

# Racial/Ethnic Disparities in Readmissions in US Hospitals: The Role of Insurance Coverage

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## Abstract

We examine differences in rates of 30-day readmissions across patients by race/ethnicity and the extent to which these differences were moderated by insurance coverage. We use hospital discharge data of patients in the 18 years and above age group for 5 US states, California, Florida, Missouri, New York, and Tennessee for 2009, the latest year prior to the start of Centers for Medicare & Medicaid Services' Hospital Compare program of public reporting of hospital performance on 30-day readmissions. We use logistic regression models by state to estimate the association between insurance status, race, and the likelihood of a readmission within 30 days of an index hospital admission for any cause. Overall in 5 states, non-Hispanic blacks had a slightly higher risk of 30-day readmissions relative to non-Hispanic whites, although this pattern varied by state and insurance coverage. We found higher readmission risk for non-Hispanic blacks, compared with non-Hispanic whites, among those covered by Medicare and private insurance, but lower risk among uninsured and similar risk among Medicaid. Hispanics had lower risk of readmissions relative to non-Hispanic whites, and this pattern was common across subgroups with private, Medicaid, and no insurance coverage. Uninsurance was associated with lower risk of readmissions among minorities but higher risk of readmissions among non-Hispanic whites relative to private insurance. The study found that risk of readmissions by racial ethnic groups varies by insurance status, with lower readmission rates among minorities who were uninsured compared with those with private insurance or Medicare, suggesting that lower readmission rates may not always be construed as a good outcome, because it could result from a lack of insurance coverage and poor access to care, particularly among the minorities.

## Keywords

hospital readmissions, race/ethnicity, insurance coverage, US states, multivariate regression, cross sectional analysis, administrative data

### What do we already know about this topic?

While there is abundance of evidence of variation in readmission rates across hospitals, there is considerable concern that a large portion of the interhospital variation in readmissions may be due to differences in patient profiles that are beyond the control of hospitals.

### How does your research contribute to the field?

This research provides a better understanding of the key drivers of population-level differences in readmissions that also might be linked to both race/ethnicity and insurance status.

### What are your research's implications towards theory, practice, or policy?

This research can inform the development of interventions at the practice and policy levels to reduce overall inappropriate readmissions.

Hospital readmissions can increase as a result of inappropriate care transitions across multiple practice settings. Reducing

preventable readmissions has become a policy focus because it represents an opportunity to simultaneously improve quality and reduce costs. Because most US hospitals are now subject to some level of financial penalty for high readmission rates, it is important to understand the contribution of factors other than quality to those rates so that these factors can be addressed in improving performance at the population level and to avoid unfairly penalizing hospitals caring for

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disadvantaged populations. While a few studies have found that, in the aggregate, across all conditions, black patients have slightly increased odds of readmission than white patients,<sup>1-3</sup> others have found no such effect.<sup>4</sup> A better understanding of the key drivers of population-level differences in readmissions (such as limited access to follow-up care and/or postdischarge care needs, or barriers to readmission among those who are uninsured) that also might be linked to both race/ethnicity and insurance status can inform the development of interventions at the practice and policy levels to reduce overall inappropriate readmissions.

One of the major factors that could moderate readmission risks by racial/ethnic groups is the insurance status of patients. This potential arises from several findings noted in the literature. First, considerable evidence connects insurance coverage with different aspects of post-acute care, with varying implication for readmission risk. Lack of insurance may increase the risk of readmission due to poorer access to outpatient care follow-up.<sup>5</sup> Also those without insurance and those covered under a prospective payment system, such as Medicare, were found to have shorter lengths of stay,<sup>6,7</sup> thereby potentially increasing risk of readmission. Also, a national study of nursing home patients found that “driven by the financial incentives,” nursing homes hospitalize more Medicaid residents than those on private pay.<sup>8</sup> On the contrary, lower reimbursement insurance coverages, such as Medicaid, has been associated with lower risk of hospitalization<sup>9-11</sup>; this pattern may also arise from greater care-seeking among those with commercial and Medicare coverage. Insurance coverage also has been associated with patient outcomes,<sup>12</sup> with 1 study finding Medicaid coverage and lack of insurance associated with higher risk of death.<sup>13,14</sup> Second, there is considerable evidence by race/ethnicity in the type of insurance coverage and lack of insurance.<sup>15</sup> Nationally, the uninsurance rate in 2013 among adults aged 18 to 64 years was considerably higher among Hispanics (41%) and (non-Hispanic) blacks (25%) than among (non-Hispanic) whites (15%).<sup>15</sup> In contrast, the corresponding proportions of Medicaid patients were higher among whites (41%) than among Hispanics (30%) and blacks (21%) in 2013.<sup>16</sup> Third, much of the current evidence of racial/ethnic disparities in risk of readmission is from patient groups with homogeneous insurance coverage, mainly Medicare coverage. The current system for evaluating hospital performance on readmissions is based on Medicare-covered patients.<sup>17,18</sup> Evidence from national Medicare data for patients admitted for AMI, heart failure, and pneumonia indicated higher 30-day readmission rates for blacks and Hispanics compared with whites.<sup>1,19</sup> With all subjects covered by Medicare, these studies cannot identify the effect of insurance coverage.<sup>20</sup> Studies that have examined those under 65 years of age have also not focused on the role of insurance as a determinant of readmissions,<sup>21-23</sup> with few exceptions.<sup>5</sup>

Examination of the role of insurance is important for evaluating the current efforts aimed at reducing readmissions.

