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RESEARCH ARTICLE

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Adjusting for social risk factors impacts performance and penalties in the hospital readmissions reduction program

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Objective: Medicare's Hospital Readmissions Reduction Program (HRRP) does not account for social risk factors in risk adjustment, and this may lead the program to unfairly penalize safety-net hospitals. Our objective was to determine the impact of adjusting for social risk factors on HRRP penalties.

Study Design: Retrospective cohort study.

Data Sources/Study Setting: Claims data for 2 952 605 fee-for-service Medicare beneficiaries with acute myocardial infarction (AMI), congestive heart failure (CHF) or pneumonia from December 2012 to November 2015.

Principal Findings: Poverty, disability, housing instability, residence in a disadvantaged neighborhood, and hospital population from a disadvantaged neighborhood were associated with higher readmission rates. Under current program specifications, safety-net hospitals had higher readmission ratios (AMI, 1.020 vs 0.986 for the most affluent hospitals; pneumonia, 1.031 vs 0.984; and CHF, 1.037 vs 0.977). Adding social factors to risk adjustment cut these differences in half. Over half the safety-net hospitals saw their penalty decline; 4-7.5 percent went from having a penalty to having no penalty. These changes translated into a $17 million reduction in penalties to safety-net hospitals.

Conclusions: Accounting for social risk can have a major financial impact on safety-net hospitals. Adjustment for these factors could reduce negative unintended consequences of the HRRP.

KEYWORDS
Medicare, readmission

1 | INTRODUCTION

Since its implementation in 2012, Medicare's Hospital Readmissions Reduction Program (HRRP) has been the source of significant controversy. One major source of that controversy has been the program's lack of accounting for social risk factors that are beyond hospitals' control but may influence readmissions, such as poverty, low education, and homelessness, either in its risk-adjustment models or in program administration. Critics have argued that as a consequence, safety-net hospitals, which care for a disproportionate share of patients with such risk factors, are being unfairly penalized under the HRRP.[1] Proponents of the program have argued that adjustment is only appropriate for medical, not social, risk factors[2] and that accounting for social risk should be done in other ways or not at all.

While a large body of evidence has demonstrated that social risk factors such as individual poverty and residence in a highly disadvantaged community are powerfully linked to readmission,[3-11] less is known about how these relationships might impact performance under the HRRP or the magnitude of penalties levied against safety-net hospitals. In the first year of the HRRP, safety-net hospitals were more likely to receive maximum penalties than non–safety-net hospitals,[12] but as the program expanded in its first few years, these differences became smaller.[13] In the only peer-reviewed study to date examining the potential impact of adding adjustment for social risk factors to the HRRP, Bernheim et al[14] reported that adjusting readmission rates for Medicaid enrollment status and/or area income did not meaningfully change hospital performance, with only 3-4 percent of low socioeconomic status hospitals moving from penalty to no penalty after adjustment. However, the social risk factors evaluated in that study were limited, and the authors' treatment of improved performance with the inclusion of those factors was a dichotomous outcome (ie, penalty vs no penalty), while in actual application HRRP penalties are continuous (ie, hospitals can receive anywhere from a 0 to 3 percent penalty).[15,16] In addition, no information was provided on the overall penalty percent or dollar impact of adjustment, which could be substantial if such adjustment impacted performance assessment broadly.

Whether to adjust for social risk factors, and the real-world impact of doing so, has become even more salient recently, as Congress passed the 21st Century Cures Act requiring Medicare to take social risk into account in the HRRP by 2019.[17] In the short term, Medicare plans to stratify penalty assignments by the proportion of poor beneficiaries at each hospital, but the statute allows for different approaches to social risk to be implemented in the future. This debate also has important and broad implications for the rapidly growing list of other value-based payment programs that include readmission measures, including those for physician groups,[18] accountable care organizations,[19] dialysis facilities,[20] skilled nursing facilities,[21] and home health agencies.[22]

We therefore set out with three key aims. First, to characterize the association between claims-based social risk factors and readmission rates, using a broader group of such factors than previously analyzed; second, to characterize safety-net hospitals' performance on readmissions with and without adjustment for social risk factors; and third, to determine whether accounting for social risk factors changes penalties levied on safety-net hospitals, both in terms of the proportional and absolute dollar penalty for these institutions.

