ORIGINAL RESEARCH

Not All Insurance Is Equal: Differential Treatment and Health Outcomes by Insurance Coverage Among Nonelderly Adult Patients With Heart Attack

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Background—The Affordable Care Act has provided health insurance to a large portion of the uninsured in the United States. However, different types of health insurance provide varying amounts of reimbursements to providers, which may lead to different types of treatment, potentially worsening health outcomes in patients covered by low-reimbursement insurance plans, such as Medicaid. The objective was to determine differences in access, treatment, and health outcomes by insurance type, using hospital fixed effects.

Methods and Results—We conducted a multivariate regression analysis using patient-level data for nonelderly adult patients with acute myocardial infarction in California from January 1, 2001, to December 31, 2014, as well as hospital-level information to control for differences between hospitals. The probability of Medicaid-insured and uninsured patients having access to catheterization laboratory was higher by 4.50 and 3.75 percentage points, respectively, relative to privately insured patients. When controlling for access to percutaneous coronary intervention facilities, however, Medicaid-insured and uninsured patients had a 4.24– and 0.85–percentage point lower probability, respectively, in receiving percutaneous coronary intervention treatment compared with privately insured patients. They also had higher mortality and readmission rates relative to privately insured patients.

Conclusions—Although Medicaid-insured and uninsured patients with acute myocardial infarction had better access to catheterization laboratories, they had significantly lower probabilities of receiving percutaneous coronary intervention treatment and a higher likelihood of death and readmission compared with privately insured patients. This provides empirical evidence that treatment received and health outcomes strongly vary between Medicaid-insured, uninsured, and privately insured patients, with Medicaid-insured patients most disproportionately affected, despite having better access to cardiac technology. **(*J Am Heart Assoc*. 2018;7:e008152. DOI: 10.1161/JAHA.117.008152.)**

Key Words: acute myocardial infarction • disparities • health outcomes • insurance coverage

Through the Medicaid expansion, health insurance subsidies, and the individual coverage mandate, the Affordable Care Act reduced uninsured rates from 20.3% in 2012 to 12.6% in 2015.[1] Although the healthcare reform bill also focused on issues of cost and quality of health care, the Affordable Care Act mainly focused on increasing insurance coverage, which had been declining up until that point. Insurance coverage acts as an important first step to helping people effectively access preventive and short-term medical care in the United States, as several studies point to a positive association between insurance coverage and good health outcomes.[2–5]

However, although those with some form of insurance generally have better access to medical care resources than the uninsured when an acute healthcare need arises,[6] not all insurance coverage is equal. Patients eligible for Medicare receive more intensive care than those just below age 65 years and privately insured, Medicaid insured, or uninsured.[7] In particular, insurance coverage has been shown to be associated with the type of treatment received in patients with acute myocardial infarction (AMI).[8] Partly because of more generous reimbursement rates, patients covered by

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Accompanying Tables S1 through S3 are available at http://jaha.ahajournals.org/content/7/11/e008152/DC1/embed/inline-supplementary-material-1.pdf

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Clinical Perspective

What Is New?

- Previous literature has documented that Medicaid-insured cardiac patients generally receive fewer recommended procedural interventions, but has not evaluated *within*-hospital differences in treatment.
- Using data for all nonelderly adult patients hospitalized with acute myocardial infarction in California between January 1, 2001, and December 31, 2014, we found that Medicaid-insured patients had a consistently lower likelihood of receiving cardiac catheterization or percutaneous coronary intervention treatment and a higher likelihood of mortality and readmission compared with privately insured patients, even when comparing similar patients within the same hospital who had the same access to catheterization capabilities.
- Our results held true even when we limited the sample to patients with ST-segment–elevation myocardial infarction; Medicaid patients continued to have lower probability of receiving percutaneous coronary intervention compared with comparable private patients within the same hospitals, where clear guidelines recommending percutaneous coronary intervention treatment exist.

What Are the Clinical Implications?

- It is imperative for practitioners to recognize that disparities in treatment and outcome occur, even within the same hospital, for cardiac patients because of insurance status, even after controlling for demographics and comorbidities.

private insurance or Medicare have a higher probability than the uninsured or Medicaid insured of receiving percutaneous coronary intervention (PCI) or coronary artery bypass graft treatments, which generally have better outcomes than lower-cost treatments, such as fibrinolytics.[8–10] On the other hand, Medicaid-insured patients in general, not just those admitted for AMI, have a higher likelihood of being readmitted within 30 days after discharge.[11] However, prior studies focusing on insurance do not control for hospital fixed effects, which is crucial given that other studies have shown systematic differences in treatment patterns and health outcomes across hospitals.[8–11] In addition, literature to date either has a limited sample of hospitals[8,9] or only looks at a limited set of outcomes (PCI[10] or readmission).[11]

Our study uses the full census of all admitted patients from a large and diverse state to control carefully for hospital characteristics and quality using hospital fixed effects and to analyze a broad set of outcomes. Our article examines differences by insurance status in access, treatment, and mortality and readmission outcomes for all nonelderly adult patients hospitalized in California between 2001 and 2014. In a subgroup analysis, we also look at patients with ST-segment–elevation myocardial infarction (STEMI), a more acute subset of myocardial infarctions for which guidelines for procedural interventions have been well established.

Methods

The data and study materials will not be made available to other researchers; they are available from the California Office of Statewide Health Planning and Development and the American Hospital Association, pending application and payment of appropriate fees. Analytic methods and Stata code, for purposes of reproducing the results, are available from the authors by request.