While there is abundance of evidence of variation in readmission rates across hospitals, there is considerable debate on the source of this variation. Current public policy, including Centers for Medicare & Medicaid Services’ (CMS) ongoing Hospital Readmissions Reduction Program, penalizes hospitals whose readmission rates exceed estimated expected rates for Medicare patients. Some evidence indicates that this program may have reduced readmissions in some regions of the country.<sup>24</sup> In contrast, there is considerable concern that a large portion of the interhospital variation in readmissions may be due to differences in patient profiles that are beyond the control of hospitals. A recent study of Medicare readmissions in Texas attributed substantial variation in 30-day readmissions to patient factors,<sup>23,25</sup> much less to hospital factors.

Using all payer data sources covering all inpatient admissions for all adult age groups in 5 states (California, Florida, Missouri, New York and Tennessee), we estimated differences in rates of all-cause 30-day readmissions across patients by race/ethnicity, and the extent to which these differences were moderated by insurance coverage. Our findings can inform Improving Medicare Post-Acute Care Transformation Act (IMPACT), the 2014 law calling for a better understanding of the factors affecting patient quality of care, including readmissions.

## Objectives and Hypotheses

The purpose of this study is to assess the risks of readmissions associated with race/ethnicity and insurance status among adults. Based on previous research, we expect that racial and ethnic minorities could be at increased risk readmissions because of limited access to postdischarge care, disparities in health care quality, and socioeconomic factors. However, it is not known whether among minorities, those lacking insurance coverage or having limited coverage could be at risk of higher or lower readmissions than their better insured counterparts. Lack of insurance may result in barriers to readmission, and these barriers could differ by race in part due to racial/ethnic disparities in decision making around hospital admission. Better access to primary care can potentially decrease readmission rates through better care transitions and ongoing management, or increase rather than decrease<sup>26,27</sup> the rate of hospital readmissions due to increased monitoring. In this study, we hypothesize that minorities may be at lower (than higher) risks of readmissions relative to whites when covered by low reimbursement insurances or absence of any insurance coverage. Because these relationships are complex and multifactorial, the associations could also vary by state, depending on insurance coverage, access to primary care, postdischarge care follow-ups, and availability of safety net hospitals.

Because of the complex interplay of personal, medical, and social factors that contribute to readmissions,<sup>28</sup> we use a framework that uses a multilevel context to study the research

question as to whether lack of insurance coverage may reduce readmission risks among minorities relative to whites. The study uniquely links patient data with contextual and primary care physician (PCP) data by patients' area of origin known as primary care service area (PCSA), a small area unit not previously used to provide contextual information of patients in readmissions analysis. We examined the following research questions:

**Research Question 1:** Do racial ethnic minority subgroups face risks of readmission that are different from those for whites?

**Research Question 2:** Do the readmission risks among minorities versus whites vary by their insurance status?

## Conceptual Framework

A readmission is considered to be clinically related to a prior admission and potentially preventable if there is reasonable expectation that it could have been prevented by one or more of the following: (1) the provision of quality care in the initial hospitalization, (2) adequate discharge planning, (3) adequate postdischarge follow-up, or (4) improved coordination between inpatient and outpatient health care teams. Vest et al<sup>29</sup> delineate factors contributing to readmissions, using both population health and medical care perspectives operating within 4 levels: patient, encounter, organization, and environment. Commonly included in the patient factors are race, ethnicity, culture, education, health insurance, and income. Among provider factors, lack of engagement of clinicians with patients and patient-clinician communications gaps are cited as major reasons for observed disparities across racial ethnic groups. Health care organizational factors could include location, resources, and complexity of a clinic or practice, as well as comprehensiveness and coordination of care in services delivered. In addition, community characteristics<sup>30</sup> can also influence a patient's access to and quality of health care they receive.

Studies<sup>31,32</sup> likewise suggest multilevel determinants of disparities, including patient, provider, health systems, and the community, in health care outcome. The factors that contribute to racial and ethnic differences in readmission patterns include patient, provider, and community factors described as above. In particular, provider factors are those occurring during the hospital stay such as process of care (delivery of care such as care coordination, service utilization, adequate length of stay [LOS], and equitable care, safety-net status), and structure and organization of care (workforce, number of hospital beds) followed by the transition into a suitable postdischarge care environment (such as care coordination, self-management capabilities, and access to primary care).<sup>27</sup> In the multivariate analysis that follows, we will use variables based on this conceptual framework highlighting predisposing (age, sex, race/ethnicity), enabling (insurance status, and income), and need (health status, disease severity) character-

istics of patients, as well as their contextual and provider factors (to be described below).

