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Health Care Insurance, Financial Concerns in Accessing Care, and Delays to Hospital Presentation in Acute Myocardial Infarction

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MORE THAN 45 MILLION INDIVIDUALS in the United States are without health care insurance¹ and another 25 million avoid care because of financial concerns.² Although insurance status has been shown to affect use of preventive screening and chronic care,^{3,4} little is known about how health care insurance status affects decisions to seek care during an emergency medical condition, such as an acute myocardial infarction (AMI). While current public policy measures, such as the US Emergency Medical Treatment and Active Labor Act, ensure the provision of care during emergency medical conditions irrespective of insurance coverage, there is no guarantee that patients with health care insurance can afford such treatment.⁵ As a result, patients may still delay seeking care for acute, life-threatening conditions because of the potential financial costs of care.

Acute myocardial infarction is a clinical condition for which delays in seeking care can have significant, adverse consequences on patients' outcomes.⁶⁻⁹ Acute myocardial infarction is common, affecting almost 1 million indi-

Context Little is known about how health insurance status affects decisions to seek care during emergency medical conditions such as acute myocardial infarction (AMI).

Objective To examine the association between lack of health insurance and financial concerns about accessing care among those with health insurance, and the time from symptom onset to hospital presentation (prehospital delays) during AMI.

Design, Setting, and Patients Multicenter, prospective study using a registry of 3721 AMI patients enrolled between April 11, 2005, and December 31, 2008, at 24 US hospitals. Health insurance status was categorized as insured without financial concerns, insured but have financial concerns about accessing care, and uninsured. Insurance information was determined from medical records while financial concerns among those with health insurance were determined from structured interviews.

Main Outcome Measure Prehospital delay times (≤ 2 hours, $>2-6$ hours, or >6 hours), adjusted for demographic, clinical, and social and psychological factors using hierarchical ordinal regression models.

Results Of 3721 patients, 2294 were insured without financial concerns (61.7%), 689 were insured but had financial concerns about accessing care (18.5%), and 738 were uninsured (19.8%). Uninsured and insured patients with financial concerns were more likely to delay seeking care during AMI and had prehospital delays of greater than 6 hours among 48.6% of uninsured patients and 44.6% of insured patients with financial concerns compared with only 39.3% of insured patients without financial concerns. Prehospital delays of less than 2 hours during AMI occurred among 36.6% of those insured without financial concerns compared with 33.5% of insured patients with financial concerns and 27.5% of uninsured patients ($P < .001$). After adjusting for potential confounders, prehospital delays were associated with insured patients with financial concerns (adjusted odds ratio, 1.21 [95% confidence interval, 1.05-1.41]; $P = .01$) and with uninsured patients (adjusted odds ratio, 1.38 [95% confidence interval, 1.17-1.63]; $P < .001$).

Conclusion Lack of health insurance and financial concerns about accessing care among those with health insurance were each associated with delays in seeking emergency care for AMI.

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viduals in the United States each year,¹⁰ and the benefits of early treatment are clear and substantial.^{11,12} Prior studies of prehospital delays for AMI to date have focused primarily on nonmodifiable patient factors such as age, race, and sex, and education-based community interventions, which have not been shown to reduce prehospital delays.^{13,14} However, studies have not examined whether financial concerns from the patient's per-

spective about accessing medical care in those with health care insurance is associated with prehospital delays. Prior studies have defined patients with difficulty affording health care services or treatment despite having some form of health insurance as being underin-

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sured.¹⁵⁻¹⁷ Because prehospital delays are associated with higher AMI morbidity and mortality,⁶⁻⁹ demonstrating that patients with no insurance or those with insurance but reporting financial concerns about accessing care are at higher risk for prehospital delays is important because it would suggest that reducing financial barriers to care—perhaps through expansion of benefits or health insurance coverage—could reduce delays and improve outcomes.

To address this current gap in knowledge, we examined the association between lack of health insurance and financial concerns about accessing care among those with health insurance, and the time from symptom onset to hospital presentation (prehospital delays) during AMI in the Translational Research Investigating Underlying Disparities in Acute Myocardial Infarction Patients' Health Status (TRIUMPH) study. Given the growing number of uninsured and insured individuals in the United States with financial concerns about accessing care, an understanding of the effect of health care insurance, from a patient's perspective, on decisions to seek prompt medical attention for AMI may have important implications in the current debate on US health care reform.

