Title: From Policy to Practice: Assessing the State Innovation Models Initiative's Early Success in Incorporating Social Determinants of Health in ASCVD Hospitalizations in the United States

Authors: Tarang Parekh, PhD, MBBS1,2; Hong Xue, PhD1; Rishi K Wadhera, MD, MPP, M.Phil3,4; Lawrence J. Cheskin, MD, FACP, FTOS5 ; Alison E Cuellar, PhD1

ORCiD IDs: Parekh (0000-0002-3494-0020); Xue (0000-0002-3641-6396); Wadhera (0000-0003-1089-3896); Cheskin (0000-0003-0262-1030);Cuellar (0000-0001-6702-7601);

Correspondence Address: Tarang Parekh, PhD, MBBS Assistant Professor, Epidemiology Program College of Health Sciences, University of Delaware, Newark, DE Email: tparekh@udel.edu Contact: 302-831-0433

Joint Authorship: N/A

Affiliations: [1] Department of Health Administration and Policy, George Mason University, Fairfax, VA, USA [2] Epidemiology Program, College of Health Sciences, University of Delaware, Newark, DE, USA [3] Richard A. and Susan F. Smith Center for Outcomes Research, Beth Israel Deaconess Medical Center, Boston, MA, USA [4] Harvard Medical School, Boston, MA, USA [5] Department of Nutrition and Food Studies, George Mason University, Fairfax, VA, USA

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Abstract

The study examines effects of the CMS State Innovation Models(SIM) on capturing social risk factors in adults hospitalized with Atherosclerotic Cardiovascular Disease (ASCVD). Using a difference-in-differences(DID) approach with propensity score weights, the study compared documentation of secondary diagnosis of SDOH/social factors using ICD-9 V codes ("SDOH codes") in adults hospitalized with ASCVD as a primary diagnosis (N= 1,485,354). Data were gathered from January 1, 2010, to September 30, 2015, covering the period before and after the SIM implementation in October 2013. From January 2010 to September 2015, SDOH codes were infrequently utilized among adults with ASCVD(0.55%, 95% CI: 0.43%-0.67%). SDOH codes with ASCVD increased from pre- to post-period in SIM states(0.56% to 0.93%) and comparison states (0.46% to 0.56%). SIM implementation was associated with greater improvement in SDOH codes utilization (adjusted OR 1.30, 95%CI: 1.18-1.43) during ASCVD hospitalizations. The odds of SDOH codes utilization were 86% higher in ED admissions(AOR 1.86, 95%CI: 1.76-1.97) than in routine admissions with ASCVD. Findings were similar when limiting population to older adults(>=65 years) enrolled in Medicare(AOR 1.50, 95%CI 1.31-1.71), whereas not significant for Medicaid beneficiaries. The study points to challenges for healthcare providers in documenting SDOH in adults with ASCVD.

Keywords: cardiovascular disease; social risk factors; state innovation model; payment model; social determinants of health

Key Points:

Question

Did financial incentives improve capturing social determinants of heath among adults hospitalized with atherosclerotic cardiovascular disease (ASCVD)?

Findings

In this cohort study for 1,485,354 patients hospitalized with ASCVD, the State Innovation Model (SIM) initiative was associated with 30% higher odds of capturing SDOH codes. However, their overall use remains infrequent. By payer type, SIM effectiveness was greater in Medicare beneficiaries than in Medicaid.

Meaning

The findings of this study suggest that SIM led to small improvements in capturing SDOH codes in adults hospitalized with ASCVD. Additional state reforms may be needed to more fully recognize and improve the management of social determinants of health in a high-risk population.

Introduction

The Centers for Medicaid and Medicare Services (CMS) State Innovation Models (SIMs) initiative funds states to develop and test innovative delivery systems and payment reforms to enhance health system performance, improve care quality, and decrease healthcare costs. The first round of funding was awarded in 2013 and granted more than $300 million to 6 states. Under this initiative, each state created its own implementation plan, but common strategies included multi-payer value-based payment models, behavioral health and primary care integration, health information technology expansion, and workforce development.[1,2] In light of these new strategies, health systems may have been more likely to capture Social Determinants of Health related ICD-9 V codes ("SDOH codes"), to better tailor care delivery to vulnerable populations. However, little is known about the association between SIM and coding for SDOH.