2 | METHODS

2.1 | Data

We used Medicare 100 percent Research Identifiable Files (RIF) including inpatient and outpatient claims for beneficiaries ages 65 and older with an index admission for acute myocardial infarction (AMI), congestive heart failure (CHF), or pneumonia between December 1, 2012, and November 30, 2015. Because risk adjustment for the HRRP requires a 1-year lookback period for comorbidities, claims for these beneficiaries generated between December 1, 2011, and November 30, 2012, were also used where appropriate. CMS Master Beneficiary Summary File data were used to identify dual-eligibility for Medicaid, original Medicare eligibility for disability status, and monthly enrollment in Medicare Part A.

The CMS Vital Records File was used to geocode beneficiary mailing addresses to a highly granular geographic unit—the census block group-level (ie, "neighborhood level")—which allows for precise linkage to area-based social factor measurements. We merged the geocoded records with 2013 Area Deprivation Index (ADI) data from the University of Wisconsin, School of Medicine and Public Health (www.neighborhoodatlas.medicine.wisc.edu) to obtain an ADI score for each address.[10,11,23] The ADI measures neighborhood disadvantage across an array of social factors such as education, employment, income, and housing quality, and has been previously demonstrated to be associated with readmission.[10,11] We used the CMS fiscal year 2017 Inpatient Prospective Payment System (IPPS) final rule impact file to obtain information on HRRP penalties.

2.2 | Patient cohort

We identified index admissions for AMI, CHF, and pneumonia using principal diagnosis codes used by CMS for the HRRP.[24] Diagnosis codes for claims during the final 2 months of our study period were converted from 10th to the 9th revision of International Classification of Diseases, Clinical Modification (ICD-10 CM to ICD-9 CM). Admissions were excluded per CMS methodology if the beneficiary was under age 65 or not fully enrolled in Medicare Part A during the 365 days prior to and 30 days following the index admission; if the claim included a final disposition of transferred, self-discharged against medical advice, or deceased; if the patient was readmitted on the same day as discharge; or if the claim occurred at a non–acute care facility.

2.3 | Primary predictors: social risk factors

A conceptual framework for inclusion of social risk factors in Medicare payment policy has been proposed by the National Academies of Sciences, Engineering, and Medicine.[25,26] From this framework, we evaluated several measures of beneficiaries' community and individual social risk factors as predictors of readmission. The first was residence in a neighborhood belonging to the highest (most disadvantaged) ADI quintile, based on prior work[10,11] and our own confirmatory analyses suggesting that the relationship between neighborhood disadvantage and readmission is concentrated in the highest quintile (Figures S1-S3). We also included an indicator for beneficiaries with missing ADI as a result of invalid address information, which constituted 10.4 percent of our sample. Dual-eligibility for Medicaid was used as an indicator of low income. We considered beneficiaries as dually eligible if they had at least 1 month of Medicaid eligibility during the year of the index admission. Original Medicare eligibility prior to age 65 as a result of disability was used as a marker of functional status, which is related to many social risk factors.[24] We categorized housing stability into groups reporting one, 2-3, or 4 or more unique residential ZIP codes on inpatient and outpatient claims between 2012 and 2015, with 4 or more indicating the most unstable housing. Finally, we included an indicator of disadvantage at the hospital level for hospitals' surrounding communities, using the fifth-quintile of hospitals' percentage of patients residing in the most disadvantaged ADI quintile of neighborhoods. We categorized hospitals into safety-net status using quintiles of dual-eligible payer mix. We defined first quintile hospitals as most affluent, second through fourth quintile hospitals as mid-affluence, and fifth-quintile hospitals as safety-net providers as has been done previously.[14,17]

2.4 | Primary outcome: readmission

Unplanned readmissions occurring within 30 days of discharge from an index admission were identified using the criteria defined by CMS for the HRRP.[24] As per CMS specifications, we excluded planned readmissions for procedures, transplantation, chemotherapy, and rehabilitation, and multiple readmissions, such that each beneficiary within a cohort was eligible for only one index admission and readmission pair per thirty days.

