is included in Appendix Table 1, and a density map of patients identified as homeless by metro-area census tracts is included in Appendix Figure 1. The total frequency of individual SDOH codes identified in the appendix table does not sum to the total number of claims due to instances where multiple codes were assigned to individual claims.

Are SDOH codes consistently applied in Missouri? The uniformity of coding for social factors across hospitals in Missouri was evaluated by comparing rates of poverty to rates of patients diagnosed with social complexity at the county and ZIP code levels, as well as a comparison of Medicaid and uninsured payer mix to rates of patients diagnosed with social complexity at the hospital level.

At the county level, rates of residents diagnosed with an ICD-10 SDOH code were loosely correlated with 2016 poverty rates (Figure 3, top panel). The number of individual patients identified with social complexity per 1,000 residents explained less than 3 percent of variation in the poverty rate for counties, and the interrater reliability for quintiles of each measure across 115 counties was limited (weighted Kappa = 0.11). The association between hospital-identified SDOH and poverty increased modestly when evaluated across ZIP codes, with 16.3 percent of variation explained (Figure 3, bottom panel); however, after accounting for randomness, the quintile agreement between the two measures was again limited (weighted Kappa = 0.16).

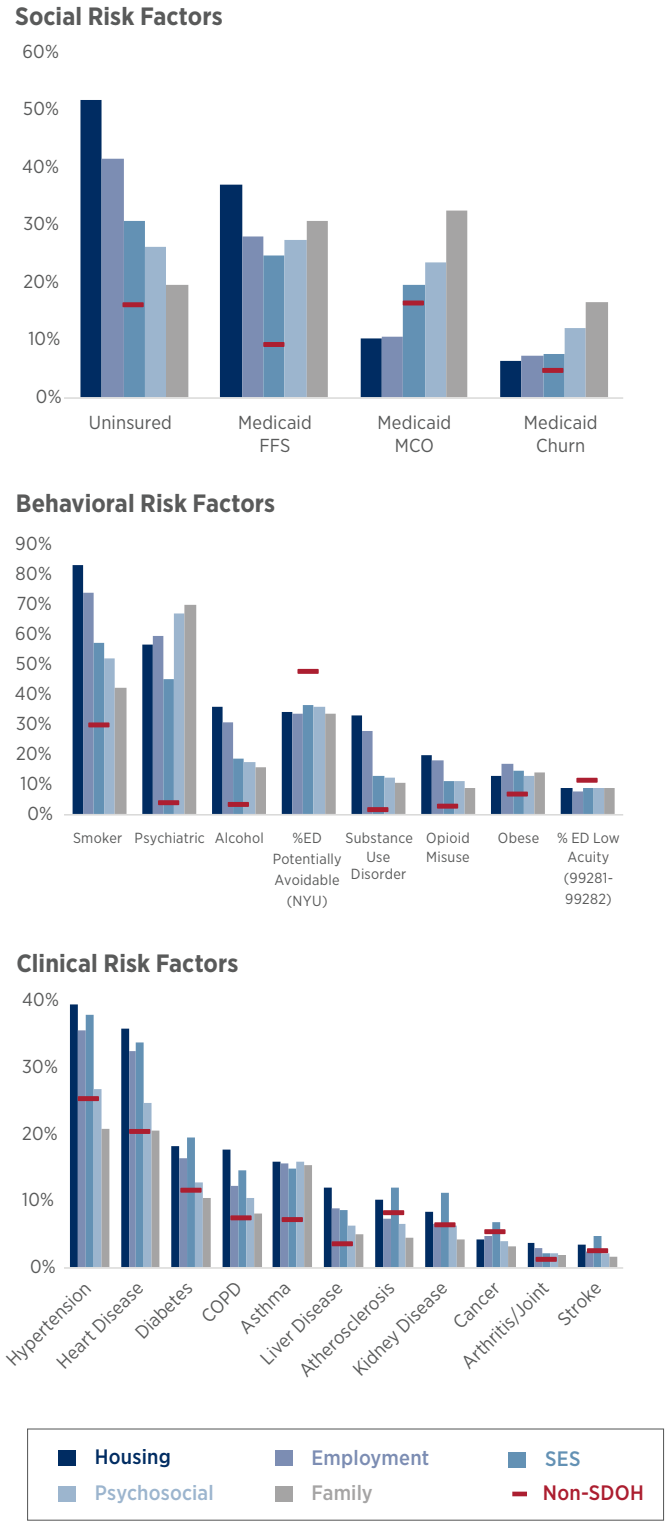
At the hospital level, the rates of coding for SDOH featured similarly limited correlation and quintile agreement with Medicaid and uninsured payer mix. The two hospitals that most frequently diagnose social factors in Missouri accounted for 32.4 percent of SDOH-coded claims; 12.1 percent of claims with Medicaid, self-pay or charity care listed as primary payer; and 9 percent of all claims.