Historically, SDOH codes have been used very minimally by clinicians.[3,4] However, many SIM reforms attempted to address selected barriers to their use. For example, Vermont conducted learning collaboratives for providers that covered how to work with community health workers to address patients' unmet needs.[2] Improvements in code use may have been particularly likely in hospitals because, as significant drivers of high costs, unnecessary hospitalizations, and readmissions were a major focus of all SIM states. Patients with unmet social needs have higher rates of hospitalization than those without unmet needs.[5] Screening and documenting social risks in hospitals are central to identifying high-use patients and preventing additional hospitalizations, especially considering that patients with unmet needs are less likely to have regular sources of outpatient care.[6] The Atherosclerotic Cardiovascular Disease (ASCVD) population presents a particularly compelling case for promoting systematic understanding of social risk factors for

several reasons. First, ASCVD represents one of the most common causes for hospitalization in the U.S..[7] Addressing SDOH within this patient group has been shown to reduce hospital admissions and healthcare costs.[3,8–10] A substantial body of evidence also demonstrates that SDOH significantly increase the risk of poor outcomes among individuals already at a higher risk due to ASCVD, underscoring the importance of addressing the social factors that contribute to health disparities in this population.[9,11–14] By capturing and addressing these social risk factors, healthcare providers can mitigate the negative impact of SDOH and potentially improve the prognosis for ASCVD patients, while healthcare systems can implement targeted interventions and policies that aim to reduce social risk factors, ultimately improving the overall health and well-being of individuals with ASCVD while also promoting health equity.

To examine whether the broad-based delivery system and payment reforms can incentivize social risk factor diagnosis with SDOH codes in hospital settings, this study leverages a natural experiment to estimate the impact of SIM implementation on the use of SDOH codes in adults hospitalized with ASCVD.

Methods

Data Source and Study Population

The study primarily identified states participating in the SIM round-1 Test model (Arkansas, Massachusetts, and Vermont). Our comparison group of states that did not participate in SIM included Florida, Nebraska, and New Mexico. The study used data were from the Agency for Healthcare Research and Quality's Healthcare Cost and Utilization Project (AHRQ- HCUP) State Inpatient Database, which contains all-payer encounter-level discharge records for inpatient stays within participating states, to identify all adults aged >18 years with a primary diagnosis of

ASCVD in these states between January 1, 2010, and September 30, 2015 (N= 1,485,354).[15] ASCVD diagnosis was determined using ICD-9 Diagnosis Codes. Encounter records were included if they contained any-listed ICD-9 codes as a primary diagnosis. The list of codes used to capture ASCVD admissions is presented in **Supplement Table 1**

A summary of differences in the major statewide delivery system and payment reforms in the context of improvement in population health by addressing SDOH is provided in **Supplement Table 2**. SIM funding began on April 1, 2013, which included an initial 6-month test period, with the final test implementation phase beginning on October 1, 2013.[16] The overall timeline for the study period is reported in **Supplement Figure 1**.

Outcome Measure

SDOH codes were captured using ICD-9 V codes and binarized. The variable equaled 1 if the encounter has at least one SDOH code reported, and 0 otherwise. In 2021, the (CMS published a list of ICD-10 Z codes that can be used to document SDOH data.[17,18] For this study, these ICD-10 Z codes are mapped back to the closest ICD-9 V codes to capture encounters with any condition that falls under SDOH and reported as a secondary diagnosis. The list of SDOH codes is available in **Supplement Table 3**. Selected factors are categorized into problems related to housing and economics, problems related to the social environment, and other personal and environmental circumstances.