Data

We used nonpublic data from the California Office of State Health Planning and Development for hospitalizations beginning January 1, 2001, to December 31, 2014. We also obtained death records from Vital Statistics from January 1, 2001, to December 31, 2011, linked to each patient. The data provide detailed information from discharge records for the full census of inpatient admissions, for all payers, at all licensed hospitals in the state. We linked data from the Healthcare Cost Report Information System and American Hospital Association to obtain additional hospital-level information. The requirement of informed consent was waived. The University of California, San Francisco, Committee on Human Research approved this study.

Patient Population

We identified patients with AMI by extracting discharge records with principal diagnosis codes of 410.x0 or 410.x1.[12] We focused on nonelderly adult patients (18–64 years old) because this population is most likely to be affected by ongoing policy debates on the Affordable Care Act, and insurance coverage variations are limited among those ≥65 years because they typically have Medicare coverage. Because some hospitals do not have the ability to perform primary PCI, some patients originally admitted to a hospital without PCI capability are transferred to hospitals with PCI capability. To avoid double counting, we excluded all patients who were transferred to another hospital and only included admissions where the discharge status was not a transfer to another immediate care hospital. We were able to link all episodes of care for these patients using a unique patient identifier that allows for tracking patients across all California hospitals in the Office of State Health Planning and Development data. We also excluded patients not admitted through the emergency department to focus on the most

immediate cases and to reduce selection bias because individuals with private insurance might be more or less likely to be directly admitted on the basis of another physician's referral. We also excluded patients admitted >100 miles from their home zip code because these patients likely did not live in the stated address or were admitted while traveling. We also dropped 36 142 patients (18%) who did not fit the 3 insurance categories defined: private, Medicaid, or uninsured. We excluded nonelderly Medicare patients because they had a lower probability of receiving surgical interventions because of high rates of certain comorbidities. Finally, for the 30-day readmission analysis, we used Centers for Medicare and Medicaid Services guidelines when selecting the subsample of patients and excluding the patients who died during the initial admission, among other criteria.[13]

Insurance Definitions

We coded insurance variables on the basis of the patient's expected source or primary payment into 3 main categories: private, Medicaid, and uninsured. Private coverage included all employer-sponsored health insurance and individual plans. Medicaid included both managed care and fee-for-service Medicaid plans. The uninsured category included self-pay patients and those covered through indigent programs.

Outcomes Measured

We examined 3 different dimensions of patient outcomes: access, treatment, and health outcomes. We defined access as being admitted to a hospital with a cardiac catheterization laboratory; treatment as whether a patient received cardiac catheterization or PCI, as defined by procedure codes in the discharge record; and outcomes as death within 30, 90, and 365 days of admission and readmission within 30 days of the index discharge. Because of the lag time in our Vital Statistics data, we restricted mortality outcomes to the sample of patients who were treated between January 1, 2001, and December 31, 2010, to allow for a 1-year follow-up period. Other outcomes are not subject to this limitation and are measured for patients through December 31, 2014.

In a sensitivity analysis, we restricted the sample to patients with STEMI. In addition to replicating our main analysis on this subpopulation, we also examined whether a patient with STEMI received PCI only (as opposed to the main analysis, where the treatment outcome is whether a patient received cardiac catheterization or PCI), because practice guidelines clearly state that patients with STEMI should receive PCI treatment. We identified patients with STEMI using principal diagnosis codes 410.0x to 410.6x and 410.8x.[14]

Statistical Models

We used multivariate regression analysis to examine the association between type of insurance coverage and outcomes of interest (access, treatment, and health outcomes), controlling for other potentially confounding factors. Independent variables in the models included types of insurance coverage: private (reference group), Medicaid, or uninsured (self-pay or indigent programs). Although the data do not report the actual source of payment received by the hospital, Office of State Health Planning and Development records the primary expected source of payment. In all models, we control for patient comorbidities[15] (Table 1 has a list in subheading "Diseases").

In model 1, we estimated a linear probability model on the 3 sets of outcomes and included insurance categories, patient demographics (age, sex, and race/ethnicity), comorbidities, and year and day of the week to control for time-varying trends. This model allowed us to compare *net* differences in outcomes by insurance coverage among patients with similar comorbidity and demographic characteristics. In other words, the differences by insurance category captured by this model could be driven by differences attributable to site of treatment or differential treatments within the same facility.

In model 2, we added hospital fixed effects and controlled for access to cardiac technology at the admitting hospital in addition to the variables already included in model 1. Hospital fixed effects allowed us to compare risk-adjusted differences in treatment and health outcomes among patients with different insurance coverage types *within the same hospital* by controlling for unobserved hospital-level differences that are unchanged over the sample period.

In model 3, we added controls for treatment received in addition to the variables included in model 2. Using model 3, we captured the risk-adjusted differences in health outcomes by insurance type in patients who had the same level of access to cardiac technology *and* received the same treatment within the same hospital.

Because we include hospital fixed effects in our models, we use a linear probability model for all regressions. We do so because the incidental parameters problem with fixed effects in logistic regression models leads to inconsistent parameter estimates.[16–18]

Results

Table 1 shows patient characteristics of our sample. The final sample contained a total of 198 420 patients, with 65.5% of patients privately insured, 18.6% of patients with Medicaid coverage, and the remaining 15.9% of patients being uninsured. Compared with privately insured patients, a greater proportion of Medicaid-insured patients were women