METHODS

Participants and Study Design

Participants were consecutively enrolled between April 11, 2005, and December 31, 2008, from 24 US urban hospitals as part of the TRIUMPH study, which maintained a multisite, prospective AMI registry focused on specific gaps in knowledge about racial differences in AMI care. Participating hospitals within TRIUMPH were geographically diverse and included both academic and non-academic institutions (see eAppendix 1 at <http://www.jama.com> for a list of the participating study sites). Patients were eligible for inclusion if they were aged 18 years or older, had elevated cardiac enzymes (troponin I or creatinine kinase MB) within 24 hours of hospital admission and supporting evidence suggestive of AMI, including either prolonged ischemic symptoms or electrocardio-

graphic ST elevation changes. Exclusion criteria were patients who were incarcerated, refused participation, were unable to provide consent, did not speak English or Spanish, were transferred to the participating hospital from another facility more than 24 hours after initial admission, died, or were discharged prior to being contacted by the investigators.

Of the 6163 patients who met eligibility criteria, 1823 patients refused to participate in the study. Compared with patients who consented, patients who refused participation were more likely to be white (74% vs 67%; $P < .001$), older (mean [SD], 62 [14] vs 59 [12] years; $P < .001$), and have health insurance (85% vs 80%; $P < .001$). No difference in participation by sex was noted (refused participation: 34% female; agreed to participate: 33% female). Among the 4340 patients who provided consent and were enrolled in TRIUMPH, patients were excluded if they had missing information on insurance status ($n = 63$ [2%]), if prehospital delay time was not documented ($n = 534$ [12%]), or if delay time could not be determined because they did not experience ischemic symptoms prior to hospital arrival ($n = 22$ [0.5%]). The final study cohort consisted of 3721 patients.

Demographic, social, clinical, health status, and psychological data for patients were collected from chart abstraction and baseline interviews by trained staff within 24 to 72 hours of the index AMI admission. All participants provided written informed consent and the study protocol was approved by the institutional review board at each participating center.

Insurance Status

For this study, 3 categories of health insurance coverage were compared: no insurance, insurance with financial concerns about accessing care, and insurance without financial concerns. Health insurance information was determined from the medical records. In instances in which patients had more than 1 form of health insurance, the following hierarchy was used: (1) fee-for-service (preferred provider organization), (2) health maintenance organization, (3) Medicare, (4) Medicaid, (5) Veterans Administration, (6) other,

or (7) none. Using structured interviews, patients with health care insurance were further classified as having or not having financial concerns in accessing medical care. Using patient-centered questions that have been used to describe economic barriers to seeking care in patients with coronary artery disease,^{18,19} patients with health insurance were defined to have financial concerns in accessing care if, because of concerns about costs, they either (1) avoided care in the past year, (2) were non-adherent to medications in the past year, or (3) were currently having difficulty obtaining health care services.

Study Outcomes

The primary outcome was time to hospital presentation (prehospital delays), which was determined as the time from symptom onset to hospital presentation, and was obtained from the available medical records (including all emergency department and physician records). Time to hospital presentation was collected in discrete categories (≤ 1 hour, $> 1-2$ hours, $> 2-4$ hours, $> 4-6$ hours, $> 6-12$ hours, $> 12-24$ hours, and > 24 hours). To enhance interpretability, the number of categories was reduced by merging them into commonly used and clinically relevant classification categories (≤ 2 hours, $> 2-6$ hours, or > 6 hours).^{8,9,20} As a sensitivity analysis, time to hospital presentation also was examined using the original 7 time categories.

Demographic, Social, and Patient-Centered Variables

Demographic variables included age, sex, race, and residential area. Information on race was self-identified and collected during patient interviews. Residential area was determined from the 2000 US Census²¹ by examining the proportion of rural residents for each zip code and then patients were categorized as living in an urban ($< 10\%$ rural), mixed (10%-33% rural), or rural ($> 33\%$ rural) environment.

Additionally, during the index AMI hospitalization, detailed information on patients' social background, health status, and psychological factors—variables that have not been systematically examined in prior studies of prehospital

delays—also was obtained because these may confound the association between insurance status and prehospital delays. Social variables included marital status (single, widowed, or married), educational level (did not complete high school, high school graduate, college graduate, or graduate school degree), and perceived social support as measured by the 7-item Enhancing Recovery in Coronary Heart Disease Patients (ENRICH) Social Support Inventory. Based on prior work,²² low social support was defined as a score of 3 or greater on 2 or more items (excluding items on instrumental social support and marital status) and having a sum score of 18 or greater on the remaining 5 items.