The limited linear association and quintile agreement of SDOH code assignment and standard measures of socioeconomic status at both geographic and hospital levels suggest inconsistent uniformity in coding standards and practices for SDOH among hospitals in Missouri. Since the transition to ICD-10 in October 2015, 30 hospitals in Missouri have included a social factor diagnosis on more than 1,000 inpatient, outpatient or ED claims. However, 15 hospitals are not using the codes at all, and another 62 identified them less than 100 times during the 30-month period. **Increased use and standardization of SDOH coding among hospitals will result in significant advances in the availability of data on social factors, including their potential applications in future risk-adjustment schemas and reimbursement policies.**

Do patients diagnosed with social complexity have higher rates of comorbid risk factors and hospital utilization? During calendar year 2017, there were 32,470 individual Missourians diagnosed with at least one of the 87 ICD-10 SDOH codes in a hospital inpatient, outpatient or ED setting. Based on their specific diagnoses, these patients were assigned to one or more of five SDOH subcategories developed for this analysis and compared to 1.88 million non-SDOH-diagnosed hospital patients to evaluate observed characteristics related to inpatient and ED utilization, as well as the prevalence of social, behavioral and clinical risk factors. The comparative analysis was limited to Missouri residents with at least one inpatient hospitalization or ED visit during 2017.

Table 1 contains demographic and utilization statistics for each patient cohort. Demographically, individuals diagnosed with social complexity accounted for 1.7 percent of all hospital patients from Missouri, and they were more commonly male, African American and had less stable housing as indicated by the number of residential ZIP codes reported during the year. Patients with social complexity also had significantly higher rates of hospital inpatient and ED utilization during 2017. On average, they had nearly five hospital visits compared to 1.8 visits for all other patients — a relative difference of 167 percent.

Figure 4: Prevalence of Social, Behavioral and Clinical Risk Factors Among Missouri Patients Diagnosed With SDOH (n=32,470) During 2017 Compared to All Other Hospital Patients (n=1,880,886)



They also had three times the average number of hospital visits during the previous year, and frequented more hospitals than non-SDOH patients during 2017.

The most profound difference detected in hospital utilization for patients with social complexity was 11.3 percent had 10 or more inpatient or ED visits during 2017, signaling extreme hospital super-utilization within the cohort. Among patients diagnosed with housing problems, which is primarily indicative of homelessness, the rate of super-utilization was 21.7 percent. This was 26 times the same rate in the non-SDOH cohort.

"Several expert panels have recommended taking social and economic factors into account when measuring provider performance. Lack of data on those social and economic factors in medical records or in billing databases has been a key barrier to taking up those recommendations. Increasing use of ICD-10 codes will help solve the absence of data problem. Hospitals and other health care providers are being asked to address social determinants of health, but there are generally no funding mechanisms available to support that work. If the ICD-10 codes on social determinants were linked to payment for activities addressing those social determinants, then there would be a strong positive incentive for the accurate use of those codes."