## Methods

We used hospital discharge data of patients in 5 US states, California, Florida, Missouri, New York, and Tennessee for 2009, a year immediately preceding the Affordable Care Act (ACA), in the adult age group (18 years and above), obtained from the Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID) of the Agency for Healthcare Research and Quality,<sup>33</sup> linked to contextual and provider availability data from Area Resource File (Health Resources and Services Administration), and American Hospital Association's (AHA) Annual Survey of hospitals to obtain data on hospital characteristics. As public reporting of hospital performance on 30-day readmissions by the CMS, under the Hospital Compare program, began in 2009, we believe our data (for 2009) largely reflect prereporting trends.<sup>34</sup> The states were selected based on the availability of confidential 2009 HCUP-SID data to calculate readmissions, as this requires tracking all patient admissions across hospitals. Multilevel analysis combined characteristics of patients, their providers, and the areas where they reside. We used a unique geographical unit of patients' residential area, PCSA, to obtain the contextual data of patients and link to patient-level data. PCSA-level contextual data have not been used previously in multilevel analysis of readmissions, partly because of the complex process involved in mapping patients' confidential discharge data by zip code to the PCSA categories. A PCSA, usually comprising of multiple zip codes, is defined as an area where most residents obtain primary care from providers within that area<sup>35</sup> and is the smallest area unit to combine discharge information by patient with their contextual and provider data. There were a total of 1146 PCSAs in the 5 states we used for the study, with an average PCSA population size ranging between 816 (FL) to 1 482 527 (FL) and average population density ranging from 190 (MO) to 7799 (NY) per square mile land area. To create the analytical files, we linked the patient's resident zip code available from HCUP-SID to the PCSAs from Health Resources and Services Administration (HRSA) files to obtain the contextual data at the PCSA level for each patient. Finally, we linked the data to AHA data files to obtain characteristics of the hospitals where patients were initially admitted.

## Measures

### *Dependent Variable: Hospital Readmission*

Our outcome measure was a binary indicator (0/1) of all-cause hospital readmission within 30 days of an index hospital admission of any type, with a few exclusions. The 30-day readmission was defined as any repeat admission within 30

days after being discharged from an index hospital stay for any cause between January and November 2009. Each hospital stay can be a new index admission and a single patient can be counted multiple times during the course of the January through November observation period. In addition, a hospital stay may be a readmission for a prior stay and the index admission for a subsequent readmission.<sup>36</sup> However, no more than one readmission was counted within the 30-day period. We excluded transfers, trauma-related readmissions (using the clinical classification code categories  $\leq 236$  and  $\geq 225$ ),<sup>37</sup> as well as elective readmissions from the study sample. Trauma-related readmissions accounted for 2% of all readmissions in 5 states. Elective readmissions were excluded (about 15% of all readmissions in 5 states) as these types of readmissions are planned and previously scheduled and not really preventable through policy changes. Such exclusion also reduced the bias in the sample as the uninsured could have fewer planned readmissions.

### *Covariates of Readmission*

The independent variables consisted of patient-level, PCSA-level, and hospital-level factors as found on the discharge record of the index admission. The following independent variables were considered in the regression model, consistent with the conceptual framework described above, as well as those reported in previous research.<sup>27</sup> The first set of patient-level factors represented predisposing (age, sex, race/ethnicity) and enabling characteristics (insurance status, and income). Age was measured as a continuous variable while race/ethnicity was a categorical variable defined by the following groups: non-Hispanic white (reference), non-Hispanic black or African American, Hispanics, and other races (includes Asian or Pacific Islander, Native Americans, and others). The observations with missing race/ethnicity, constituting 1.19% in the overall 5-state total, were dropped. Sex likewise was categorized as male (reference) and female. Insurance status represents an enabling characteristic measured at the individual level and was a categorical variable with the following insurance types: private (reference), Medicare, Medicaid, uninsured, and other payers (including charities and a small group of public programs). Another enabling characteristic of the patient is the household income, measured as the median household income of patient zip code (2009) grouped by quartile, the best possible approximation to individual income available in HCUP.

The next set of patient-level factors indicated need for health care and related to patients' health status and disease severity. The first variable included in this category was the number of chronic conditions as reported on discharge record of the patient. The study used the set of chronic conditions developed by the Department of Health and Human Services (HHS) Interagency Workgroup on multiple chronic conditions (MCC) and the Office of the Assistant Secretary of Health.<sup>38</sup> The number of chronic conditions was used as a

count variable in the study. The counting process for chronic conditions included both physical and behavioral health factors on each discharge record, following other research using HCUP-SID data.<sup>39</sup>

The second and third health status indicators used were derived from the All Patient Refined Diagnosis Related Group (APR-DRG) classification system, a variant of case-mix adjustment method used by CMS (Hierarchical Condition Categories). The APR-DRG classification produces 2 case-mix indicators of patients at the original admission: APR-DRG disease severity and APR-DRG risk of mortality. Using individual-level data, previous research showed that even after controlling for number of chronic conditions, severity score was expected to vary directly with the risks of readmissions.<sup>40</sup> The assignment of a patient to a severity of illness or a risk of mortality subclass starts from applying a base APR-DRG to the patient, and then taking into account the severity level of secondary diagnoses as well as the interaction among secondary diagnoses, age, principal diagnosis, and the presence of certain operating room and nonoperating room procedures.<sup>41</sup> A detailed description of the method of APR-DRG Classification System, developed by 3M Health Information Systems, can be found in [https://www.hcup-us.ahrq.gov/db/nation/nis/v261\\_aprdrgrmeth\\_ovrview.pdf](https://www.hcup-us.ahrq.gov/db/nation/nis/v261_aprdrgrmeth_ovrview.pdf), version 26.1. Both APR-DRG severity and APR-DRG risk of mortality are reported in 4 categories: minor, moderate, major, and extreme.