Patients' baseline disease-specific health status (including angina frequency and angina stability over the 4 weeks preceding the index AMI) was assessed using the Seattle Angina Questionnaire (SAQ), a validated disease-specific quality-of-life instrument for coronary artery disease.²³ Scores for each SAQ domain range from 0 to 100, with higher scores indicating better functional status (ie, less frequent angina and more stable angina). Angina frequency was categorized into 3 clinically meaningful categories: daily to weekly angina (scores of 0-60), monthly angina (scores of 61-99), or no angina (score of 100).²⁴

The TRIUMPH registry also collected information on psychological variables, including depression and perceived stress. Depression was assessed with the 9-item Patient Health Questionnaire (PHQ).²⁵ Patients were classified as having no depression (PHQ scores of 0-4), mild depression (PHQ scores of 5-9), and moderate to severe depression (PHQ scores of 10-27).²⁶ Levels of perceived stress were measured with the 4-item Perceived Stress Scale,²⁷ with scores of 4 or greater categorized as representing high perceived stress.²⁸

Statistical Analysis

Unadjusted analyses evaluated baseline differences between the 3 insurance coverage groups (no insurance, insured with financial concerns, and insured without financial concerns) using analyses of vari-

ance for continuous variables and χ^2 tests for categorical variables. Normality was confirmed for continuous variables.

Because the primary outcome was ordinal, multivariable hierarchical cumulative-logit models were constructed to evaluate the independent relationship between health insurance and prehospital delay. This method adjusts for clustering at the site level and between-hospital effects and provides a single odds ratio (OR) of cumulative probabilities for the relationship between a predictor variable and each combination of higher risk vs lower risk outcome categories (eg, >6 hours vs \leq 6 hours and >2 hours vs \leq 2 hours).

Besides insurance status, all models included established predictors of prehospital delay (age, race, sex, diabetes mellitus, residential area [rural, mixed, or urban]),⁶ social factors (marital status, education level, and perceived social support), patients' health status (SAQ angina frequency and angina stability), psychological factors (depression and perceived stress), and other clinical variables (see eAppendix 2 at <http://www.jama.com> for definitions of clinical variables). Clinical variables included medical comorbidities (hypercholesterolemia, hypertension, peripheral arterial disease, prior AMI, prior percutaneous coronary intervention [PCI] or coronary artery bypass graft surgery, prior stroke, chronic kidney disease, chronic obstructive pulmonary disease, chronic heart failure), recent smoking, obesity (body mass index [calculated as weight in kilograms divided by height in meters squared] \geq 30), family history of coronary artery disease, AMI characteristics and severity (ST elevation vs non-ST elevation AMI, left ventricular ejection fraction <40%, and Killip class [class I-II vs III-IV]), absence of chest pain in the prehospital setting, and time of day during hospital presentation (weekday, weeknight, or weekend admission).

At least 1 study covariate was missing in 12.3% of patients and the average number of missing data fields per patient was 0.23. Missing covariate data were assumed to be missing at random and imputed using IVEware software version 2.0 (University of Michigan Survey Research Cen-

ter, Institute for Social Research, Ann Arbor).²⁹ Rates of missing delay time were not significantly different across insurance status categories ($P = .65$) and potential bias attributable to those without prehospital delay times was addressed by creating a nonparsimonious model for the propensity of missing data on delay time.³⁰ The reciprocal of this probability was used to weight the associations among responders in the hierarchical cumulative-logit model. Results with and without weighting were comparable so only the weighted results are presented.

As a sensitivity analysis, while time to hospital presentation was evaluated as 3 clinically meaningful categories, the relationship between insurance status and the original 7 time categories described above also was examined. Additionally, each of the 3 questions used to define insured patients with financial concerns were systematically eliminated and the robustness of the relationship between insurance status and prehospital delays was examined. In all models, the validity of the ordinal relationship between insurance status and the dependent variable (ie, the assumption of common slopes for all cumulative logits) was verified.