Difference-In-Differences (DID) Model

A quasi-experimental DID design was applied to estimate the impact of SIM on capturing SDOH codes as a secondary diagnosis using data from hospitalized adult patients with a primary diagnosis of ASCVD from 6 states from 2010 to 2015. Difference-in-difference (DID) models,

comparing changes in outcomes for treated states to changes in outcomes for comparison states, were estimated using logistic regression, in which binary outcome denotes whether a discharge record contained at least 1 SDOH code or no SDOH code at all. In particular, the following model was estimated,

$$Y_{it} = \beta_0 + \beta_1 post_t + \beta_2 SIM_s * post_t + \beta_3 X_{it} + \beta_4 State_i + \varepsilon_{it}$$

Where,

i indexes patients, *s* indexes states, and *t* indexes years.

Y_{it} – Presence of at least one SDOH code in the discharge record (1) or lack of any SDOH code (0) in discharge *i* at time *t*

$post_t$ – Indicator for CVD discharges occurring after SIM implementation in October 2013.

$SIM_s * post_t$ – an indicator for a SIM treatment state in the post period or the DID coefficient.

X_{it} - Individual-level covariates; age, sex, race/ethnicity, payer, emergency department admission, metropolitan location, total charges, length of stay

$State_i$ – denotes state fixed-effects that account for state-invariant confounders.

ε_{it} – Error term

Standard Errors were estimated by clustering at the hospital level to allow for correlation within hospitals over time. Evidence suggests a significant intersection between race/ethnicity and SDOH.[14] To account for this we adjusted for race and ethnicity in separate models that omitted Nebraska because the state data did not include racial or ethnic information. One critical assumption of the DID model is that both the treatment and control groups exhibited parallel trends in the pre-SIM policy implementation period.[19] Trends in the pre-SIM period (2010-2013) were examined by conducting regressions across the primary outcome with an interaction term

between year-quarters and the SIM status indicator as the primary independent variable. The results showed little evidence of diverging trends and provided support of the parallel trends assumption **(Supplement Figure 2).**

In alternate models, a propensity scores weighted version of DID model was implemented along with additional sensitivity analysis by merging data with American Hospital Association (AHA) Survey to adjust for hospital level characteristics. Detailed approach provided in **supplement method.** The study was deemed IRB exempt by George Mason University.

Results

Overall, ASCVD patients in the SIM and comparison states had similar age and sex at birth, Medicaid coverage, length of stay, and comorbidities. **(Table 1)**. A higher proportion of inpatients admissions in SIM states were through emergency departments relative to comparison states (61.23% vs. 69.44%) . All-cause mortality was greater in SIM states (3.16% vs. 2.66%) relative to comparison states, whereas total admission charges, a proxy for service intensity, were lower ($44,857 vs. $74,888) in SIM states than in comparison states. At baseline in the year 2010, the rates of SDOH coding were marginally higher in SIM states [0.43 (95% CI: 0.40 – 0.45)] than in comparison states [0.39 (95% CI: 0.37 - 0.43)].

Throughout the study period, SDOH codes were infrequently utilized at very low rate. In SIM states the fraction of discharges with SDOH codes was low and, in absolute terms, only slightly higher than in comparison states (0.59% of discharges vs. 0.46% of discharges). While SDOH coding increased over time across the board, but the increase was more pronounced in SIM states than in comparison states **(Supplement Figure 2)**. DID estimates without accounting

for patient characteristics, or hospital-level covariates are reported in **Supplement Table-5**. The column labeled DID shows the model-free results. SDOH codes utilization among adults with ASCVD increased from the pre-SIM period to the post-SIM period in SIM states (0.59% to 0.93%) and comparison states (0.46% to 0.56%). A significant 0.24% points improvement ($p<0.05$) was observed in SDOH codes utilization rates after SIM implementation in 2013, compared to control states.