2.5 | Analyses

First, we replicated CMS 30-day readmission performance assessments for AMI, CHF, and pneumonia with hierarchical generalized logistic models (HGLM) using CMS-supplied SAS packs. Next, we compared observed readmission rates for each of the social risk factors evaluated. We fit social risk-only hierarchical models for the AMI, CHF, and pneumonia cohorts using age, gender, and the social risk variables that we evaluated, first entering each into the model on its own, and then running a model with all social risk factors included. We then fit hierarchical models for each cohort using the CMS-specified clinical covariates in addition to our social risk variables. Following HRRP methodology, we calculated and compared readmission performance, in the form of excess readmission ratios, before and after the inclusion of social risk factors in risk adjustment. We conducted sensitivity analyses in which we used generalized linear models to calculate relative risk ratios as a robustness check, as well as analyses examining the frequency and impact of missing address within our models (Tables S1-S2).

Finally, we calculated HRRP penalties. We estimated base operating DRG payments for AMI, CHF, and pneumonia as well as total base operating DRG payments for each hospital using 2013-2015 MedPAR data. We then scaled the cohort-specific DRG payments by the readmission ratios derived with the CMS baseline and social risk-augmented models. The results were divided by total base operating DRG payments and subtracted from one to estimate the readmissions adjustment factor for each of the competing models. We imposed a floor of 0.97 for these factors to ensure a maximum possible penalty of 3 percent of total base operating DRG payments, as prescribed by the HRRP.[27] To simulate the penalty impact for federal fiscal year 2017, we applied the readmission adjustment factors for each competing model to 2017 base operating IPPS revenue using the CMS final rule impact file of the same year.

All analyses were conducted using SAS version 9.4, SAS Institute, Cary, NC. We considered a two-tailed *P*-value of <0.05 to be statistically significant.

3 | RESULTS

3.1 | Sample, patient, and hospital characteristics

We identified 2084 hospitals participating in the HRRP for AMI, 2949 for pneumonia, and 2874 for CHF during the study period (Table 1). Across clinical cohorts, patients at safety-net hospitals were more often female, much more often dually enrolled in Medicaid, and more often originally entitled to Medicare due to disability. They were also less often white and had a higher prevalence of housing instability (4 or more ZIP codes). Patients at safety-net hospitals more often resided in highly disadvantaged neighborhoods, and safety-net hospitals much more often cared for large populations residing in highly disadvantaged neighborhoods.

3.2 | Relationship between social risk factors and readmission

We found much higher raw readmission rates for individuals with social risk factors: For example, for AMI, dually enrolled patients had a raw readmission rate of 18.9 percent (odds ratio [OR] 1.48, 95% confidence interval [CI] 1.45-1.51, $P < 0.0001$), and those with disability 18.1 percent (OR 1.35, 95% CI 1.32-1.38, $P < 0.0001$, Table 2). Individuals reporting 2-3 or 4 or more ZIP codes during the study period, as well as those from highly disadvantaged neighborhoods or discharged from hospitals caring for more patients from highly disadvantaged neighborhoods, also had higher odds of readmission.

TABLE 1 Patient and hospital characteristics

Patient characteristics	AMI cohort			Pneumonia cohort			CHF cohort		
	All	Most affluent	Safety-net	All	Most affluent	Safety-net	All	Most affluent	Safety-net
Number of index admissions (mean)	516 793 (122.3)	108 869 (245.8)	53 528 (120.8)	1 215 126 (257.7)	276 796 (322.2)	158 771 (184.8)	1 220 686 (262.2)	286 437 (370.6)	146 776 (189.9)
Number of hospitals participating in HRRP	2084	417	417	2949	590	590	2874	575	575
Age 85+ (%)	26.9%	26.3%	30.5%	37.4%	40.1%	36.8%	38.1%	42.3%	34.4%
Female	46.6%	43.5%	51.2%	53.2%	51.8%	55.2%	54.0%	51.6%	57.4%
Medicaid	20.9%	9.4%	47.1%	30.3%	15.1%	58.4%	26.5%	12.8%	55.6%
Originally entitled to Medicare due to disability	14.7%	10.8%	18.1%	17.0%	12.1%	21.3%	16.8%	12.5%	20.7%
Race									
White	86.4%	91.6%	69.0%	87.3%	91.2%	72.3%	82.5%	90.1%	61.9%
Black	8.2%	4.3%	16.2%	7.4%	4.8%	12.8%	12.5%	6.6%	23.9%
Unknown/other	5.4%	4.2%	14.8%	5.3%	4.1%	14.9%	4.9%	3.2%	14.2%
Hispanic	1.7%	0.8%	7.0%	1.9%	1.0%	6.8%	1.8%	0.9%	7.4%
Housing stability									
4 or more ZIPs during study period	0.2%	0.2%	0.4%	0.3%	0.3%	0.4%	0.3%	0.2%	0.5%
2-3 ZIPs during study period	12.2%	12.2%	13.2%	15.8%	16.7%	15.3%	15.0%	15.8%	14.4%
One ZIP during study period	87.6%	87.7%	86.4%	83.8%	83.0%	84.2%	84.6%	84.0%	85.2%
Proportion of beneficiaries residing in ADI Quintile 5 (highly disadvantaged home neighborhood)	14.7%	7.6%	21.0%	14.9%	6.8%	24.5%	15.8%	7.6%	26.2%
Proportion of hospitals in Quintile 5 of beneficiaries residing in most highly disadvantaged neighborhoods	17.8%	1.9%	33.0%	14.3%	0.8%	38.5%	12.2%	1.4%	36.8%
Mean number of comorbidities (HCCs)	9.00	8.61	9.45	10.17	9.84	10.22	9.50	9.40	9.27