As secondary analyses, whether prehospital delays among patients presenting with ST-elevation AMI were associated with lower rates of treatment with thrombolytic therapy or PCI also were examined using multivariable modified Poisson regression models. All statistical analyses were conducted using SAS software version 9.1.3 (SAS Institute Inc, Cary, North Carolina), IVEware, and R software version 2.6.0 (Free Software Foundation, Boston, Massachusetts). All tests for statistical significance were 2-tailed and were evaluated at a significance level of .05.

RESULTS

Of 3721 patients in the cohort, 2294 were insured without financial concerns (61.7%), 689 were insured but had financial concerns about accessing care (18.5%), and 738 were uninsured (19.8%). Among those with insurance reporting financial concerns, 82.8% avoided medical care, 55.6% avoided taking medications, and 12.8% had

Table 1. Baseline Characteristics by Health Care Insurance Status^a

	Health Care Insurance Status			P Value
	Insured Without Financial Concerns (n = 2294)	Insured With Financial Concerns (n = 689)	No Insurance (n = 738)	
Insurance payer				
PPO	1208 (52.7)	296 (43.0)	0	<.001
HMO	345 (15.0)	86 (12.5)	0	
Medicare	505 (22.0)	160 (23.2)	0	
Medicaid	127 (5.5)	78 (11.3)	0	
Veterans Administration	29 (1.3)	17 (2.5)	0	
Other	80 (3.5)	52 (7.5)	0	
Age, mean (SD), y	61.6 (12.5)	56.5 (11.3)	51.7 (8.6)	<.001
Female sex	739 (32.2)	265 (38.5)	215 (29.1)	<.001
Race ^b				
White	1706/2289 (74.5)	473/688 (68.8)	337/733 (46.0)	<.001
Black	473/2289 (20.7)	177/688 (25.7)	290/733 (39.6)	
Other	110/2289 (4.8)	38/688 (5.5)	106/733 (14.5)	
Residential area ^{b,c}				
Urban	1294/2294 (56.4)	386/688 (56.1)	521/736 (70.8)	<.001
Mixed	326/2294 (14.2)	106/688 (15.4)	78/736 (10.6)	
Rural	673/2294 (29.3)	196/688 (28.5)	136/736 (18.5)	
Marital status ^b				
Married	1367/2289 (59.7)	319/689 (46.3)	272/736 (37.0)	<.001
Single	634/2289 (27.7)	294/689 (42.7)	430/736 (58.4)	
Widowed	288/2289 (12.6)	76/689 (11.0)	34/736 (4.6)	
Education ^b				
<High school	365/2276 (16.0)	172/686 (25.1)	204/736 (27.7)	<.001
High school	1338/2276 (58.8)	411/686 (59.9)	439/736 (59.6)	
College	350/2276 (15.4)	73/686 (10.6)	73/736 (9.9)	
Graduate school	223/2276 (9.8)	30/686 (4.4)	20/736 (2.7)	
Depression assessed by PHQ ^b				
Not clinically depressed	1347/2162 (62.3)	264/637 (41.4)	389/693 (56.1)	<.001
Mild	509/2162 (23.5)	186/637 (29.2)	157/693 (22.7)	
Moderate	185/2162 (8.6)	106/637 (16.6)	84/693 (12.1)	
Moderately severe	87/2162 (4.0)	55/637 (8.6)	49/693 (7.1)	
Severe	34/2162 (1.6)	26/637 (4.1)	14/693 (2.0)	
Perceived stress level ^b				
Low	1185/2220 (53.4)	193/671 (28.8)	270/721 (37.4)	<.001
High	1035/2220 (46.6)	478/671 (71.2)	451/721 (62.6)	
Low social support ^b	259/2205 (11.7)	188/665 (28.3)	168/724 (23.2)	<.001
SAQ angina frequency ^b				
Daily or weekly	340/2287 (14.9)	131/688 (19.0)	142/735 (19.3)	<.001
Monthly	640/2287 (28.0)	220/688 (32.0)	221/735 (30.1)	
None	1307/2287 (57.1)	337/688 (49.0)	372/735 (50.6)	
SAQ angina stability, mean (SD)	45.7 (20.9)	42.7 (23.2)	42.9 (22.8)	<.001
Medical history				
Hypercholesterolemia	1230 (53.6)	344 (49.9)	262 (35.5)	<.001
Hypertension	1546 (67.4)	473 (68.7)	444 (60.2)	<.001
Peripheral arterial disease	129 (5.6)	28 (4.1)	11 (1.5)	<.001
Diabetes mellitus	656 (28.6)	246 (35.7)	205 (27.8)	<.001
Prior MI	479 (20.9)	173 (25.1)	116 (15.7)	<.001
Prior PCI or CABG surgery	625 (27.2)	220 (31.9)	122 (16.5)	<.001
Prior stroke	135 (5.9)	35 (5.1)	17 (2.3)	<.001
Chronic kidney disease	173 (7.5)	48 (7.0)	24 (3.3)	<.001
COPD	167 (7.3)	54 (7.8)	27 (3.7)	<.001
Chronic heart failure	161 (7.0)	76 (11.0)	49 (6.6)	.001
Smoked within last 30 d	1256 (54.8)	452 (65.6)	520 (70.5)	<.001
Obese (BMI ≥30) ^{b,d}	891/2220 (40.1)	311/671 (46.3)	271/657 (41.2)	.02
Family history of CAD ^b	1716/2271 (75.6)	522/679 (76.9)	505/732 (69.0)	<.001