David Nerenz, Ph.D., Director Emeritus of the Center for Health Policy and Health Services Research at Henry Ford Health System, and Co-Chair of the NQF Expert Panel on Risk Adjustment for Socioeconomic Factors

Table 2: 2017 Super-Utilizer Model Results Using ICD 10-CM SDOH Code Categories as Predictors in Bivariate and Multivariate Terms

Model Parameters		Frequency	Bivariate Models		Multivariate Model	
			Odds Ratio	P-Value	Odds Ratio	P-Value
SOCIO-DEMOGRAPHIC RISK FACTORS	Age (mean)	37.6	1.01	<.0001	0.99	<.0001
	Male	44.8%	0.86	<.0001	0.84	<.0001
	Number of ZIP codes (mean)	1.05	6.72	<.0001	2.19	<.0001
	Medicaid Managed Care	16.3%	1.20	<.0001	2.08	<.0001
	Medicaid Fee for Service	9.2%	6.18	<.0001	1.91	<.0001
	Uninsured	16.1%	2.16	<.0001	1.78	<.0001
	SDOH-Employment	0.3%	19.69	<.0001	1.29	<.0001
	SDOH-Family	0.7%	10.64	<.0001	1.33	<.0001
	SDOH-Housing	0.5%	30.01	<.0001	1.43	<.0001
	SDOH-Psychosocial	0.2%	12.92	<.0001	1.25	0.0032
	SDOH-Socioeconomic	0.4%	13.03	<.0001	1.35	<.0001
BEHAVIORAL RISK FACTORS	Psychological Disorder	4.5%	10.81	<.0001	2.88	<.0001
	Alcohol Use	3.0%	7.19	<.0001	1.20	<.0001
	Substance Use	1.5%	11.42	<.0001	1.65	<.0001
	Smoker	29.7%	6.95	<.0001	1.73	<.0001
	Obese	6.2%	6.45	<.0001	1.70	<.0001
	Opioid Misuse	2.5%	13.98	<.0001	2.38	<.0001
	Previous Year Visits (mean)	1.04	1.43	<.0001	1.26	<.0001
CLINICAL RISK FACTORS	COPD	7.4%	6.44	<.0001	1.64	<.0001
	Stroke	2.4%	4.43	<.0001	1.85	<.0001
	Diabetes	11.5%	4.08	<.0001	1.36	<.0001
	Hypertension	25.3%	4.20	<.0001	1.53	<.0001
	Heart Disease	20.2%	7.80	<.0001	3.49	<.0001
	Liver Disease	3.5%	8.10	<.0001	2.54	<.0001
	Asthma	7.1%	5.58	<.0001	1.92	<.0001
	Cancer	5.2%	2.86	<.0001	1.69	<.0001
	Atherosclerosis	8.0%	4.25	<.0001	1.17	<.0001

N = 1,913,336
Super-Utilizers (%) = 19,433 (1.02%)
C-Statistic (multivariate) = 0.961

Higher rates of hospital utilization among patients with social complexity is driven in part by the presence of comorbid clinical, behavioral and social risk factors. Figure 4 compares these rates for each SDOH cohort to the larger population of hospital patients in Missouri during 2017. **While the prevalence of nearly all evaluated risk factors is significantly higher among socially complex patients, there also is wide variation in prevalence between the five SDOH subgroups.** For example, the rate of uninsured status among individuals identified as having housing instability is more than double the rate for individuals with family-related complexity (Figure 4, top panel). Individuals with housing and employment problems are more likely than other SDOH cohorts to have substance and opioid use disorders (Figure 4, middle panel). Clinically, individuals with housing, employment and SES difficulties have significantly higher rates of hypertension, while the same prevalence for individuals with psychosocial and family-related problems are at or significantly below the hypertensive rate of the larger population (Figure 4, bottom panel).

Can SDOH codes be used as predictors in model-based applications? The ICD-10 codes provide an advancement of SDOH data availability at the patient level that eventually will provide a rich context in drawing risk-adjusted comparisons on quality or other performance-related metrics. At the same time, despite known constraints related to coding consistency, the SDOH categories used in this analysis demonstrated significant predictive ability in bivariate and multivariate models designed to estimate risk of hospital super-utilization in Missouri during 2017 (Table 2).