Table 2 shows the main result of the standard DID logistic regression models after adjusting for patient-level characteristics as well as payer and hospital-level characteristics. SIM implementation led to statistically significant increase in SDOH coding during ASCVD hospitalizations. The AOR of 1.26 (95% CI: 1.14 – 1.38) indicates the odds of SDOH codes documentation on a hospitalization discharge record of adults with ASCVD was higher in SIM by 26% relative to comparison states over the same period. Models that included race/ethnicity, and excluded Nebraska from the comparison group found consistent results in terms of effect size **(Table 2, model 2).**

The propensity-score weighted models yielded results comparable to the standard DID model for SDOH codes utilization in SIM states (AOR 1.30, 95% 1.18 – 1.43), including models that adjusted for the race **(Table 3)**. The odds of SDOH codes utilization were 86% higher in ED-originating admissions (AOR 1.86, 95% CI: 1.76 - 1.97) than in routine admissions among adults with ASCVD. Interestingly, the odds of SDOH code utilization were 2.40 in Medicaid beneficiaries (AOR 2.40, 95% CI: 2.19 - 2.56) compared to Medicare beneficiaries with ASCVD **(Table 3, model-3).** In contrast, private insured had 47% lower odds of SDOH codes utilization

(AOR 0.53, 95% 0.49 - 0.58). In race-adjusted model 4, odds of SDOH codes capturing were 10% higher in African American/Black (AOR 1.10, 95% CI 1.03 - 1.18), while 13% and 40% lower among Hispanics (AOR 0.87, 95%: 0.80 - 0.96) and Asian/Pacific islanders (AOR 0.60, 95% CI: 0.45 - 0.80) with ASCVD respectively, when compared to non-Hispanic White encounters with ASCVD.

In Medicaid beneficiaries, SDOH codes utilization showed no significant increase post-SIM (AOR 1.02, 95% CI 0.80 – 1.26). However, Medicare beneficiaries exhibited a 50% higher odds of SDOH codes utilization post-SIM (AOR 1.50, 95% CI 1.31 – 1.71) in comparison to pre-SIM **(Table 4)**. Notably, females with Medicaid had 55% lower odds of SDOH codes utilization (AOR 0.45, 95% CI 0.39-0.51) while those with Medicare had 7% higher odds (AOR 1.07, 95% CI 1.01—1.14) for ASCVD. Metropolitan areas had 45% higher odds of capturing SDOH codes for Medicaid beneficiaries (AOR 1.45, 95% CI 1.16-1.82) but 34% lower odds for Medicare beneficiaries (AOR 0.66, 95% CI 0.60 – 0.73) than non-metropolitan areas.

Analyzing state-specific effects, Arkansas and Massachusetts demonstrated significant improvements capturing SDOH codes post-SIM (AOR 1.11, 95% CI 1.01- 1.23; AOR 1.43, 95% CI 1.28 - 1.59, respectively) relative to pre-SIM in adults with ASCVD **(Supplement Table 6)**. After considering pre-SIM trends, Arkansas remained significant (AOR 1.44, 95% CI 1.09 - 1.90), while Massachusetts exhibited faster increasing in pre-SIM period trends of SDOH codes utilization (AOR 1.15, 95% CI 1.08 – 1.22). Vermont did not differ significantly from comparison states post-SIM in capturing SDOH codes **(Supplement Table 7).**

Robustness Test

Alternate models were studied to include hospital characteristics to ensure that the DID findings are not biased. Data from four states (AR, FL, MA, VT) were included and merged with AHA survey data for the study period. The study sample was restricted to short-term general or surgical hospitals by services. A total of 1,372,188 hospital encounters with ASCVD were included from 4 states. After removing missing values on key variables (n=33,220), the analytic sample includes 1,338,968 hospital encounters with a primary diagnosis of ASCVD. Among adults hospitalized with ASCVD, the share of private non-profit hospitals was higher in SIM states (82.32%) versus comparison states (46.14%), and the share of government, non-federal hospitals was lower among SIM states (2.52%) versus comparison states (15.60%). The proportion of larger hospitals with more than 500 beds was lower in SIM states (36.16%) versus comparison states (41.64%).