The next set of patient factors were indirectly related to severity and health status of the patients during the initial hospital stay. A high average LOS in the original admission is an indicator of higher severity of the patient, or could be marker of lower quality care with higher rates of complications or lower efficiency, which may contribute to increased likelihood of readmissions as found in some studies.<sup>42</sup> On the contrary, this variable could potentially vary inversely with hospital readmission rates, as lower LOS may lead to premature discharge triggering a second admission.<sup>43</sup> LOS was a continuous variable at the patient level obtained from the discharge record. Several other patient characteristics indirectly relating to severity and patients' needs were admission types, number of procedures performed, and total charges. These variables were obtained from the patient discharge record and indicated higher severity if the admission types were urgent or emergency, incurred higher total charges, and involved greater number of procedures performed at the original admission.

Three variables representing environmental characteristics of the PCSA were primary care provider density, population density, and PCSAs with urban/rural residence status, retrieved from HRSA's spatial data warehouse and calculated, respectively, as the 2007 crude clinically active PCPs per 100 000 population, thousands of total population per square mile land area, and urban rural commuting area (RUCA). Rural residence is a proxy measure of travel time and other barriers to accessing primary care services and RUCA can be conceptualized as an ordinal variable in the following categories: urban (reference), suburban, large

town, small town, rural/isolated, all at the PCSA level. We found a notable gradient of hospitalization across levels of rurality.

Among provider factors, 3 hospital attributes—bed size, mortality rate, and teaching status—were considered, with data obtained from AHA linked to HCUP file to indicate the characteristics of the hospital where the patients were initially admitted. The expected association of hospital bed size with readmissions is not quite clear, but there is evidence of its likely positive association with readmission rates for Medicare beneficiaries.<sup>44</sup> As in the AHA data, hospital bed size was measured in 3 categories: small (reference), medium, and large.

Hospital mortality rate is an indicator of hospital quality, computed by averaging the number of deaths for admitted patients by hospital in 2009. A high mortality could also mean fewer patients to be readmitted to the hospital, possibly because patients most likely to die during the 30-day period are also more likely to be rehospitalized if they survive initial treatment. There is mixed evidence on the role of hospital mortality in hospital readmissions.<sup>45,46</sup>

Teaching hospitals provide a major proportion of their services to nation's underserved populations. Separate indicators for safety net hospitals (measured as percent share of Medicaid and uninsured patients) were also included but later dropped due to collinearity with teaching hospitals. Teaching status is reported in AHA data in 3 categories: rural, urban nonteaching, and urban-teaching. The first 2 categories were combined as nonteaching and used as the reference group.

**Estimation.** We estimated risk-adjusted rates of 30-day readmissions by insurance and race/ethnicity, and estimated generalized logit models with aforementioned covariates at patient, hospital, and area levels. The multilevel structure accommodates correlation among observations within a cluster, eg, between patients from the same PCSA or hospital.<sup>47</sup> We adjusted for clusters within patient's PCSA of residence using STATA Version 14. To answer the research questions, we conducted 2 sets of analyses: In the first set (Analysis I), we examined the association between race/ethnicity and the probability of a readmission, controlling for all the covariates described below. In the second set (Analysis II), we examined whether association of race ethnicity with readmission risk varies by insurance status by using interactions of race/ethnicity with insurance categories. An added strength of the interaction model is that indicators of each insurance category (eg, Medicare or Medicaid)—besides their interaction with race/ethnicity—enable accounting for systematic unobserved differences by insurance cohorts.

## Findings

Table 1 provides sample mean values of the variables used in the multivariate analysis by state. The selected states show wide variations in geographic characteristics, race/ethnicity mix, and socioeconomic characteristics. California, Florida,

and New York have larger urban areas; New York being the most densely populated, and Missouri and Tennessee are mostly rural with much less population density. While Missouri is predominantly white, New York has the largest proportion of blacks and California has the largest proportion of Hispanics. Uninsurance among all hospital discharges is lower in California than in Florida or Tennessee, while higher proportions of Medicaid patients live in California and in New York than rest of the states.

## Analysis I

Table 2 provides results from the multivariate analysis for each state and overall for 5 states; it reports odds of at least one 30-day all-cause readmission versus no readmission for predictor variables by race/ethnicity and insurance categories (full results are available upon request). Compared with non-Hispanic whites, Hispanics were at a significantly lower risk of readmissions in California, Florida, Missouri, and Tennessee (odds ratio [OR] < 1.0 with all *P* values < .01) and overall in 5 states, and "other races" were at a significantly lower risk of readmissions in all 5 states as well as overall. The risk-adjusted likelihood of 30-day readmissions among blacks, compared with whites, was higher overall (OR = 1.05, *P* < .01) and in California (OR = 1.08, *P* < .01), New York (OR = 1.05, *P* < .01), and Tennessee (OR = 1.08, *P* < .01); no significant differences were found in other states. Compared with the privately insured, across all patients, Medicare and Medicaid patients were significantly more likely to be readmitted in all 5 states. In contrast, uninsured patients were less likely to be readmitted than privately insured in California as well as overall 5 states, while other payer groups were not significantly different from private insurers in most states.