The five SDOH categories were tested for their ability to predict Missouri patients at risk of 10 or more hospital visits during 2017 using bivariate and multivariate logistic regression. The super-utilization model was developed and validated in 2017.[xiii] In the bivariate (single predictor) analyses, the SDOH cohorts comprised five of the eight largest observed effects out of 27 social, behavioral and clinical variables tested. The housing and employment categories were first and second respectively (OR = 30.01 & 19.69, P<.0001), while the SES domain carried the fourth-largest effect (OR = 13.03, P<.0001), which was slightly below opioid use disorder (OR=13.98, P<.0001). In the multivariate (all 27 predictors) analysis, the effects of the SDOH domains were diminished in size; however, each remained positively associated with hospital super-utilization and statistically significant (P≤.0032).

This poses two meaningful implications. First, the results suggest that with greater uniformity in coding practices, the ICD-10 SDOH codes may provide exceptionally granular information that can be employed in risk-adjustment for social factors at the patient level in performance assessments and incentive-based programs such as the HRRP. Widely available patient-level SDOH data currently are limited to administrative sources, such as dual-eligibility, which can be prone to external influences, such as interstate differences in Medicaid eligibility for the aged. Second, **the SDOH codes may be useful for hospitals to begin using immediately in predictive applications used to identify high-risk patients for targeted interventional approaches,** particularly in catchment areas with greater standardization in coding.

Conclusion

The ICD-10 clinical modification presents an opportunity for hospitals and health systems to identify and diagnose patients with 87 different social factors that can have a profound impact on health. While hospitals have incentives to standardize the use of SDOH diagnosis codes, the associated return on investment horizon is largely long-term or consists of benefits that could accrue immediately, although indirectly. These considerations may help to explain the inconsistent use of SDOH coding practices among Missouri hospitals between October 2015 and March 2018. Although recent policies suggest the potential for future financial impacts related to SDOH coding through risk-adjustment or direct reimbursement, hospitals and health systems may find immediate use for the codes in identifying high-risk patients and addressing social factors through community and population health improvement initiatives.

Appendix Table 1: Frequency of ICD 10-CM SDOH Codes by Type and Category for Missouri Residents Diagnosed in Inpatient, Outpatient or Emergency Department Settings: October 2015 - March 2018