Note: Most affluent hospitals are those in the lowest quintile of proportion dually enrolled (Medicare and Medicaid) individuals; safety-net hospitals are those in the highest quintile. Source: Authors' calculations using CMS 100% Inpatient and Outpatient Research Identifiable File Claims Data for Medicare Fee-For-Service beneficiaries aged 65 and older with an index admission for AMI, pneumonia, or CHF between December 1, 2012, and November 30, 2015. Notes: Dual quintiles assigned to hospitals with 25 or more index admissions. Column percentages are based on the total number of index admissions.

AMI, acute myocardial infarction; CHF, congestive heart failure; HCC, hierarchical condition categories; ZIP, zone improvement plan.

TABLE 2 Relationship between social risk factors and readmission

	AMI cohort				Pneumonia cohort				CHF cohort			
	Observed readmission rate (%)	Odds from model with each social risk factor alone	Odds from model with all social risk factors	Odds from model with social and medical risk factors	Observed readmission rate (%)	Odds from model with each social risk factor alone	Odds from model with all social risk factors	Odds from model with social and medical risk factors	Observed readmis-sion rate (%)	Odds from model with each social risk factor alone	Odds from model with all social risk factors	Odds from model with social and medical risk factors
Overall	14.7	-	-	-	15.2	-	-	-	19.6	-	-	-
Medicaid	18.9	1.48**	1.34**	1.09**	17.4	1.26**	1.20**	1.14**	22.8	1.30**	1.22**	1.16**
		1.45-1.51	1.31-1.36	1.07-1.12		1.24-1.27	1.19-1.22	1.13-1.16		1.29-1.31	1.21-1.24	1.15-1.17
Disability	18.1	1.35**	1.38**	1.10**	18.3	1.32	1.18**	1.14**	23.0	1.28**	1.14**	1.10**
		1.32-1.38	1.35-1.41	1.07-1.12		1.30-1.33	1.16-1.20	1.12-1.16		1.27-1.30	1.13-1.16	1.09-1.11
Housing stability												
One ZIP	14.3	Ref	Ref	Ref	15.0	Ref	Ref	Ref	19.3	Ref	Ref	Ref
2-3 ZIPs	17.7	1.29**	1.19**	1.01	16.2	1.10**	1.07**	1.04**	21.2	1.13**	1.10**	1.07**
		1.26-1.32	1.16-1.22	0.99-1.04		1.08-1.11	1.06-1.08	1.03-1.06		1.11-1.14	1.08-1.11	1.05-1.08
4 or more ZIPs	22.4	1.68**	1.47**	1.08	22.1	1.59**	1.39**	1.28**	28.2	1.61**	1.39**	1.29**
		1.47-1.92	1.29-1.67	0.94-1.24		1.48-1.71	1.29-1.49	1.19-1.38		1.51-1.73	1.29-1.49	1.20-1.38
Patient's neighborhood disadvantage by ADI												
Q1-Q4	14.4	Ref	Ref	Ref	15.0	Ref	Ref	Ref	19.3	Ref	Ref	Ref
Q5 most	16.3	1.15**	1.06**	1.02	16.4	1.11**	1.04**	1.02*	21.1	1.12**	1.03**	1.02~
		1.13-1.18	1.04-1.08	0.99-1.04		1.10-1.13	1.03-1.06	1.01-1.04		1.11-1.13	1.01-1.04	1.01-1.04
Hospital population residing in highly disadvantaged neighborhoods by ADI												
Q1-Q4	14.5		Ref	Ref	15.1	Ref	Ref	Ref	19.4	Ref	Ref	Ref
Q5 most	15.8	1.11**	1.07**	1.04*	15.9	1.07**	1.02*	1.03*	21.0	1.10**	1.05**	1.05**
		1.09-1.13	1.04-1.10	1.01-1.07		1.05-1.08	1.00-1.05	1.01-1.05		1.09-1.12	1.03-1.07	1.03-1.07