Table 1. Characteristics of Study Population

Characteristics	All	Privately Insured	Medicaid	Uninsured	*P* Value (Private vs Medicaid)	*P* Value (Private vs Uninsured)
Outcomes, %						
Cardiac catheterization laboratory available	74.0	73.0	75.2	76.4	0.00	0.00
Percutaneous coronary intervention	69.7	70.1	65.9	72.9	0.00	0.00
Deceased within 30 d of discharge	3.4	2.8	6.3	3.1	0.00	0.01
Deceased within 90 d of discharge	4.3	3.4	8.4	3.6	0.00	0.12
Deceased within 1 y of discharge	6.2	4.9	12.9	5.1	0.00	0.07
Readmitted within 30 d, all cause	14.6	12.9	21.5	13.4	0.00	0.04
Insurance, %						
Private	65.5	. . .	. . .	. . .	. . .	. . .
Medicaid	18.6	. . .	. . .	. . .	. . .	. . .
Uninsured	15.9	. . .	. . .	. . .	. . .	. . .
Demographics						
Age, y	53.6	53.9	53.1	52.7	0.00	0.00
Sex, %						
Male	74.4	76.8	63.7	79.1	0.00	0.18
Female	25.6	23.2	36.3	22.9	0.00	0.18
Race/ethnicity, %						
White	66.3	72.7	50.3	58.2	0.00	0.00
Black	8.2	6.1	14.6	9.2	0.00	0.00
Hispanic	19.8	15.7	28.6	26.4	0.00	0.00
Race other than above; may be mixed	5.7	5.4	6.4	6.2	0.00	0.00
Diseases, %						
Peripheral vascular disease	5.0	4.7	7.5	3.4	0.00	0.00
Pulmonary circulation disorders	1.7	1.3	3.0	1.6	0.00	0.00
Diabetes mellitus	31.7	28.2	44.2	31.2	0.00	0.00
Renal failure	7.2	5.8	14.1	4.6	0.00	0.00
Cancer	1.3	1.3	1.7	0.4	0.00	0.00
Dementia	0.1	0.0	0.2	0.0	0.00	0.27
Valvular disease	4.8	4.5	6.2	4.6	0.00	0.44
Hypertension	60.7	58.8	68.6	59.2	0.00	0.17
Chronic pulmonary disease	12.6	10.6	20.2	11.5	0.00	0.00
Rheumatoid arthritis/collagen vascular	1.3	1.4	1.6	0.5	0.00	0.00
Coagulation deficiency	2.6	2.4	3.7	2.1	0.00	0.01
Obesity	17.7	18.1	18.5	15.2	0.05	0.00
Substance abuse	9.0	5.4	15.8	16.3	0.00	0.00
Depression	4.6	4.5	6.1	3.3	0.00	0.00
Hypothyroidism	4.8	5.2	5.1	3.1	0.31	0.00
Paralysis and other neurological disorder	3.4	2.6	7.0	2.3	0.00	0.00
Weight loss	0.9	0.7	1.9	0.8	0.00	0.00
Fluid and electrolyte disorders	11.2	9.2	17.9	11.2	0.00	0.00
Anemia (blood loss and deficiency)	9.5	8.0	16.3	7.9	0.00	0.50

January 1, 2001, to December 31, 2014, California Office of Statewide Health Planning and Development data; *P* values for 2-sample *t* tests of equal means. See main text for variable definitions and other details.

Table 2. Regression Results From Model 1

Variable	Access to Catheterization Laboratory	PCI	Died 30 d	Died 90 d	Died 1 y	Readmitted 30 d
Medicaid	4.50**	0.3	2.10**	3.05**	4.99**	5.58**
	0.29	0.28	0.16	0.18	0.21	0.28
	(3.94 to 5.07)	(−0.26 to 0.85)	(1.78 to 2.41)	(2.70 to 3.40)	(4.57 to 5.40)	(5.04 to 6.12)
Uninsured	3.75**	2.77**	0.47**	0.49**	0.77**	0.64**
	0.28	0.28	0.12	0.13	0.15	0.25
	(3.20 to 4.30)	(2.22 to 3.32)	(0.23 to 0.70)	(0.23 to 0.74)	(0.47 to 1.08)	(0.16 to 1.12)
Mean for privately insured	73.04	70.06	2.76	3.41	4.85	12.89
Control for technology accessed?	. . .	No	No	No	No	No
Control for treatment received?	. . .	. . .	No	No	No	No

Privately insured patients are the reference group in all regression models. Standard errors and 95% confidence intervals (2 sided) included below the regression coefficients; additional controls (data not shown) for patient-level factors, including demographics, comorbidities, and year. PCI indicates percutaneous coronary intervention.
*P<0.05; **P<0.01.

(13.1 percentage points; P<0.001) and black (8.5 percentage points; P<0.001) or Hispanic (12.9 percentage points; P<0.001). In addition, Medicaid-insured patients had higher rates of comorbidities, including hypertension (9.7 percentage points; P<0.001), substance use (10.5 percentage points; P<0.001), and diabetes mellitus (16.0 percentage points; P<0.001).

The regression results from model 1 (where we did not control for site of care) in Table 2 show that both Medicaid-insured and uninsured patients had a higher probability than privately insured patients of being admitted to a hospital equipped with a catheterization laboratory. The probability was higher by 4.50 percentage points for Medicaid patients (95% confidence interval [CI], 3.94–5.07 percentage points) and by 3.75 percentage points for the uninsured (95% CI, 3.20–4.30 percentage points) compared with privately insured patients (among whom the probability of being admitted to catheterization laboratory was 73.0%). Despite the relatively better access, the results showed no significant overall differences in probability of receiving cardiac catheterization or PCI treatment between Medicaid-insured and privately insured patients, whereas the uninsured had a higher probability of 2.77 percentage points (95% CI, 2.22–3.32 percentage points) in receiving cardiac catheterization or PCI treatment relative to privately insured patients. Table 2 also shows that Medicaid-insured and uninsured patients had a higher probability of dying within 30 days (2.10 [95% CI, 1.78–2.41] and 0.47 [95% CI, 0.23–0.70] percentage points, respectively), 90 days (3.05 [95% CI, 2.70–3.40] and 0.49 [95% CI, 0.23–0.74] percentage points, respectively), or 365 days (4.99 [95% CI, 4.57–5.40] and 0.77 [95% CI, 0.47–1.08] percentage points, respectively), and of being readmitted to the hospital within 30 days (5.58 [95% CI, 5.04–6.12] and 0.64 [95% CI, 0.16–1.12] percentage points, respectively) compared with privately insured patients.