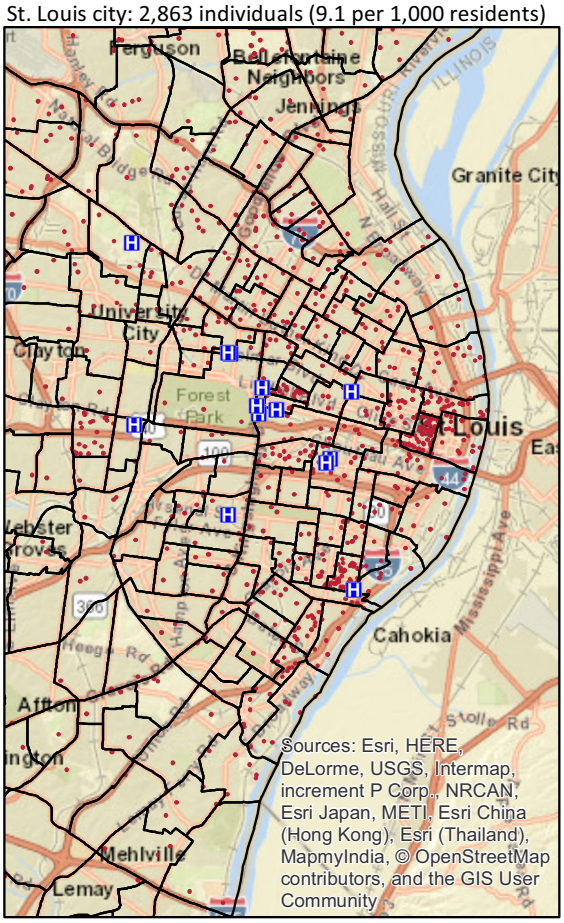
ICD10	CATEGORY	DESCRIPTION	COUNT	PERCENT
Z560	EMP	Unemployment, unspecified	17,004	9.5%
Z569	EMP	Unspecified problems related to employment	2,419	1.4%
Z5689	EMP	Other problems related to employment	920	0.5%
Z578	EMP	Occupational exposure to other risk factors	456	0.3%
Z566	EMP	Other physical and mental strain related to work	453	0.3%
Z575	EMP	Occupational exposure to toxic agents in other industries	384	0.2%
Z5731	EMP	Occupational exposure to environmental tobacco smoke	312	0.2%
Z563	EMP	Stressful work schedule	205	0.1%
Z574	EMP	Occupational exposure to toxic agents in agriculture	144	0.1%
Z572	EMP	Occupational exposure to dust	116	0.1%
Z579	EMP	Occupational exposure to unspecified risk factor	101	0.1%
Z565	EMP	Uncongenial work environment	52	0.0%
Z562	EMP	Threat of job loss	41	0.0%
Z5739	EMP	Occupational exposure to other air contaminants	40	0.0%
Z570	EMP	Occupational exposure to noise	30	0.0%
Z561	EMP	Change of job	27	0.0%
Z571	EMP	Occupational exposure to radiation	25	0.0%
Z564	EMP	Discord with boss and workmates	23	0.0%
Z5682	EMP	Military deployment status	8	0.0%
Z5681	EMP	Sexual harassment on the job	6	0.0%
Z576	EMP	Occupational exposure to extreme temperature	5	0.0%
Z577	EMP	Occupational exposure to vibration	3	0.0%
Z62810	FAMILY	Personal history of physical and sexual abuse in childhood	19,125	10.7%
Z6221	FAMILY	Child in welfare custody	8,333	4.7%
Z62811	FAMILY	Personal history of psychological abuse in childhood	6,773	3.8%
Z634	FAMILY	Disappearance and death of family member	5,069	2.8%
Z62820	FAMILY	Parent-biological child conflict	3,985	2.2%
Z630	FAMILY	Problems in relationship with spouse or partner	3,804	2.1%
Z635	FAMILY	Disruption of family by separation and divorce	3,240	1.8%
Z6379	FAMILY	Other stressful life events affecting family and household	1,932	1.1%
Z62812	FAMILY	Personal history of neglect in childhood	1,757	1.0%
Z62819	FAMILY	Personal history of unspecified abuse in childhood	1,660	0.9%
Z641	FAMILY	Problems related to multiparity	700	0.4%
Z62891	FAMILY	Sibling rivalry	356	0.2%
Z636	FAMILY	Dependent relative needing care at home	327	0.2%
Z6372	FAMILY	Alcoholism and drug addiction in family	306	0.2%
Z62898	FAMILY	Other specified problems related to upbringing	295	0.2%
Z6332	FAMILY	Other absence of family member	242	0.1%
Z62821	FAMILY	Parent-adopted child conflict	174	0.1%
Z62822	FAMILY	Parent-foster child conflict	141	0.1%
Z6229	FAMILY	Other upbringing away from parents	100	0.1%
Z629	FAMILY	Problem related to upbringing, unspecified	94	0.1%
Z62890	FAMILY	Parent-child estrangement NEC	64	0.0%
Z640	FAMILY	Problems related to unwanted pregnancy	59	0.0%