Source: Authors' calculations using CMS 100% Inpatient and Outpatient Research Identifiable File Claims Data for Medicare Fee-For-Service beneficiaries aged 65 and older with an index admission for AMI, pneumonia, or CHF between December 1, 2012, and November 30, 2015. Notes: The social and medical risk factors column includes the social risk factors plus the standard CMS risk-adjustment model, which is based on medical comorbidities. Odds ratios represent the odds that readmission will occur in the group with the social risk factor divided by the odds that readmission will occur in the group without the social risk factor.

ADI, area deprivation index; AMI, acute myocardial infarction; CHF, congestive heart failure; ZIP, zone improvement plan.

*$P < 0.05$.

**$P < 0.0001$.

Patterns were similar for pneumonia and CHF (Table 2) and when we calculated relative risk ratios using generalized linear models (Table S3).

In a model that included all the social risk factors, these relationships were slightly attenuated, though they all retained significance. For example, the odds of readmission for dually enrolled individuals when also considering all other social risk factors was 1.34 (1.31-1.36, $P < 0.0001$) for AMI, 1.20 (1.19-1.22, $P < 0.0001$) for pneumonia, and 1.22 (1.21-1.24, $P < 0.0001$, Table 2) for CHF.

Finally, after fully adjusting for clinical comorbidities per the current CMS risk-adjustment model, these relationships were further attenuated, though many remained significant. For example, the fully adjusted odds of readmission for dually enrolled individuals was 1.09 (1.07-1.12, $P < 0.0001$) for AMI, 1.14 (1.13-1.16, $P < 0.0001$) for pneumonia, and 1.16 (1.15-1.17, $P < 0.0001$, Table 2) for CHF. The presence of 4 or more ZIP codes and patient residence in a highly disadvantaged neighborhood remained associated with readmission for pneumonia and CHF after clinical risk adjustment, and hospital service of more individuals from highly disadvantaged neighborhoods remained associated with readmission for all three conditions. Full model results are presented in Tables S4-S6.

3.3 | Safety-net performance with and without social risk adjustment

Under current program specifications, safety-net hospitals had higher readmission rates for all three conditions even after adjustment for medical comorbidities, resulting in mean readmission ratios that were higher for all three conditions (for AMI, 1.020 vs 0.986 for the most affluent hospitals, difference 0.034; for pneumonia, 1.031 vs 0.984, difference 0.047; and for CHF, 1.037 vs 0.977, difference 0.060, Table 3).

After adding social risk adjustment, differences narrowed significantly. Mean readmission ratios for safety-net hospitals vs the most affluent hospitals dropped roughly in half (for AMI, to 1.014 vs 0.992, difference 0.021; pneumonia 1.016 vs 0.996, difference 0.020; CHF, 1.018 vs 0.989, difference 0.029, Table 3), while the ratios for the most affluent hospitals increased. For AMI, 96.2 percent of the most affluent hospitals had their readmission ratio increase after adjustment, compared with just 13.0 percent of safety-net hospitals; conversely, only 3.8 percent of the most affluent hospitals' readmission ratios became lower (better) after adjustment, compared with 87.1 percent of safety-net hospitals. Patterns were similar for other conditions (Table 3).

Consequently, there were significant shifts in penalty status and penalty amount for both safety-net hospitals and more affluent hospitals under social risk adjustment (Figure 1A). Over half of the safety-net hospitals saw their penalty decline for each condition, while between 4 and 7.5 percent went from having a penalty to having no penalty. Among the most affluent hospitals, 33-40.5 percent saw an increase in their penalty, and between 5 and 6 percent were newly penalized.