The Figure shows the results for the analysis of treatment, mortality, and readmissions with hospital fixed effects and controls for access (model 2) and access and treatment (model 3) included. Within the same hospital, the probability of Medicaid patients receiving PCI treatment was lower by 4.24 (95% CI, −5.04 to −3.45) percentage points relative to privately insured patients, and lower by 0.85 (95% CI, −1.60 to −0.10) percentage points for the uninsured. To better understand the magnitude of differences, 70.1% of the privately insured patients received cardiac catheterization or PCI treatment. In other words, Medicaid patients were 6.1% less likely to receive cardiac catheterization or PCI treatment compared with other comparable privately insured counterparts when they were both admitted to the same hospital. The health outcome gaps remained in models 2 and 3. Medicaid-insured patients had a 1.46 (95% CI, 1.08–1.85) percentage point higher probability of dying within 30 days, a 52.9% increase from the base rate of 2.8% for the privately insured; a 2.36 (95% CI, 1.92–2.79) percentage point higher probability of dying within 90 days; and a 4.05 (95% CI, 3.57–4.54) percentage point higher probability of dying within 365 days. Medicaid-insured patients also had a 4.30 (95% CI, 3.59–5.01) percentage point higher probability of being readmitted, a 33.4% increase from the base rate of 12.9% for the privately insured. We found no significant differences in 30-, 90-, or 365-day mortality and readmission rate between uninsured and privately insured patients (Table S1). Table S2 shows results for an alternative regression specification (logistic regression with hospital-level random effects). The results are generally the same for Medicaid patients, although the association with readmissions is no longer statistically significant. For the uninsured, we find the association with mortality relative to the privately insured is of the opposite sign, but remains small in magnitude.

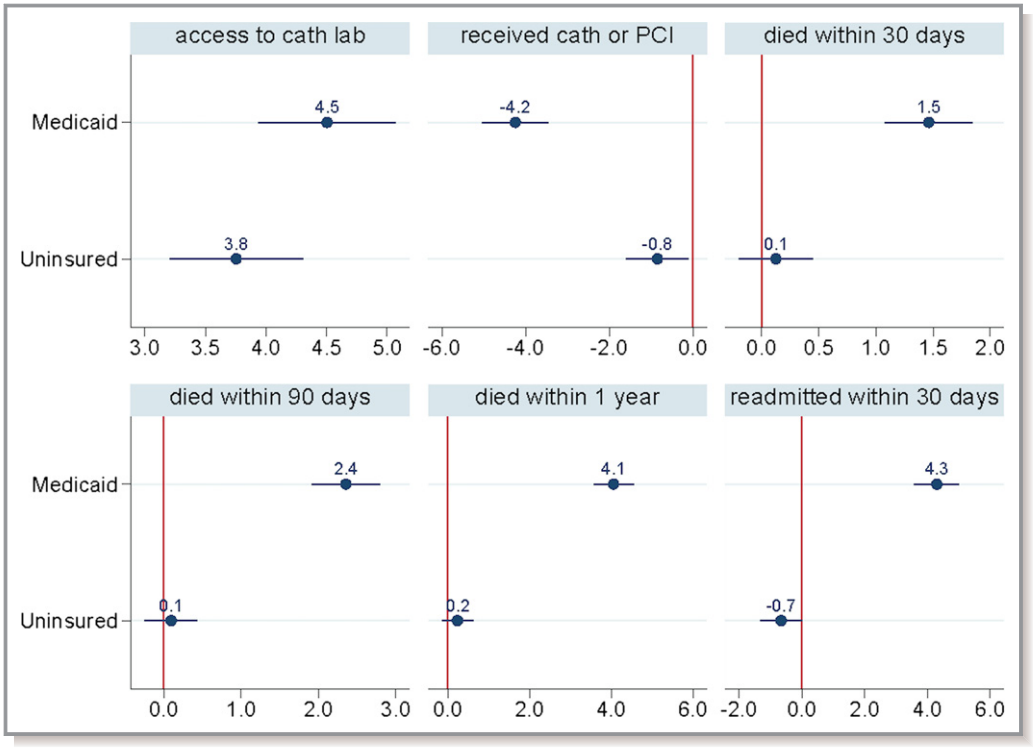

Figure. Regression results from models with hospital fixed effects (except "access to catheterization laboratory [cath lab]," which is a hospital-level measure): access to cardiac cath lab (model 1), percutaneous coronary intervention (PCI; model 2), and death or readmission (model 3). Privately insured patients are the reference group in all regression models. See main text for model details.

Table S3 shows that the results for patients with STEMI are largely similar. Patients with STEMI with Medicaid had a higher likelihood of being admitted to hospitals with PCI capacity (2.35 [95% CI, 1.52–3.19] percentage points), but a lower likelihood of receiving PCI treatment when compared with privately insured patients within the same hospital (−2.07 [95% CI, −2.84 to −1.31] percentage points). Uninsured patients with STEMI also had a higher likelihood of being admitted to hospitals with PCI capacity (2.06 [95% CI, 1.33–2.79] percentage points), but had no significant difference in the likelihood of receiving PCI treatment when compared with privately insured patients. Medicaid-insured patients with STEMI also had a higher likelihood of dying within 30 days (2.31 [95% CI, 1.67–2.94] percentage points), 90 days (3.19 [95% CI, 2.52–3.86] percentage points), or 365 days (4.45 [95% CI, 3.67–5.23]) of admission, or being readmitted within 30 days of discharge (3.64 [95% CI, 2.61–4.66] percentage points). Results are similar when we restrict the treatment variable to include only PCI and not cardiac catheterization.