Among other notable findings, several variables showed signs as predicted—for example, across states, all of the patient's health status and need variables showed positive associations with readmission rates with adjusted risk ratios greater than 1. Patient characteristics during hospital stay, such as LOS, predicted higher risks of readmissions in all 5 states. Among hospital characteristics, a positive association was found between readmission and teaching status. Larger hospitals were associated with higher risk of readmissions in some states. Average mortality rate of the admitting hospital was negatively associated with readmission rates in all states but MO. The PCP density at PCSA did not generally have a significant association with readmission risk, while population density and urbanization predicted higher risk. Higher median household income at patient's zip codes predicted lower readmission in some states.

## Analysis II

To assess whether readmission rates of racial ethnic minorities vary with their insurance status, we conducted additional analysis that included interactions between race and insurance

**Table 1.** Means of Independent Variables for the Multivariate Analysis by State: 2009.

	California (n = 2 443 046)	Florida (n = 1 930 337)	New York (n = 1 807 383)	Tennessee (n = 515 960)	Missouri (n = 609 560)
Mean probability of 30-day readmission (%)	0.05	0.06	0.04	0.06	0.06
Patient characteristics					
Demographics					
Female (%)	0.62	0.59	0.59	0.61	0.60
Age (year)	55.24	58.55	58.05	57.07	57.03
White (%)	0.53	0.67	0.62	0.79	0.83
African American (%)	0.08	0.16	0.17	0.18	0.14
Hispanic (%)	0.28	0.12	0.12	0.02	0.01
Other race (%)	0.11	0.05	0.09	0.01	0.02
Privately insured (%)	0.29	0.25	0.30	0.36	0.28
Medicare (%)	0.39	0.49	0.45	0.50	0.48
Medicaid (%)	0.23	0.14	0.19	0.15	0.16
Uninsured (%)	0.04	0.06	0.04	0.07	0.05
Other pay (%)	0.05	0.06	0.02	0.02	0.03
No. of chronic conditions (n)	3.90	4.60	3.95	4.71	4.72
Risk of mortality (%)					
Minor	0.57	0.54	0.58	0.50	0.54
Moderate	0.23	0.26	0.24	0.27	0.26
Major	0.14	0.14	0.13	0.16	0.14
Extreme	0.06	0.06	0.05	0.07	0.06
APR-DRG severity (%)					
Minor	0.33	0.29	0.35	0.27	0.29
Moderate	0.36	0.39	0.38	0.38	0.40
Major	0.23	0.24	0.21	0.27	0.24
Extreme	0.08	0.08	0.06	0.08	0.07
Admission type (%)					
Emergency	0.77	0.63	0.68	0.49	0.45
Urgent	—	0.15	0.11	0.21	0.26
Other	—	0.01	0.00	0.00	0.00
Length of stay (day)	4.72	4.69	5.65	4.73	4.55
No. of procedures (n)	1.88	1.66	2.10	1.58	1.54
Total charges (\$)	55 304.21	40 746.96	30 002.82	28 994.41	26 490.68
Hospital characteristics (%)					
Mortality rate	0.03	0.02	0.03	0.03	0.02
Teaching	0.32	0.32	0.67	0.51	0.29
Bed size of hospital (%)					
Small	0.10	0.05	0.06	0.10	0.14
Medium	0.22	0.20	0.26	0.26	0.17
Large	0.68	0.75	0.68	0.64	0.69
PCSA characteristics					
Rural/urban (%)					
Suburban	0.03	0.05	0.04	0.06	0.09
Large city	0.06	0.03	0.07	0.18	0.13
Small city	0.01	0.02	0.02	0.12	0.10
Rural/isolated	0.0106	0.00	0.02	0.04	0.08
PCPs/100 000	254.86	252.97	182.99	131.38	133.86
Population density	4234.05	1751.28	17 888.12	524.79	1012.66
Median household income national quartile for patient zip code					
\$0-39 999	18.18%	29.72%	26.00%	50.93%	43.32%
\$40 000-49 999	20.09%	33.78%	21.80%	24.11%	24.02%
\$50 000-65 999	29.29%	25.98%	20.71%	16.32%	19.78%
\$66 000+	32.44%	10.52%	31.49%	8.64%	12.88%

Note. Rounding errors are present. The unit of entries with % actually represents 100th of a percent. In this table, we exclude missing age or gender but retain cases with a missing DRG, missing diagnosis or missing payer. Discharges for patients who died at an initial stay or whose initial stay occurred in December 2009 were also disqualified because they could not be followed for 30 days. We retain discharges with death, but a stay (if any) following a discharge with death is disqualified as a readmission. If a patient was transferred to a different hospital on the same day as or next day after discharge from the previous stay, the 2 admissions were combined as a single stay. Transfers, thus, were not considered as a readmission. We do not combine transfers into single stays, but indication of transfer out on the index stay or transfer in on the potential readmission stay disqualifies readmission. We drop cases for persons living out-of-state and drop the cases with missing zip codes, and/or with missing person ID. We also exclude newborn admissions, elective readmissions, and trauma-related readmissions. PCSA = primary care service area; PCP = primary care physicians.

**Table 2.** Logistic Regression Model Results by State: Selected Odds Ratios of All-Cause 30-Day Readmission (Versus No Readmission), 2009.