TABLE 3 Hospital performance by safety-net status

	AMI			Pneumonia			CHF		
	Most affluent	Mid-affluence	Safety-net	Most affluent	Mid-affluence	Safety-net	Most affluent	Mid-affluence	Safety-net
Hospitals	417	1250	417	590	1769	590	575	1724	575
Observed 30-d readmission rate	13.3%	14.7%	17.4%	14.3%	15.5%	16.6%	18.4%	19.8%	21.9%
Mean readmission ratio with only medical risk adjustment	0.986	0.999	1.020	0.984	1.006	1.031	0.977	1.001	1.037
Mean readmission ratio after adding social risk adjustment	0.992	0.999	1.014	0.996	1.007	1.016	0.989	1.002	1.018
Proportion with higher (worse) ratio after social risk adjustment	96.2%	63.7%	13.0%	99.3%	61.2%	3.6%	97.0%	64.4%	4.9%
Proportion with lower (better) ratio after social risk adjustment	3.8%	36.3%	87.1%	0.68%	38.8%	96.4%	3.0%	35.6%	95.1%

Source: Authors' calculations using CMS 100% Inpatient and Outpatient Research Identifiable File Claims Data for Medicare Fee-For-Service beneficiaries aged 65 and older with an index admission for AMI, pneumonia or CHF between December 1, 2012, and November 30, 2015. Notes: Results include hospitals eligible for penalties under the HRRP (IPPS acute care hospitals with 25 or more index admissions for each condition during the 36-mo study period). Medical risk adjustment is the standard CMS comorbidity model. Social risk adjustment includes Medicaid dual-eligibility status, original entitlement for disability status, number of residential ZIP codes, fifth-quintile of ADI for census block group of patient residence, fifth-quintile of ADI for hospital population.
AMI, acute myocardial infarction; CHF, congestive heart failure.

	Most Affluent	Mid-Affluence	Safety Net
AMI Cohort			
Higher Penalty	37.9%	23.1%	0.7%
Newly Penalized	5.0%	1.0%	0.0%
No Penalty Before/After	54.9%	51.9%	40.0%
Lower Penalty	2.2%	23.0%	55.2%
Newly Non Penalized	0.0%	1.0%	4.1%
Pneumonia Cohort			
Higher Penalty	40.5%	23.5%	0.0%
Newly Penalized	5.9%	0.9%	0.0%
No Penalty Before/After	53.1%	49.6%	37.5%
Lower Penalty	0.5%	25.0%	55.9%
Newly Non Penalized	0.0%	1.0%	6.6%
CHF Cohort			
Higher Penalty	33.2%	22.3%	0.0%
Newly Penalized	5.2%	2.0%	0.0%
No Penalty Before/After	58.8%	48.7%	35.3%
Lower Penalty	2.8%	25.5%	57.2%
Newly Non Penalized	0.0%	1.5%	7.5%

FIGURE 1 A, Proportion of hospitals with changes in penalties after social risk adjustment. B, Change in Dollar amount of penalties (in millions of dollars) [Color figure can be viewed at wileyonlinelibrary.com]
Source: (A) Authors' calculations using CMS 100% Inpatient and Outpatient Research Identifiable File Claims Data for Medicare Fee-For-Service beneficiaries aged 65 and older with an index admission for AMI, pneumonia or CHF between December 1, 2012 and November 30, 2015. (B) Penalty estimates provided by DataGen using CMS base operating DRG payment data applied to the authors' calculations using CMS 100% Inpatient and Outpatient Research Identifiable File Claims Medicare Fee-For-Service beneficiaries aged 65 and older with an index admission for AMI, pneumonia or CHF between December 1, 2012 and November 30, 2015.
Notes: (A) Results include hospitals eligible for penalties under the HRRP (IPPS acute care hospitals with 25 or more index admissions for each condition during the 36-month study period). Social risk risk adjustment includes Medicaid dual-eligibility status, original entitlement for disability status, number of residential ZIP codes, fifth-quintile of ADI for census block group of patient residence, fifth-quintile of ADI for hospital population. AMI=acute myocardial infarction; CHF=congestive heart failure. (B) Results include hospitals eligible for penalties under the HRRP (IPPS acute care hospitals with 25 or more index admissions for each condition during the 36-month study period). Social risk adjustment includes Medicaid dual-eligibility status, original entitlement for disability status, number of residential ZIP codes, fifth-quintile of ADI for census block group of patient residence, fifth-quintile of ADI for hospital population. AMI=acute myocardial infarction; CHF=congestive heart failure.