(continued)

Table 1. Baseline Characteristics by Health Care Insurance Status^a (continued)

	Health Care Insurance Status			P Value
	Insured Without Financial Concerns (n = 2294)	Insured With Financial Concerns (n = 689)	No Insurance (n = 738)	
Clinical characteristics at MI admission				
ST-segment elevation MI	1040 (45.3)	307 (44.6)	329 (44.6)	.90
Ejection fraction <40% ^b	371/1978 (18.8)	115/586 (19.6)	153/615 (24.9)	.004
Killip class ^b				
I or II	2240/2271 (98.6)	672/682 (98.5)	715/733 (97.5)	.12
III or IV	31/2271 (1.4)	10/682 (1.5)	18/733 (2.5)	
No chest pain	233 (10.2)	50 (7.3)	37 (5.0)	<.001
Time of hospital arrival ^b				
Weekday	850/2292 (37.1)	253/688 (36.8)	284/738 (38.5)	.30
Weeknight	694/2292 (30.3)	226/688 (32.8)	241/738 (32.7)	
Weekend	748/2292 (32.6)	209/688 (30.4)	213/738 (28.9)	

Abbreviations: BMI, body mass index; CABG, coronary artery bypass grafting; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; HMO, health maintenance organization; MI, myocardial infarction; PCI, percutaneous coronary interventions; PHQ, Patient Health Questionnaire; PPO, preferred provider organization; SAQ, Seattle Angina Questionnaire.

^aValues are expressed as number (percentage) unless otherwise indicated. Percentages may not equal 100 due to rounding.

^bValues are expressed as number/total (percentage).

^cResidential area was determined by the proportion of rural residents for each zip code from the 2000 US Census²¹ and categorized as urban (<10% rural), mixed (10%-33% rural), or rural (>33% rural).

^dCalculated as weight in kilograms divided by height in meters squared.

Table 2. Hospital Presentation Times by Health Care Insurance Status

	Health Care Insurance Status, No. (%)			P Value
	Insured Without Financial Concerns (n = 2294)	Insured With Financial Concerns (n = 689)	No Insurance (n = 738)	
Time to hospital presentation, h				
≤2	839 (36.6)	231 (33.5)	203 (27.5)	<.001
>2-6	554 (24.1)	151 (21.9)	176 (23.8)	
>6	901 (39.3)	307 (44.6)	359 (48.6)	

difficulty obtaining health care services due to costs; 44.1% met at least 2 of these criteria. Compared with insured patients without financial concerns, a greater proportion of insured patients with financial concerns received their insurance coverage from Medicaid (11.3% vs 5.5%) and a smaller proportion had fee-for-service plans (43.0% vs 52.7%) ($P < .001$ for difference across plans; TABLE 1).

There were substantial differences in baseline characteristics between the 3 insurance groups (Table 1). Compared with insured patients without financial concerns, uninsured patients and insured patients with financial concerns were more frequently younger, nonwhite, single, and current smokers, and less likely to have completed high school. These patients also had higher levels of perceived stress, more severe depressive symptoms, and more

frequent angina in the weeks preceding their index AMI. Furthermore, compared with patients with any insurance, uninsured patients were less likely to have had a prior AMI, PCI, or coronary artery bypass graft surgery; less likely to have coexisting hypercholesterolemia, hypertension, peripheral arterial disease, stroke, chronic kidney disease, and chronic obstructive pulmonary disease; and more likely to live in urban areas and present with a left ventricular ejection fraction of less than 40% during the index AMI.