continued

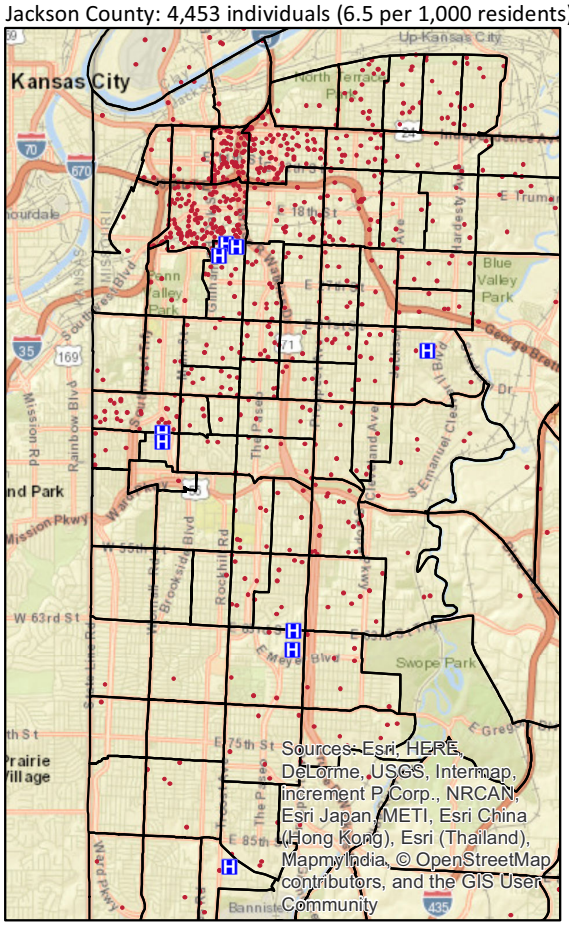
ICD10	CATEGORY	DESCRIPTION	COUNT	PERCENT
Z620	FAMILY	Inadequate parental supervision and control	46	0.0%
Z6222	FAMILY	Institutional upbringing	42	0.0%
Z631	FAMILY	Problems in relationship with in-laws	31	0.0%
Z621	FAMILY	Parental overprotection	17	0.0%
Z6331	FAMILY	Absence of family member due to military deployment	8	0.0%
Z626	FAMILY	Inappropriate (excessive) parental pressure	3	0.0%
Z623	FAMILY	Hostility towards and scapegoating of child	1	0.0%
Z6371	FAMILY	Stress on family due to return of family member from military deployment	1	0.0%
Z590	HOUSING	Homelessness	34,171	19.1%
Z593	HOUSING	Problems related to living in residential institution	878	0.5%
Z591	HOUSING	Inadequate housing	327	0.2%
Z592	HOUSING	Discord with neighbors, lodgers and landlord	69	0.0%
Z639	PSYCHOSOCIAL	Problem related to primary support group, unspecified	11,023	6.2%
Z638	PSYCHOSOCIAL	Other specified problems related to primary support group	4,182	2.3%
Z658	PSYCHOSOCIAL	Other specified problems related to psychosocial circumstances	2,711	1.5%
Z659	PSYCHOSOCIAL	Problem related to unspecified psychosocial circumstances	2,092	1.2%
Z644	PSYCHOSOCIAL	Discord with counselors	24	0.0%
Z609	SES	Problem related to social environment, unspecified	13,161	7.3%
Z599	SES	Problem related to housing and economic circumstances, unspecified	11,670	6.5%
Z653	SES	Problems related to other legal circumstances	4,061	2.3%
Z602	SES	Problems related to living alone	2,919	1.6%
Z608	SES	Other problems related to social environment	2,664	1.5%
Z598	SES	Other problems related to housing and economic circumstances	1,717	1.0%
Z559	SES	Problems related to education and literacy, unspecified	1,555	0.9%
Z651	SES	Imprisonment and other incarceration	801	0.4%
Z604	SES	Social exclusion and rejection	643	0.4%
Z558	SES	Other problems related to education and literacy	592	0.3%
Z596	SES	Low income	518	0.3%
Z553	SES	Underachievement in school	400	0.2%
Z597	SES	Insufficient social insurance and welfare support	356	0.2%
Z554	SES	Educational maladjustment and discord with teachers and classmates	245	0.1%
Z603	SES	Acculturation difficulty	200	0.1%
Z594	SES	Lack of adequate food and safe drinking water	170	0.1%
Z600	SES	Problems of adjustment to life-cycle transitions	122	0.1%
Z652	SES	Problems related to release from prison	113	0.1%
Z550	SES	Illiteracy and low-level literacy	96	0.1%
Z654	SES	Victim of crime and terrorism	70	0.0%
Z605	SES	Target of (perceived) adverse discrimination and persecution	37	0.0%
Z650	SES	Conviction in civil and criminal proceedings without imprisonment	31	0.0%
Z552	SES	Failed school examinations	29	0.0%
Z595	SES	Extreme poverty	17	0.0%
Z655	SES	Exposure to disaster, war and other hostilities	11	0.0%
Z551	SES	Schooling unavailable and unattainable	4	0.0%
na	**na**	**Total**	**179,138**	**100.0%**