These changes translated into a major shift in total penalties assessed, with over $17 million less in penalties assessed to safety-net hospitals (a 21.8 percent reduction) offset by a similar increase (22.0 percent) in penalties for the most affluent hospitals (Figure 1B).

4 | DISCUSSION

We found that social risk and readmission are closely linked, and that dual status, disability, housing instability, and neighborhood disadvantage, all of which are outside hospitals' control, had strong

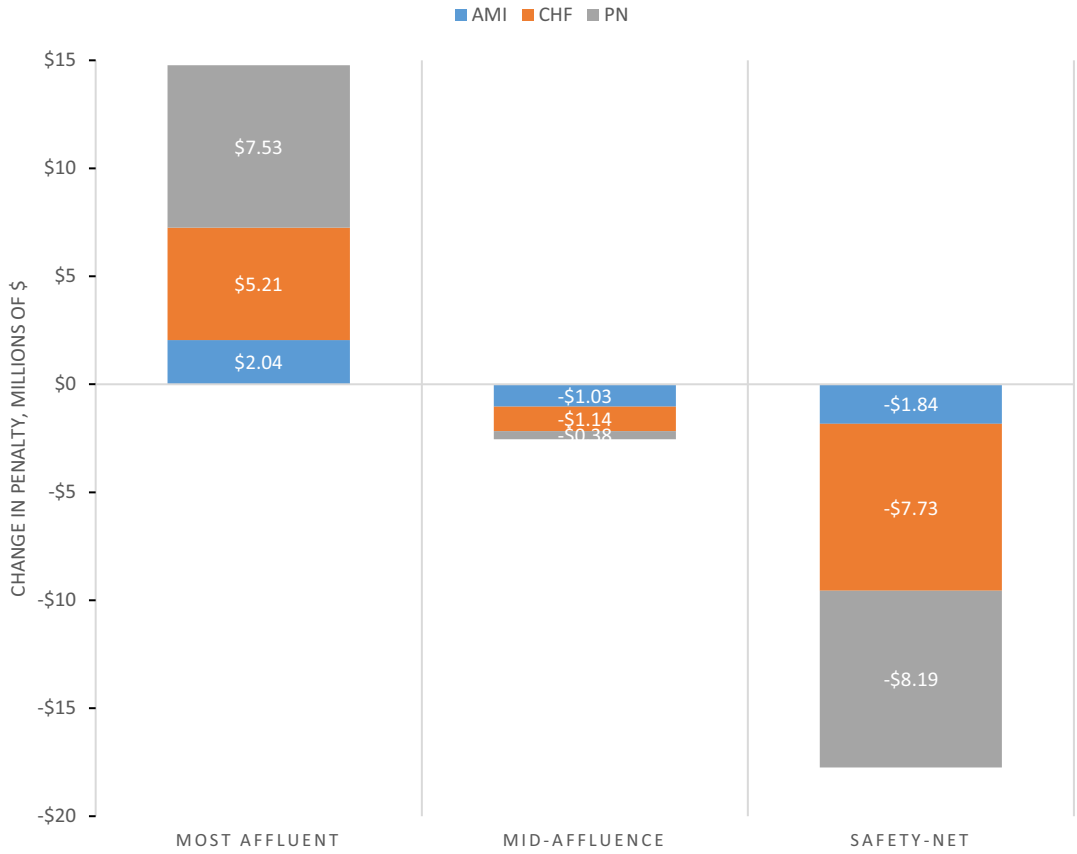

FIGURE 1 Continued

relationships with readmission even after adjusting for medical comorbidities in the standard CMS adjustment. Further, we found that accounting for these readily available claims-based markers of such risk had a major financial impact on safety-net hospitals, with over half seeing a decline in their penalty as a result of such adjustment.