	California (n = 2 443 046)	Florida (n = 1 930 337)	Missouri (n = 609 560)	Tennessee (n = 515 960)	New York (n = 1 807 383)	All 5 states (n = 7 306 286)
Patient characteristics						
Demographics						
Female	0.88*	0.90*	0.95*	0.93*	0.90*	0.89*
Age	1.00*	1.00*	1.01*	1.00*	1.00*	1.00*
Race (Ref: white)						
African American	1.09*	1.02	0.99	1.08*	1.05*	1.05*
Hispanic	0.84*	0.93**	0.71*	0.74**	1.01	0.89*
Other race	0.92*	0.91*	0.74*	0.74*	0.94*	0.91*
Insurance (Ref: private pay)						
Medicare	1.17*	1.23*	1.25*	1.23*	1.20*	1.20*
Medicaid	1.15*	1.28*	1.34*	1.30*	1.28*	1.22*
Uninsured	0.91*	0.96	0.91	0.99	1.01	0.95*
Other pay	0.97	1.05**	0.96	0.99	0.96	1.00

Note. Rounding errors are present. The model presented in Table 2 excludes newborn admissions, elective readmissions, and trauma-related readmissions. The regression models for this table are adjusted for all covariates mentioned in Table 1. Variables controlled for in each of the logistic regression models are same as those reported in Table 1 and include number of chronic conditions, severity scores, admission types, risk of mortality, length of hospital stay, total charges, number of procedures performed, teaching status of admitting hospital, bed size of admitting hospital, mortality rate at admitting hospital, median household income, primary care physician density, population density, and rural urban classification. (Full models are available upon request.) The models adjust for clusters within PCSAs using STATA 14 commands. PCSA = primary care service area.  
 \*Estimates are significant at  $\alpha = .01$  level. \*\*Estimates are significant at  $\alpha = .05$  level.

status in the main model of each state. Each of the minority groups (non-Hispanic white as the reference group) was interacted with each of the insurance groups (private payer as the reference group). Thus we created 12 interaction variables (3 races  $\times$  4 insurance groups) and included them in the logistic regression models along with the same set of covariates as in Table 2. Only selected results involving the interaction terms from these models are reported in Table 3.

### Comparison With Non-Hispanic Whites With Private Coverage

As in Table 2, the ORs of interactions in Table 3 are reported to indicate the odds of at least 1 all-cause readmission within 30-days for predictor variables relative to non-Hispanic whites with private insurance.

As reported for Analysis 1 (Table 2), African Americans overall experienced a slightly higher risk of readmissions compared with whites. However, Table 3 shows that there is considerable heterogeneity in this risk among African Americans stratified by insurance; 5-state average shows that compared with the whites on private insurance, non-Hispanic blacks on private insurance had higher readmission risk (OR = 1.08), but those on Medicare (OR = 0.96), Medicaid (OR = 0.93), uninsured (OR = 0.85), or covered by other payers (OR = 0.92, all  $P < .01$ ) had lower risk. On the contrary, among Hispanics, those on private coverage, Medicaid, other payer, or uninsured had lower risk of readmissions (OR = 0.96, 0.71, 0.75, 0.70, respectively, all  $P < .01$ ) compared with the whites on private insurance, while

those on Medicare had relatively higher readmission risk (OR = 1.08,  $P < .01$ ). Other race-ethnic group also exhibited heterogeneity in readmission risk, with lower risk among the uninsured (OR = 0.85,  $P < .01$ ) and higher risk among Medicare-covered (OR = 1.14,  $P < .01$ ) compared with the whites on private insurance. These patterns were largely consistent across all individual states, although the estimates did not attain the desired significance level in all cases.

### Cross-Race and Cross-Insurance Type Comparisons

As an extension of Table 3, Tables 4 and 5 contains an alternative representation of the ORs from the same regression models—based on combining the interaction with separate covariate estimates—suitable for making cross-race and cross-insurance comparisons of readmission rates. Tables 4 and 5 produce ORs of readmissions standardized to the private insurance category within each racial group, and ORs of readmissions standardized to the white race category within each insurance group. Only the estimates from the model combining all 5 states are presented (state by state estimates are available from the authors). Table 4 shows that compared with the privately insured, Medicare patients in all racial groups are more likely to have readmissions and Medicaid patients in all racial groups except Hispanics are more likely to have readmissions, while uninsured in all racial groups (except whites) are less likely to have readmissions. On the contrary, Table 5 shows that within each insurance group except Medicare, Hispanics and other races were less likely

**Table 3.** Odds Ratios of at Least One All-Cause 30-day Hospital Readmission Versus No Readmission: Selected Results From Race and Insurance Interactions by State, 2009.