Adjusting for hospital characteristics led to a marginal decrease in the effect size of SDOH codes utilization (AOR 1.22, 95% CI 1.10 - 1.35) as shown in **Supplement Table 8**. Notably, the change in SDOH codes utilization was no longer statistically significant for non-Hispanic African Americans/Black (AOR 1.06, 95% CI 0.96 - 1.16) when compared to the previous model (Table 3) without hospital characteristic adjustments. Moreover, non-government hospitals exhibited lower odds of SDOH codes utilization compared to non-federal government hospitals. Larger hospitals (500 or more beds) were significantly more likely to utilize SDOH codes (AOR 1.75, 95% CI 1.41 - 2.18) compared to smaller hospitals (less than 200 beds).

When stratified by Medicaid and Medicare beneficiaries **(Supplement Table 9),** Medicare beneficiaries in SIM states showed significantly higher odds of SDOH codes utilization (AOR 1.41, 95% CI 1.23 - 1.62) compared to comparison states in post-SIM period. However, the findings were not significant for Medicaid beneficiaries, consistent with the original model without hospital characteristic adjustments.

Discussion

Our study found that SDOH coding remains very low and states participating in SIM experienced only small improvements in the capture of social risk factors among adults hospitalized with ASCVD compared to non-participating states. The payment and delivery system under the SIM initiative may help incentivize diagnosis and documentation of social risk factors among a target population who are primarily vulnerable to such social risk factors. In post-implementation, providers in SIM states have noted an increased use of Health Information Technology (HIT), primarily electronic health records (EHRs), whereas patients perceived their clinicians as having better awareness and understanding of EHRs use and their medical histories.[20] The study found a very modest increase of 0.24 percentage points in the capture of SDOH codes. While this increase is noteworthy, its limited magnitude underscores the necessity for comprehensive policy reforms to effectively capture a broader range of SDOH factors within the healthcare system.[21,22] This perhaps could change with a greater number of states participating in round 2 of the SIM initiative with a focus on improving HIT systems.[23]

The study found lower odds of capturing SDOH codes in encounters of Hispanic and Asian/Pacific Islander origin when compared to non-Hispanic White. Persistent systemic barriers

may explain such differences.[24–26] Moreover, capturing race and ethnicity along with SDOH screening remains underemphasized, despite being recommended by the Institute of Medicine.[27] Explicit focus on capturing SDOH among at-risk populations, including those that are historically minoritized, could perhaps be possible with the next round of SIM initiatives with wider-reaching reforms with a population health focus and capturing racial data in EHR systems.[23,28]

There was variation by payer type in utilizing SDOH codes, with greater use among Medicaid beneficiaries and lower utilization in privately insured beneficiaries with ASCVD when compared to Medicare beneficiaries. Given Medicaid's role in serving socially and medically complex patient populations, including low-income adults, children, and individuals with disabilities – this would be expected and consistent with programs like SIM that encourage state-wide population health improvement plans.[29,30]

In assessing the effects of SIM by individual state, the results for Arkansas and Massachusetts depended on the specific model. Each showed a small increase in SDOH coding for adults hospitalized with ASCVD in models that did not adjust for pre-intervention trends or race. However, after controlling for pre-intervention trends in the outcome and race, the effect was no longer statistically significant for Massachusetts and the estimate was very small. In contrast, the estimated effect on SDOH coding for Arkansas increased from 0.05% points to 0.19% points in the adjusted models. Since it is not known if the pre-intervention trends would have continued in the post-intervention period that is absent SIM, the interpretation of this finding is not clear.