Discussion

Our results show several striking differences by insurance coverage among nonelderly adult patients with AMI. Although Medicaid-insured patients had a higher likelihood of being admitted to hospitals equipped with catheterization laboratories, they were not more likely (as one would expect if admitted to hospitals with these facilities) to receive cardiac catheterization or PCI treatment compared with privately insured patients and experienced worse health outcomes, even after controlling for patient comorbidities and demographics, including race. In fact, when comparing similar patients within the same hospital who had the same access to catheterization capabilities, Medicaid-insured patients consistently had a lower likelihood of receiving cardiac catheterization or PCI treatment and a higher likelihood of mortality and readmission compared with privately insured patients. Our results held true even when we limited the sample to patients with STEMI: Medicaid patients continued to have lower probability of receiving PCI compared with comparable private patients within the same hospitals, where clear guidelines recommending PCI treatment exist.[19]

Our study substantiates findings in previous literature: Medicaid-insured patients with AMI generally receive fewer recommended procedural interventions.[8–10,20] Yet, because our study looked at *within*-hospital differences in treatment, and thus controlled for differences in treatment patterns across hospitals, which has not been done in previous studies,[8] the implications of our findings are sobering,

especially given data that early intervention with PCI has been shown to be beneficial for certain patients with AMI, especially those with STEMI.[21,22]

Other work is also limited by not controlling for potential transfers to nearby PCI-capable hospitals in a short time window.[10] One study showed an association between insurance status and likelihood of transfer in patients with AMI.[23] However, in our study, Medicaid-insured and uninsured patients actually had a *higher* likelihood of being admitted to PCI-capable hospitals, a possible result of large populations of Medicaid-insured and uninsured patients in urban areas, which usually have larger hospitals outfitted with catheterization laboratories. Consequently, the increased access to PCI-capable hospitals might mask some of the disparities in treatment not controlled for with hospital fixed effects.

In addition, we controlled for many factors possibly related to patient treatment, including patient demographics (race, sex, and age) and comorbidities, all of which significantly differed across patients by insurance status. Despite the extensive list of controls, the treatment disparity across insurance types persisted, suggesting several possibilities. Lower likelihood of receiving PCI treatment could be a result of higher exposure to ambulance diversion,[24] where patients may be diverted to a hospital without PCI capability or experience resource shortages within the hospital if the patient receives treatment at a hospital on diversion.[25] More concerning, however, is the potential explanation of physician incentive,[26] and how physicians may provide costlier treatment, such as PCI, to patients with insurance profiles that offer higher reimbursement.

Surprisingly, the disparity in treatment and outcomes proved largest in Medicaid-insured patients, rather than uninsured patients, which at first glance suggests that having no insurance outweighs having Medicaid coverage. However, this finding could be because the uninsured population in California during the period we studied consisted of a diverse group, ranging from those with high demand for health insurance but inability to afford it because of preexisting conditions to those financially well off but who have low demand for health insurance because of lower perceived risk for expensive medical needs. An alternative explanation is that Medicaid reimbursement may actually be lower than reimbursement from uninsured patients,[27] particularly in California, where Medicaid rates are one of the lowest in the nation.[28]

Limitations

Our study includes some limitations. Our data lack some information that, while not critical, would be useful to our study. We are unable to control for time to presentation, because there exist documented differences in time to presentation for patients with AMI on the basis of insurance status.[29] We also do not have information on medication received by patients. However, even if Medicaid patients received optimal medication therapy and, therefore, decreased need for PCI, we still see increased mortality among Medicaid patients. In addition, for patients with STEMI, we still see lower rates of PCI for those with Medicaid, despite clear clinical guidelines. In addition, although type of treatment received certainly can influence patient outcomes,[30,31] other unobservable factors, including health status, may contribute to the observed differences in mortality and readmission rates between Medicaid-insured and privately insured patients. For example, we do not have information on postdischarge care, and it is possible that Medicaid patients have less access to outpatient care (both primary care and specialty care, such as cardiologists) compared with privately insured patients, which could also contribute to our mortality findings.[32,33] Similarly, although we do not have clinical data besides discharge diagnoses for purposes of deciding if PCI was warranted for patients, this is true for all patients of all insurance types. We do not expect this limitation to bias our findings. Finally, the data cover only California, which expanded coverage in 2010 to uninsured adults and required seniors and the disabled to be enrolled in managed care plans.[34] Therefore, our findings may not generalize to the nation as a whole. However, California has the largest Medicaid population in the country, with an increase in enrollment from 6.5 million in 2003 to almost 10.0 million in 2014, and its early county-based coverage expansions (known as low-income health programs) allowed a significant number of people to access health insurance and, therefore, in some ways can be seen as a precursor to the Affordable Care Act expansion.[34,35]

Conclusions

In conclusion, our article carefully controlled for patient- and hospital-level factors and provided strong evidence of treatment and outcomes disparities between Medicaid-insured and privately insured nonelderly adult patients with AMI. More important, our findings showed that, although Medicaid-insured patients are more likely to be admitted to hospitals with catheterization laboratory, they had a much lower likelihood of receiving cardiac catheterization or PCI compared with privately insured patients within the same hospital, and also experienced higher rates of 30-day, 90-day, and 1-year mortality.

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Author Contributions

Hsia, Niedzwiecki, and Shen conceived the study, designed the trial, and obtained research funding. Hsia and Shen supervised the conduct of the trial and data collection. Niedzwiecki and Shen provided statistical advice on study design and analyzed the data. All authors drafted the manuscript and critically reviewed the manuscript. Niedzwiecki had full access to all of the data in the study and takes responsibility for its integrity and the data analysis.

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Disclosures

None.

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Supplemental Material

Table S1. Insurance coefficients from all models, all AMI patients.