Appendix Figure 1: Density Maps of Homeless Patients Identified with ICD 10-CM Code Z590 in Inpatient, Outpatient or Emergency Department Settings for Missouri Metro-Area Census Tracts: October 2015 - March 2018 (one dot = 5 rounded)

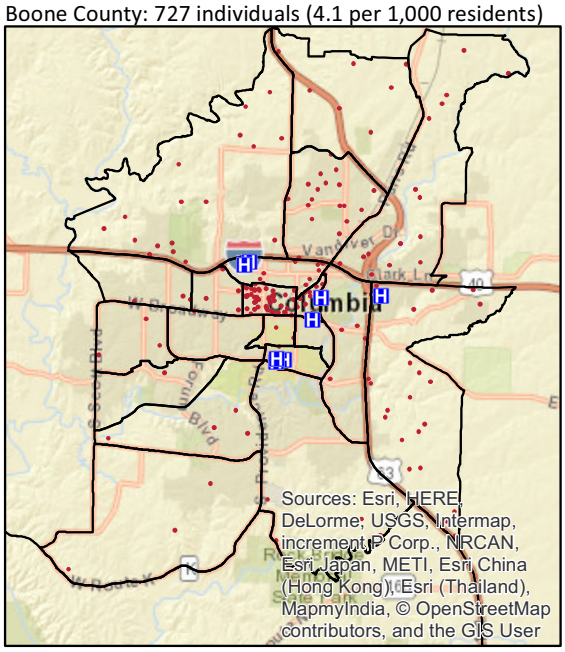
St. Louis city: 2,863 individuals (9.1 per 1,000 residents)



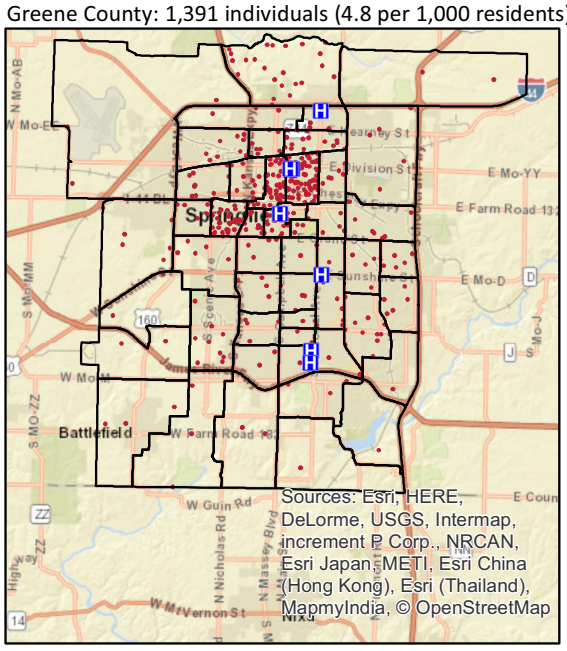
Jackson County: 4,453 individuals (6.5 per 1,000 residents)



Boone County: 727 individuals (4.1 per 1,000 residents)



Greene County: 1,391 individuals (4.8 per 1,000 residents)



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