Efforts to use SDOH-related V codes in ICD-9, now Z codes in ICD-10 to drive interventions have broadly been promoted at the payer and provider levels. Large hospitals and physician groups like American Medical Association and American Hospitals Association have offered webinars and started collaborations with other payers to increase SDOH-related code utilization.[22,31] One leading healthcare data analysis company is also considering developing a composite SDOH score that includes ICD-10 Z codes.[32] While such efforts from private entities are commendable, state and federal initiatives like SIM provides a unique opportunity to increase the use of SDOH codes in the routine healthcare system and address social needs of the population. The SIM initiative has demonstrated success in linking clinical resources with community resources. For example, Michigan allocated SIM funding to establish Community Health Innovation Regions, aimed at fostering connections between clinical care and community resources.[33] Meanwhile, Washington State supported nine regional Accountable Communities of Health, comprising clinicians, community organizations, and social service agencies. In Maine, the SIM initiative led to the creation of an alternative payment model known as Behavioral Health Homes. This model reported improvements in follow-up procedures after hospital utilization, enhanced identification of patients' clinical and social needs, and better collaboration with patients to address gaps in care.[34] Although the improvement in SDOH code utilization evident from this study is small, coupling the SIM initiative with other such strategies could help achieve greater social code utilization.

One possible reason for lower utilization of SDOH codes in practice could be the reluctance of physicians to document, which is understandable if there are no clear mechanisms

to address these factors. Evidence suggests that U.S. physicians are burdened with documentation,[35] and capturing additional SDOH information may increase this burden. While several alternatives have been suggested and are currently in practice—including sending the screening tool to patients electronically before their appointment, reviewing the responses during pre-visit planning to identify issues needing attention, and incorporating SDOH screening questions into the rooming process for medical assistants or nurses[36]—our study highlights the potential for increased utilization of existing ICD codes to capture SDOH in a standardized manner across the healthcare system under the SIM initiative.

The integration of SDOH into clinical practice requires not only documentation but also actionable pathways for intervention. Physicians are more likely to engage in documentation if it directly benefits patient outcomes or enhances their own practice efficiency and quality. Studies indicate that physicians often see limited value in documenting SDOH without the infrastructure to address these issues effectively[37,38]. For instance, Fraze et al. (2019) found that while healthcare providers recognize the importance of SDOH, they are hindered by a lack of resources and support systems to address these determinants comprehensively within clinical settings.[39] Similarly, a survey by the Robert Wood Johnson Foundation revealed that most physicians feel unprepared to address SDOH due to insufficient training and resources.[40] The implementation of SDOH documentation is more successful when integrated with comprehensive care models that provide clear benefits. For example, Accountable Health Communities (AHCs) models funded by CMS have shown that when SDOH screening is linked to community resources and interventions, there is an increase in both provider participation and patient outcomes.[41] The SIM initiative can achieve similar success by prioritizing actionable solutions, which could include

integrating social services, providing training on SDOH coding, and developing reimbursement models that incentivize comprehensive care.

The study has several limitations. First, a DID model assumes that there was no other intervention occurring contemporaneously with SIM that could have affected SDOH codes utilization among ASCVD hospitalizations. Second, the study was not able to identify specific SIM reforms that could have influenced the SDOH codes utilization. Furthermore, it is unclear whether the inclusion of other round-1 SIM states (Maine, Minnesota, and Oregon) would alter the study findings. Medicaid expansion occurred in 2014 for many states, which could possibly have an impact on the study findings. Regardless, states included in this study (except for Nebraska) already had Medicaid expansion in 2014. Therefore, it is unlikely that Medicaid expansion biased the study findings (even with the exclusion of Nebraska from the comparison group). Given the small number of grantee states, the findings are limited in broader generalizability. Furthermore, increased utilization of codes for social factors does not necessarily mean that the encounters received required social services.

Conclusion

The CMS SIM initiative exhibits early potential in promoting the documentation of social factors among adults with ASCVD. Nevertheless, our study highlights the concerning problem of remarkably low rates of SDOH codes within a highly vulnerable population, emphasizing the vulnerability to adverse outcomes when SDOH are neglected. The study also underscores the need to address ongoing, very low rates of SDOH codes, urging stakeholders to prioritize

substantial enhancements in capturing SDOH data, particularly within high-risk populations, where interventions appear promising.