	Access to Cath Lab	Cath/PCI	Died 30d	Died 90d	Died 1yr	Readmitted 30d
Risk Adjustment						
Regression 1						
Medicaid	4.50**	0.3	2.10**	3.05**	4.99**	5.58**
	0.29	0.28	0.16	0.18	0.21	0.28
	[3.94,5.07]	[-0.26,0.85]	[1.78,2.41]	[2.70,3.40]	[4.57,5.40]	[5.04,6.12]
Self-Pay/Uninsured	3.75**	2.77**	0.47**	0.49**	0.77**	0.64**
	0.28	0.28	0.12	0.13	0.15	0.25
	[3.20,4.30]	[2.22,3.32]	[0.23,0.70]	[0.23,0.74]	[0.47,1.08]	[0.16,1.12]
Control for access?	No	No	No	No	No	No
Control for treatment?	No	No	No	No	No	No
Mean, Privately Insured (Ref. Group)	73.04	70.06	2.76	3.41	4.85	12.89
Regression 2						
Medicaid		-2.60**	2.12**	3.10**	5.06**	5.65**
		0.25	0.16	0.18	0.21	0.3
		[-3.10,-2.11]	[1.80,2.44]	[2.74,3.46]	[4.64,5.48]	[5.06,6.24]
Self-Pay/Uninsured		0.52*	0.48**	0.51**	0.79**	0.48+
		0.23	0.12	0.13	0.16	0.25
		[0.07,0.98]	[0.24,0.72]	[0.26,0.77]	[0.48,1.09]	[-0.01,0.97]
Control for access?		Yes	Yes	Yes	Yes	Yes
Control for treatment?		No	No	No	No	No
Mean, Privately Insured (Ref. Group)	73.04	70.06	2.76	3.41	4.85	12.89
Regression 3						
Medicaid			1.95**	2.90**	4.81**	5.15**
			0.16	0.18	0.21	0.3
			[1.64,2.27]	[2.55,3.25]	[4.40,5.23]	[4.56,5.74]
Self-Pay/Uninsured			0.48**	0.51**	0.78**	0.19
			0.12	0.13	0.15	0.25
			[0.24,0.72]	[0.25,0.76]	[0.48,1.09]	[-0.30,0.68]
Control for access?			Yes	Yes	Yes	Yes
Control for treatment?			Yes	Yes	Yes	Yes

Mean, Privately Insured (Ref. Group)	73.04	70.06	2.76	3.41	4.85	12.89
	Access to Cath Lab	**Cath/PCI**	**Died 30d**	**Died 90d**	**Died 1yr**	**Readmitted 30d**
Risk Adjustment + Hospital Fixed Effects						
Regression 4						
Medicaid	-0.27	-4.25**	1.75**	2.68**	4.44**	4.66**
	0.37	0.41	0.2	0.22	0.25	0.35
	[-0.99,0.45]	[-5.06,-3.43]	[1.37,2.14]	[2.24,3.12]	[3.95,4.92]	[3.97,5.36]
Self-Pay/Uninsured	-0.68*	-0.92*	0.18	0.16	0.3	-0.48
	0.32	0.39	0.17	0.18	0.2	0.34
	[-1.31,-0.05]	[-1.68,-0.15]	[-0.15,0.52]	[-0.19,0.52]	[-0.10,0.70]	[-1.14,0.18]
Control for access?	No	No	No	No	No	No
Control for treatment?	No	No	No	No	No	No
Mean, Privately Insured (Ref. Group)	73.04	70.06	2.76	3.41	4.85	12.89
Regression 5						
Medicaid		-4.24**	1.73**	2.66**	4.42**	4.68**
		0.4	0.2	0.22	0.25	0.35
		[-5.04,-3.45]	[1.34,2.11]	[2.22,3.10]	[3.94,4.91]	[3.98,5.37]
Self-Pay/Uninsured		-0.85*	0.17	0.15	0.29	-0.5
		0.38	0.17	0.18	0.2	0.34
		[-1.60,-0.10]	[-0.16,0.51]	[-0.20,0.51]	[-0.11,0.69]	[-1.16,0.17]
Control for access?		Yes	Yes	Yes	Yes	Yes
Control for treatment?		No	No	No	No	No
Mean, Privately Insured (Ref. Group)	73.04	70.06	2.76	3.41	4.85	12.89
Regression 6						
Medicaid			1.46**	2.36**	4.05**	4.30**
			0.2	0.22	0.25	0.36
			[1.08,1.85]	[1.92,2.79]	[3.57,4.54]	[3.59,5.01]
Self-Pay/Uninsured			0.12	0.1	0.23	-0.66+
			0.16	0.17	0.19	0.34
			[-0.20,0.45]	[-0.24,0.44]	[-0.15,0.61]	[-1.33,0.01]
Control for access?			Yes	Yes	Yes	Yes
Control for treatment?			Yes	Yes	Yes	Yes

Mean, Privately Insured (Ref. Group)	73.04	70.06	2.76	3.41	4.85	12.89

"Cath lab" refers to catheterization laboratory. "PCI" refers to percutaneous coronary intervention. Privately insured patients are the reference group in all regression models. "Risk Adjustment" regressions include patient level controls including patient demographics (age, sex, and race) and Elixhauser comorbidity disease indicators (see Table 1 for a full list of demographic and disease controls) along with controls for year and day of the week. "Risk Adjustment + Hosp. Fixed Effects" regressions include all variables from the "Risk Adjustment" regression and also include hospital level (treatment hospital) fixed effects. Standard errors and 95% confidence intervals (two-sided) included below the regression coefficients. *($p<0.05$) **($p<0.01$).

Table S2. Insurance coefficients from logistic regression models with hospital-level random effects, all AMI patients.