	California	Florida	New York	Tennessee	Missouri	All 5 states
Patient characteristics						
Demographics						
Female	0.89*	0.90*	0.90*	0.93*	0.95*	0.90*
Age	1.00*	1.00*	1.00*	1.00*	1.01*	1.00*
Race (reference: white)						
African American	1.12*	1.04**	1.09*	1.07**	1.06	1.08*
Hispanics	0.92*	0.90*	1.06**	1.02	0.81	0.96*
Others	0.84*	0.89**	0.89*	0.85	0.74*	0.86*
Insurance (reference: private)						
Medicare	1.14*	1.21*	1.19*	1.25*	1.26*	1.19*
Medicaid	1.38*	1.33*	1.35*	1.30*	1.39*	1.35*
Uninsured	1.06**	1.07**	1.1*	1.02	0.99	1.05*
Other payer	1.07*	1.09*	0.96	1.05	0.99	1.07*
Interactions (Race × Insurance): (reference: white privately insured)						
African American × Medicare	0.94**	0.99	0.96	0.97	0.95	0.96*
African American × Medicaid	0.90*	0.97	0.91*	1.06	0.86**	0.93*
African American × Uninsured	0.89	0.80*	0.84*	0.98	0.74	0.84*
African American × Other payer	0.81*	0.93**	1.03	0.97	0.89	0.92*
Hispanic × Medicare	1.12*	1.16*	1.00	1.14	1.04	1.08*
Hispanic × Medicaid	0.63*	0.89	0.89*	0.40*	0.66**	0.71*
Hispanic × Uninsured	0.66*	0.69*	0.78*	0.44*	0.69	0.70*
Hispanic × Other payer	0.74*	0.90	0.86	0.32*	0.42	0.76*
Other Race × Medicare	1.20*	1.12*	1.12*	1.06	1.18	1.14*
Other Race × Medicaid	0.95	0.91	0.97	0.66**	1.03	0.95
Other Race × Uninsured	0.67*	0.73*	1.00	0.45**	0.39*	0.85*
Other race × Other payer	1.04	0.89	1.05	0.56	0.67	0.97

Note. Regression models were run for each state. Variables controlled for in each of the logistic regression models are same as those reported in Tables 1 and 2 and covariates include age, sex, number of chronic conditions, severity scores, admission types, risk of mortality, length of hospital stay, total charges, number of procedures performed, teaching status of admitting hospital, bed size of admitting hospital, mortality rate at admitting hospital, median household income, primary care physician density, population density, and rural urban classification. (Full models are available upon request.) The models adjust for cluster within PCSAs using STATA. PCSA = primary care service area.

\* $P < .01$ . \*\* $P < .05$ .

**Table 4.** Differences in Odds Ratios Across Insurance Coverage Among Racial/Ethnic Groups (Standardized to Private Insurance).

Race/ethnicity	Private	Medicare	Medicaid	Uninsured	Other payer
Whites	1.00	1.19*	1.35*	1.05*	1.07*
Blacks	1.00	1.15*	1.26*	0.89*	0.98
Hispanics	1.00	1.29*	0.97	0.73*	0.80*
Others	1.00	1.36*	1.29*	0.89**	1.04

to have readmissions than whites, while blacks with private and Medicare insurance were more likely. Among the uninsured, all nonwhite racial ethnic groups were less likely to have readmissions than whites.

**Sensitivity tests.** The findings are robust to the exclusion of different confounders measuring disease severity such as, LOS, total charges, number of procedures, admission types,

**Table 5.** Differences in Odds Ratios Across Racial/Ethnic Groups by Insurance Coverage (Standardized to White Race).

Race/ethnicity	Whites	Blacks	Hispanics	Others
Private	1.00	1.08*	0.96*	0.86*
Medicare	1.00	1.04*	1.04*	0.98
Medicaid	1.00	1.00	0.68*	0.82*
Uninsured	1.00	0.91*	0.67*	0.73*
Other payer	1.00	0.99	0.72*	0.83*

Note. The values in this table are derived from regression model reported in Table 3 for all states, using postestimation "lincom" option in STATA. \* $P < .01$ . \*\* $P < .05$ .

hospital mortality, and to the inclusion of variables such as safety net status, and dummy age categories (18-34, 35-64, 65-74, 85 years and above). To further validate our findings, the models were also tested by stratifying the data into younger (18-64 years) and older age groups (65 years and



above). We find that the adjusted ORs remained slightly above 1 (OR = 1.05,  $P < .05$ ) for blacks versus whites in the 65 years and above cohort. The finding should be viewed in light of the work by Jiang et al<sup>3</sup> which found black-white disparity for 30-day readmissions among Medicare patients with diabetes not statistically significant, while contrary evidence was reported in Joynt et al<sup>1</sup> for Medicare patients admitted for other common conditions. We also conducted detailed investigation stratifying the data by age and insurance groups and found consistency with our original findings. In addition, to better control for different admission categories, we tested our models by including selected Major Diagnostic Categories (MDC) as confounders, which yielded very similar results as in our original model, leaving our basic findings and conclusions unchanged. Further investigation is needed to account for differential readmission patterns across racial groups that could not be fully explained by the insurance status. It also should be noted that, as expected, our sensitivity tests revealed that risk of readmission for the uninsured relative to privately insured were further reduced in each state when elective readmissions were not dropped. The general patterns of findings with or without elective readmissions however remain the same.

## Discussion

Our main finding is that the association between the risk of readmission and race/ethnicity varies by type of insurance. One exception is Medicare: Across all race/ethnic subgroups, risk of readmission is higher among the Medicare-covered compared with those with private insurance which may be expected due to the disproportionate percentage of complex and end of life patients often with contributing social contexts served by Medicare.