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Table 1. Characteristics of Hospital Encounters in SIM and Comparison States, 2010-2015

	Comparison states	SIM States	Total
	(N= 1,073,100)	(N= 412,254)	(N= 1,485,354)
Age, years, mean ± SD	69.16 ± 13.58	68.95 ± 13.83	
Female, %	42.36	42.70	42.45
Race, % [a]			
White, NH	71.95	86.46	76.16
Black/African American, NH	11.47	6.96	10.16
Hispanic	13.82	4.26	11.04
Asian or Pacific Islander	0.68	1.17	0.83
Native American	0.39	0.15	0.32
Other	1.70	1.00	1.50
Primary Payer, %			
Medicare	67.20	64.07	66.33
Medicaid	6.41	6.16	6.34
Private Insurance	17.06	23.53	18.86
Other	9.33	6.25	8.48
Metropolitan, %	89.38	79.53	86.65
Emergency department admission, %	69.44	61.23	67.16
Length of Stay, days, mean± SD	4.46 ± 5.64	4.16 ± 4.93	4.37 ± 5.46
Comorbidity count, mean± SD	6.85 ± 3.02	6.57 ± 2.60	6.78 ± 2.90
Disposition			
Routine	59.16	54.38	57.83
Transfer	22.19	26.48	23.38
Home Health	14.74	15.40	14.93
AMA	1.24	0.58	1.06
All-Cause Mortality, %	2.66	3.16	2.80
Total charges, $, mean± SD	74,888 ± 82,428	44,857 ± 56,138	66,553 ± 77,228
Baseline SDOH coding rate, %	0.39	0.43	0.42

Notes:
SIM states include Arkansas, Massachusetts, and Vermont. Comparison states include Florida, Nebraska, and New Mexico.

AMA: Against Medical Advice

[a] Excludes Nebraska as a comparison state since Nebraska did not report race during the study period.

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Table 2. Impact of State Innovation Model on SDOH Codes Utilization in Hospital Encounter Records for Adults With ASCVD

	Model-1 (n=1,485,354)		Model-2 Race adjusted (n=1,420,793)	
Variable	AOR	95% CI	AOR	95% CI
Post	1.25***	1.18 - 1.32	1.25***	1.18 - 1.32
SIM policy	0.43***	0.38 - 0.48	0.39***	0.35 - 0.44
Post*SIM policy	1.26***	1.14 - 1.38	1.27***	1.15 - 1.39
Age	0.98***	0.98 - 0.98	0.98***	0.98 - 0.99
Female	0.84***	0.81 - 0.88	0.84***	0.80 - 0.88
Race/ethnicity				
White, NH			Ref	
African American/Black, NH			1.07*	1.00 - 1.15
Hispanic			0.84***	0.78 - 0.90
Asian/Pacific Islander			0.59***	0.44 - 0.78
Native American			0.69*	0.49 - 0.96
Other			0.73**	0.60 - 0.89
Primary payer				
Medicare	Ref		Ref	
Medicaid	2.39***	2.22 - 2.58	2.44***	2.26 - 2.63
Private	0.54***	0.49 - 0.59	0.53***	0.49 - 0.58
Other Insurance	2.48***	2.31 - 2.65	2.51***	2.34 - 2.68
Emergency Department admission	1.86***	1.76 - 1.97	1.85***	1.75 - 1.96
Length of stay	1.02***	1.01 - 1.02	1.02***	1.01 - 1.02
Metropolitan region	0.86***	0.81 - 0.93	0.86***	0.80 - 0.92
Comorbidity count	1.05***	1.04 - 1.06	1.05***	1.04 - 1.06

Notes:

SIM Impact on SDOH codes utilization among adults with ASCVD.

Models 1 and 2 are estimated using standard DID models, which include state and hospital fixed effects (not shown). Robust SEs are estimated by clustering at the hospital level.

AOR indicated adjusted odds ratio; for the interaction term, it is the ratio of 2 adjusted odds ratios.