	Access to Cath Lab	Cath/PCI	Died 30d	Died 90d	Died 1yr	Readmitted 30d
Risk Adjustment						
Regression 1						
Medicaid	1.27**	1.02	1.71**	1.87**	2.07**	1.50**
	0.02	0.01	0.06	0.06	0.06	0.03
	[1.23,1.31]	[0.99,1.05]	[1.59,1.84]	[1.75,1.99]	[1.96,2.19]	[1.45,1.56]
Self-Pay/Uninsured	1.22**	1.15**	1.20**	1.18**	1.22**	1.07**
	0.02	0.02	0.05	0.05	0.04	0.02
	[1.19,1.26]	[1.12,1.19]	[1.11,1.31]	[1.09,1.28]	[1.14,1.30]	[1.02,1.11]
Control for access?	No	No	No	No	No	No
Control for treatment?	No	No	No	No	No	No
Mean, Privately Insured (Ref. Group)	73.04	70.06	2.76	3.41	4.85	12.89
Regression 2						
Medicaid		0.80**	1.73**	1.90**	2.11**	1.50**
		0.02	0.07	0.06	0.06	0.03
		[0.77,0.83]	[1.61,1.87]	[1.78,2.03]	[2.00,2.23]	[1.44,1.56]
Self-Pay/Uninsured		1.02	1.21**	1.19**	1.22**	1.05*
		0.02	0.05	0.05	0.04	0.02
		[0.98,1.06]	[1.11,1.32]	[1.10,1.29]	[1.14,1.31]	[1.01,1.10]
Control for access?		Yes	Yes	Yes	Yes	Yes
Control for treatment?		No	No	No	No	No
Mean, Privately Insured (Ref. Group)	73.04	70.06	2.76	3.41	4.85	12.89
Regression 3						
Medicaid			1.63**	1.79**	2.01**	1.45**
			0.06	0.06	0.06	0.03
			[1.51,1.75]	[1.68,1.92]	[1.90,2.13]	[1.39,1.51]
Self-Pay/Uninsured			1.20**	1.18**	1.22**	1.03
			0.05	0.05	0.04	0.02
			[1.10,1.31]	[1.09,1.28]	[1.14,1.31]	[0.98,1.07]
Control for access?			Yes	Yes	Yes	Yes
Control for treatment?			Yes	Yes	Yes	Yes

Mean, Privately Insured (Ref. Group)	73.04	70.06	2.76	3.41	4.85	12.89

	Access to Cath Lab	Cath/PCI	Died 30d	Died 90d	Died 1yr	Readmitted 30d
Risk Adjustment + Hospital Random Effects						
Regression 4						
Medicaid			1.63**	1.78**	1.97**	1.42
			0.07	0.07	0.06	1.56
			[1.49,1.77]	[1.65,1.93]	[1.85,2.09]	[0.17,12.18]
Self-Pay/Uninsured			1.16*	1.13*	1.16**	0.99
			0.07	0.06	0.05	.
			[1.03,1.29]	[1.02,1.26]	[1.06,1.27]	[0.99,0.99]
Control for access?	No	No	No	No	No	No
Control for treatment?	No	No	No	No	No	No
Mean, Privately Insured (Ref. Group)	73.04	70.06	2.76	3.41	4.85	12.89
Regression 5						
Medicaid			1.63**	1.79**	1.98**	1.42
			0.07	0.07	0.06	5.45
			[1.49,1.78]	[1.65,1.93]	[1.86,2.10]	[0.00,2627.50]
Self-Pay/Uninsured			1.15*	1.13*	1.16**	0.99
			0.07	0.06	0.05	7.36
			[1.03,1.29]	[1.02,1.26]	[1.06,1.26]	[0.00,212139]
Control for access?		Yes	Yes	Yes	Yes	Yes
Control for treatment?		No	No	No	No	No
Mean, Privately Insured (Ref. Group)	73.04	70.06	2.76	3.41	4.85	12.89
Regression 6						
Medicaid			1.49**	1.65**	1.85**	1.38
			0.07	0.07	0.06	.
			[1.36,1.63]	[1.53,1.79]	[1.74,1.98]	[1.38,1.38]
Self-Pay/Uninsured			1.13*	1.11*	1.14**	0.97
			0.06	0.06	0.05	.
			[1.01,1.26]	[1.00,1.22]	[1.05,1.24]	[0.97,0.97]

Control for access?			Yes	Yes	Yes	Yes
Control for treatment?			Yes	Yes	Yes	Yes
Mean, Privately Insured (Ref. Group)	73.04	70.06	2.76	3.41	4.85	12.89

"Cath lab" refers to catheterization laboratory. "PCI" refers to percutaneous coronary intervention. Privately insured patients are the reference group in all regression models. "Risk Adjustment" regressions include patient level controls including patient demographics (age, sex, and race) and Elixhauser comorbidity disease indicators (see Table 1 for a full list of demographic and disease controls) along with controls for year and day of the week. "Risk Adjustment + Hosp. Fixed Effects" regressions include all variables from the "Risk Adjustment" regression and also include hospital level (treatment hospital) fixed effects. Standard errors and 95% confidence intervals (two-sided) included below the regression coefficients. *($p<0.05$) **($p<0.01$).

Table S3. Insurance coefficients from all models, STEMI patients.