Social risk and worse clinical outcomes have been definitively demonstrated to be linked.[25,26] However, the precise mechanisms linking social risk and readmission are unknown, and likely complex. There are a number of possibilities: Individuals with high levels of social risk also have higher levels of medical risk,[28] and to the degree that medical risk is uncaptured in simplistic claims data, it may be underaccounted for in risk adjustment. Poverty and disability are associated with worse functional status and higher levels of frailty;[29] these are not easily quantified in claims and may meaningfully contribute to outcomes such as 30-day readmission.[30,31] Another possibility is that social risk is associated with higher readmission rates due to post-discharge issues such as access to primary care, transportation to follow-up appointments,[32] health literacy,[33] ability to adhere to self-care regimens,[34] and ability to afford prescriptions, all of which are more difficult in the presence of social risk. Finally, prior evidence suggests that social risk is associated with the receipt of poorer-quality post-acute care, which may impact readmission rates independent of hospital quality.[3,35,36]

There has been a great degree of controversy around whether CMS should or should not adjust readmission rates and other health outcomes for social risk when judging hospital performance. Proponents of adjustment argue that social risk, like medical risk, is outside the control of the hospital, and therefore should be accounted for similarly. In addition to any shift in the penalty dollar amount, adding social risk can improve the accuracy of quality measurement and provide face validity to the overall measurement effort, as such adjustment provides a signal to hospitals that their treatment of more challenging patients will be accounted for. Opponents of adjustment argue that adjusting for social risk accepts worse performance for these populations by the hospitals serving them; however, the way in which adjustments were made in our simulations—applying social factors at the level of the patient rather than at the level of the hospital—ensures that poor performance that is linked to the hospital rather than the patient characteristic is not adjusted away. In fact, even with adjustment, safety-net hospitals had somewhat worse performance than wealthier hospitals; whether this represents true differences in the quality of care delivered by each hospital, or residual confounding by factors beyond hospitals' control, is unknown. Regardless of on which side of the debate one sits, it is inarguable that this decision has real consequences: Current policies, not only in the HRRP but also other value-based payment programs in Medicare, are disproportionately penalizing providers that serve the poor and disabled.[28,37-44]

Our findings are consistent with prior studies demonstrating a relationship between claims-based measures of social risk and

readmission rates,[3-11] though to our knowledge this is the first to combine individual, community, and housing variables in such a manner. One prior study examined the relationship between adjusting for social risk and penalties under the HRRP, and despite similar quantitative findings, came to different conclusions, but that study only evaluated the dichotomous outcome of going from penalty to no penalty, and likely had more imprecise geographic social measures than the ones used here.[14] A federal report examined the impact of adjustment for social risk factors in various ways, and similarly demonstrated significant changes, though using slightly different methods.[28]

There are limitations to our findings. Because we used administrative data and readily linked neighborhood data to assess social risk, we lack granular detail on other important risk factors, such as social support, health literacy, or individual health behaviors. Our measure of housing instability has not been validated, and analyses with this variable should be considered exploratory; we were also unable to detect housing instability within individual ZIP codes. Ongoing efforts to improve data availability for these and other social risk factors may allow more precise investigations of these relationships in the future.[45] We did not have access to physician claims for our patients due to Medicare data restrictions, which could limit our ability to ascertain all comorbidities; however, our findings were similar to published CMS statistics. We estimated base operating DRG payments for our financial analyses, and those results were limited to three of the six patient cohorts that hospitals are currently penalized under the HRRP. Our analyses are limited to hospitals subject to the HRRP and may not generalize more broadly.

5 | CONCLUSIONS

We found that social risk and readmission are closely linked and that accounting for readily available claims-based markers of such risk had a major financial impact on safety-net hospitals. Our findings suggest that direct adjustment for social risk factors has potential for leveling the playing field for hospitals that serve the most vulnerable patients, and reducing negative unintended consequences of the HRRP.

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CONFLICTS OF INTEREST

Dr. Joynt Maddox does intermittent contract work for the United States Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation. Dr. Kind receives grant funding from the NIH/National Institute on Minority Health and Health Disparities, the NIH/National Institute on Aging, the Commonwealth Fund, the US Department of Veterans Affairs, and the US Centers for Medicare and Medicaid Services, and has performed work as a consultant for the US state of Maryland. Dr. Zaslavsky receives support under grants and contracts from the National Institutes on Aging and on Mental Health, and from the Centers for Medicare and Medicaid Services. Mr. Reidhead, Dr. Nerenz, Dr. Nagasako, and Dr. Hu report no conflicts.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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