Using comprehensive discharge data including all age groups under different insurance coverages, we find that overall Hispanics and Other races had lower risks of readmission compared with non-Hispanic whites, while African Americans had a higher risk. In state-specific data, this was noticeable among Hispanics in all states except New York and in all 5 states for other races. African Americans in California, New York, and Tennessee had higher risks of readmissions than whites. In addition, in every state and overall, Medicaid and Medicare patients were found more likely to be readmitted than any other payers, which again are expected results based on social factors and comorbidities.

We analyzed whether the association of race/ethnicity with readmission rates could be affected by different insurance coverages (or the absence of it) within the various racial groups. Per our hypothesis, an analysis with interaction effects showed that this could be partially explained by the insurance status. The result supports our hypothesis that minorities may be at lower (than higher) risks of readmissions relative to whites when covered by low reimbursement insurances or absence of any insurance coverage. In most

states, and across 3 minority racial/ethnic groups, having no insurance was uniformly associated with lower risks of a 30-day readmission relative to whites. Thus, readmission rates may reflect barriers to needed care as well as suboptimal outcomes.

This finding of lower readmissions among uninsured result is supported in other studies which found health insurance expansion to be associated with a slight increase in readmission rates in Massachusetts for adults in the 18 to 64 years age group.<sup>5</sup> Our study complements previous work by showing the association between uninsurance and lower risks of readmissions, particularly among minorities relative to whites. A test run of the model shows the findings to hold for the younger age group (18-64 years) as well. Our findings on Medicare population and race/ethnicity is consistent with work by Jencks et al,<sup>2</sup> which also did not find a large black-white difference in all-cause readmission. Our study findings are also consistent with previous work with Medicare data that showed Hispanics on Medicare to have higher readmission rates than whites on Medicare.<sup>19</sup> Our work additionally contributes new findings by highlighting the readmissions patterns of the minorities not covered by Medicare insurance and who may have no to limited insurance coverage. Although we found Medicaid patients overall as well as in certain racial groups such as whites and African Americans to have higher risks of readmissions relative to the privately insured individuals, a disparate pattern across racial ethnic groups in readmission risks among Medicaid patients (Table 5) was observed.

The study has several strengths, including its multilevel framework, state-level focus on states with different sociodemographic composition and insurance coverages, capturing patient's contextual and provider factors at the small area level, as well as including all patients both below and above age 65 years. Because of our interest in examining the role of insurance type, looking at all-cause readmissions in the adult age group gives us more diversity in patient age and insurance type. The focus on all-cause readmission deviates from the CMS emphasis on specific conditions: eg, AMI, heart failure, and pneumonia, which are more prevalent in older patients. A recent 2014 publication<sup>48</sup> reports a wide range of various conditions by insurance type causing readmission among adults. Similarly, a few other recent studies have focused on readmissions following all types of admissions.<sup>2,5</sup> Furthermore, to capture the common characteristics across different admissions, we use a large number of features in our models to control for a wide range confounders for the index admission (as found in Table 1), including index admission type, severity, risks of mortality, length of hospital stay, and total charges, among others. Excluding some of these confounders, eg, total charges, produces no significant changes in findings.

We acknowledge several limitations, including the inability to account for the postdischarge care coordination and transitional care which could not be directly measured.

Several unmeasurable factors such as hospitals' policies to keep patients in observational status without admitting them could also account for variations by insurance status. In addition, the associations of hospital's post-acute care referral pattern and readmission rates highlighted in recent research<sup>49</sup> could also have important implications for readmissions by race/ethnicity and insurance coverage. The role of primary care clinicians and care teams needs to be better addressed including the role of nonphysician clinicians.

Among sociodemographic factors, education or literacy levels were not included to avoid collinearity with median income. Because median income was measured at the zip code level, it did not adequately capture the variations in socioeconomic status due to differences in personal income, which was not available in HCUP data. Research, however, has shown that race and ethnicity in terms of stratification often determine a person's socioeconomic status.<sup>50</sup> In addition, the use of individual-level data on patient's insurance and various patient comorbidity measures are expected to provide additional controls for socioeconomic status. Another source of potential bias is our inability to correctly identify from discharge data those Medicaid patients who were previously uninsured and moved into Medicaid at hospitalization, and the potential of enrollment of sicker patients during index hospitalization. The extensive control on patient comorbidities, eg, severity of illness, risks of mortality, race, income, number of chronic conditions, number of procedures, LOS, etc, should control for this bias even though some could remain. The study also focused broadly on 4 insurance types and did not include finer categories within each insurance type (eg, Medicare Medicaid dually eligible, Fee for service and managed care, etc). Finally, because the data used in this study are from 2009, a baseline year before hospitals started reporting their readmission rates, a comparison of study results with a more recent year would be worthwhile to pursue.

## Conclusion

We found that insurance coverage is associated with modified risks of racial/ethnic differences in 30-day readmissions, with higher readmissions among minorities covered by private insurance and Medicare compared with those uninsured. The study indicates that lower readmission rates may not always be construed as a good outcome, because it could result from a lack of insurance coverage and poor access to care, particularly among the minorities. The findings of this study may have implications for states expanding Medicaid coverage in our sample: California, Missouri, and New York. The findings could be useful in implementing insurance expansion and Medicaid expansion in different states. Future studies should look into whether insurance expansion made a difference in the readmission patterns by race/ethnicity.

## Authors' Note

The views expressed in this article are those of the authors. No official endorsement by any agency of the federal government is intended or should be inferred.

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