*** p<0.001, ** p<0.01, * p<0.05

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Table 3. Difference-In-Differences Logistic Regression with Propensity Score Weights

	Model-3 (n=1,485,354)		Model-4 Race adjusted (n=1,420,793)	
Variable	AOR	95% CI	AOR	95% CI
Post	1.26***	1.19 – 1.33	1.26***	1.19 – 1.33
SIM policy	0.42***	0.37 – 0.47	0.39***	0.35 – 0.44
Post*SIM policy	1.30***	1.18 – 1.43	1.31***	1.19 – 1.44
Age	0.98***	0.98 – 0.98	0.98***	0.98 – 0.99
Female	0.86***	0.82 – 0.90	0.84***	0.80 – 0.88
Race/ethnicity				
White, NH				
African American/Black, NH			1.10**	1.03 – 1.18
Hispanic			0.87**	0.80 – 0.96
Asian/Pacific Islander			0.60***	0.45 – 0.80
Native American			0.75	0.51 – 1.10
Other			0.73**	0.59 – 0.89
Primary payer				
Medicare				
Medicaid	2.37***	2.19 – 2.56	2.40***	2.21 – 2.60
Private	0.53***	0.49 – 0.58	0.52***	0.47 – 0.57
Other Insurance	2.40***	2.24 – 2.57	2.37***	2.21 – 2.55
Emergency Department admission	1.86***	1.76 – 1.97	1.86***	1.75 – 1.97
Length of stay	1.02***	1.01 – 1.02	1.02***	1.02 – 1.02
Metropolitan region	0.87***	0.81 – 0.94	0.87***	0.81 – 0.94
Comorbidity count	1.06***	1.05 – 1.06	1.06***	1.05 – 1.07

Notes:
SIM Impact on SDOH codes utilization among adults with ASCVD.

Models 3 and 4 are estimated using 4-group propensity score weighting. Models include state and hospital fixed effects (not shown). Robust SEs are estimated by clustering at the hospital level.

AOR indicated adjusted odds ratio; for the interaction term, it is the ratio of 2 adjusted odds ratios.

*** p<0.001, ** p<0.01, * p<0.05

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Table 4. Impact of State Innovation Model on SDOH Codes Utilization in Medicaid and Medicare Beneficiaries

	Model-5 Medicaid beneficiaries (n= 92,292)		Model-6 Medicare beneficiaries (n= 943,327)	
Variable	AOR	95% CI	AOR	95% CI
Post	1.23**	1.07 – 1.41	1.23***	1.13 – 1.34
SIM policy	0.58**	0.38 – 0.87	0.37***	0.31 – 0.43
Post*SIM policy	1.02	0.80 – 1.26	1.50***	1.31 – 1.71
Age	0.99***	0.99 – 0.99	0.98***	0.98 – 0.98
Female	0.45***	0.39 – 0.51	1.07*	1.01 – 1.14
Race/ethnicity				
White, NH				
African American/Black, NH	0.91	0.79 – 1.04	1.16**	1.04 – 1.29
Hispanic	0.61***	0.51 – 0.74	1.02	0.89 – 1.18
Asian/Pacific Islander	0.34***	0.19 – 0.63	0.81	0.53 – 1.22
Native American	1.13	0.38 – 3.37	0.72	0.45 – 1.14
Other	0.56**	0.37 – 0.85	0.83	0.59 – 1.16
Emergency Department admission	1.87***	1.61 – 2.17	1.86***	1.71 – 2.01
Length of stay	1.01***	1.01 – 1.02	1.02***	1.02 – 1.02
Metropolitan region	1.45**	1.16 – 1.82	0.66***	0.60 – 0.73
Comorbidity count	1.05***	1.03 – 1.07	1.03***	1.02 – 1.04

Notes:
SIM Impact on SDOH codes utilization among Medicaid and Medicare beneficiaries hospitalized with ASCVD.

Models 5 (Medicaid beneficiaries) and model 6 (Medicare beneficiaries) are estimated using a 4-group propensity score weighting. Models include state and hospital fixed effects (not shown). Robust SEs are estimated by clustering at the hospital level.

AOR indicated adjusted odds ratio; for the interaction term, it is the ratio of 2 adjusted odds ratios.

*** $p<0.001$, ** $p<0.01$, * $p<0.05$