	Access to Cath Lab	Cath/PCI	PCI only	Died 30d	Died 90d	Died 1yr	Readmitted 30d
Risk Adjustment							
Regression 1							
Medicaid	2.35**	0.85*	-1.50**	2.77**	3.68**	5.05**	4.46**
	0.42	0.39	0.47	0.27	0.29	0.33	0.42
	[1.52,3.19]	[0.09,1.62]	[-2.42,-0.59]	[2.23,3.30]	[3.10,4.25]	[4.41,5.69]	[3.63,5.29]
Self-Pay/Uninsured	2.06**	1.12**	-0.01	0.54**	0.57**	0.88**	0
	0.37	0.35	0.43	0.18	0.2	0.22	0.34
	[1.33,2.79]	[0.43,1.82]	[-0.85,0.82]	[0.17,0.90]	[0.19,0.96]	[0.45,1.32]	[-0.67,0.67]
Control for access?	No	No	No	No	No	No	No
Control for treatment?	No	No	No	No	No	No	No
Mean, Privately Insured (Ref. Group)	78.92	78.96	63.27	3.14	3.65	4.71	12.66
Regression 2							
Medicaid		-0.77*	-2.97**	2.81**	3.73**	5.11**	4.50**
		0.35	0.45	0.28	0.3	0.33	0.46
		[-1.45,-0.09]	[-3.85,-2.10]	[2.27,3.34]	[3.15,4.32]	[4.46,5.76]	[3.60,5.40]
Self-Pay/Uninsured		-0.17	-0.97*	0.54**	0.56**	0.86**	-0.09
		0.29	0.38	0.19	0.2	0.22	0.35
		[-0.73,0.40]	[-1.72,-0.22]	[0.17,0.90]	[0.17,0.94]	[0.42,1.29]	[-0.77,0.60]
Control for access?		Yes	Yes	Yes	Yes	Yes	Yes
Control for treatment?		No	No	No	No	No	No
Mean, Privately Insured (Ref. Group)	78.92	78.96	63.27	3.14	3.65	4.71	12.66
Regression 3							
Medicaid				2.70**	3.62**	4.98**	4.23**
				0.27	0.3	0.33	0.46
				[2.16,3.23]	[3.04,4.19]	[4.33,5.62]	[3.33,5.13]
Self-Pay/Uninsured				0.50**	0.52**	0.82**	-0.32
				0.18	0.2	0.22	0.35
				[0.14,0.86]	[0.14,0.90]	[0.38,1.25]	[-1.00,0.36]
Control for access?				Yes	Yes	Yes	Yes
Control for treatment?				Yes	Yes	Yes	Yes

Mean, Privately Insured (Ref. Group)	78.92	78.96	63.27	3.14	3.65	4.71	12.66
	Access to Cath Lab	**Cath/PCI**	**PCI only**	**Died 30d**	**Died 90d**	**Died 1yr**	**Readmitted 30d**
Risk Adjustment + Hospital Fixed Effects							
Regression 4							
Medicaid	-0.23	-2.12**	-3.42**	2.47**	3.36**	4.63**	3.88**
	0.39	0.38	0.48	0.32	0.35	0.4	0.52
	[-0.99,0.53]	[-2.87,-1.37]	[-4.36,-2.47]	[1.84,3.11]	[2.68,4.04]	[3.85,5.41]	[2.86,4.90]
Self-Pay/Uninsured	-0.35	-0.57	-0.34	0.24	0.23	0.45+	-0.91*
	0.31	0.35	0.41	0.23	0.24	0.26	0.44
	[-0.97,0.27]	[-1.27,0.12]	[-1.14,0.46]	[-0.22,0.70]	[-0.24,0.70]	[-0.07,0.96]	[-1.77,-0.05]
Control for access?	No	No	No	No	No	No	No
Control for treatment?	No	No	No	No	No	No	No
Mean, Privately Insured (Ref. Group)	78.92	78.96	63.27	3.14	3.65	4.71	12.66
Regression 5							
Medicaid		-2.07**	-3.37**	2.46**	3.35**	4.63**	3.84**
		0.39	0.49	0.33	0.35	0.4	0.52
		[-2.84,-1.31]	[-4.33,-2.42]	[1.82,3.10]	[2.67,4.04]	[3.84,5.41]	[2.82,4.86]
Self-Pay/Uninsured		-0.55	-0.32	0.23	0.21	0.42	-0.93*
		0.35	0.41	0.23	0.24	0.26	0.44
		[-1.25,0.14]	[-1.12,0.49]	[-0.23,0.69]	[-0.26,0.68]	[-0.09,0.94]	[-1.79,-0.07]
Control for access?		Yes	Yes	Yes	Yes	Yes	Yes
Control for treatment?		No	No	No	No	No	No
Mean, Privately Insured (Ref. Group)	78.92	78.96	63.27	3.14	3.65	4.71	12.66
Regression 6							
Medicaid				2.31**	3.19**	4.45**	3.64**
				0.32	0.34	0.4	0.52
				[1.67,2.94]	[2.52,3.86]	[3.67,5.23]	[2.61,4.66]
Self-Pay/Uninsured				0.2	0.18	0.4	-1.03*
				0.23	0.23	0.25	0.44
				[-0.25,0.64]	[-0.27,0.63]	[-0.10,0.89]	[-1.90,-0.17]
Control for access?				Yes	Yes	Yes	Yes

Control for treatment?				Yes	Yes	Yes	Yes
Mean, Privately Insured (Ref. Group)	78.92	78.96	63.27	3.14	3.65	4.71	12.66

"Cath lab" refers to catheterization laboratory. "PCI" refers to percutaneous coronary intervention. Privately insured patients are the reference group in all regression models. Regression results from the subsample of STEMI patients. "Risk Adjustment" regressions include patient level controls including patient demographics (age, sex, and race) and Elixhauser comorbidity disease indicators (see Table 1 for a full list of demographic and disease controls) along with controls for year and day of the week. "Risk Adjustment + Hosp. Fixed Effects" regressions include all variables from the "Risk Adjustment" regression and also include hospital level (treatment hospital) fixed effects. Standard errors and 95% confidence intervals (two-sided) included below the regression coefficients. *($p<0.05$) **($p<0.01$).