Delays to Hospital Presentation

While 1273 patients presented promptly within 2 hours of symptom onset (34.2%), 1567 patients had delay times exceeding 6 hours (42.1%). There were important differences in time from symptom onset to hospital presentation during AMI by insurance status ($P < .001$;

TABLE 2). A greater proportion (36.6%) of insured patients without financial concerns arrived within 2 hours of symptom onset compared with 33.5% of insured patients with financial concerns and 27.5% of uninsured patients. Conversely, a smaller proportion (39.3%) of insured patients without financial concerns arrived more than 6 hours from symptom onset compared with 44.6% of insured patients with financial concerns and 48.6% of uninsured patients.

In analyses adjusted for study site only, compared with insured patients without financial concerns, insured patients with financial concerns (OR, 1.22; 95% confidence interval [CI], 1.06-1.40) and uninsured patients (OR, 1.30; 95% CI, 1.12-1.51) were more likely to delay seeking care during AMI. After adjustment for demographics, clinical comorbidities, AMI characteristics, baseline health status, social factors, and psychosocial variables, insured patients with financial concerns (adjusted OR, 1.21 [95% CI, 1.05-1.41]; $P = .01$) and uninsured patients (adjusted OR, 1.38 [95% CI, 1.17-1.63]; $P < .001$) continued to have longer delays to hospital presentation (TABLE 3). In sensitivity analyses, these estimates were similar when prehospital delay was examined as 7 distinct time categories (results not shown). Moreover, because patients with

managed care or public insurance plans also were more likely to have prehospital delays (see eAppendix 3 at <http://www.jama.com>), payor type was additionally adjusted for in the subgroup of patients with any insurance. The relationship with longer delay times remained similar for insured patients with financial concerns (adjusted OR, 1.23 [95% CI, 1.06-1.43]; $P = .008$) (see eAppendix 4 at <http://www.jama.com>). The relationship between insurance status and prehospital delays remained robust when each of the criterion questions used to define financial concerns was systematically eliminated among those with health insurance (see eAppendix 5 and eAppendix 6 at <http://www.jama.com>).

The final model results for prehospital delays are presented in the FIGURE. Consistent with prior studies,^{6,7,9} coexisting diabetes mellitus and weekday working hours were associated with an increased risk of prehospital delays, while a low Killip class, a prior history of AMI, or prior coronary revascularization were each associated with shorter delay times. However, previously described associations between age, female sex, and black race with prehospital delays^{6,7,9} were attenuated after adjustment for insurance status, social and psychological factors, and clinical characteristics. Notably, lower educational level, higher angina frequency in the weeks preceding the AMI, and depressive symptoms were associated with prehospital delays, whereas patients with higher perceived stress scores were more likely to present to the hospital within 2 hours of symptom onset (Figure).

Among patients presenting with ST-elevation AMI, those with prehospital delays exceeding 6 hours were less likely to receive primary reperfusion therapy with either thrombolytics or PCI (≤ 2 hours [reference group], 93.5%; > 2 -6 hours, 92.5% [adjusted relative risk, 1.00; 95% CI, 0.97-1.04; $P = .88$]; > 6 hours, 83.9% [adjusted relative risk, 0.91; 95% CI, 0.85-0.96; $P = .002$]; TABLE 4).

COMMENT

In this prospective, multisite AMI registry study, we found that nearly 2 in ev-

Table 3. Association Between Insurance Status and Prehospital Delays^a

	Adjusted OR (95% CI)	P Value
Adjusted for study site		
Insured without financial concerns	1 [Reference]	
Insured with financial concerns	1.22 (1.06-1.40)	.005
No insurance	1.30 (1.12-1.51)	<.001
Adjusted for study site, age, sex, race, and residential area		
Insured without financial concerns	1 [Reference]	
Insured with financial concerns	1.27 (1.10-1.47)	<.001
No insurance	1.44 (1.23-1.68)	<.001
Adjusted for variables above plus comorbidities and clinical characteristics		
Insured without financial concerns	1 [Reference]	
Insured with financial concerns	1.25 (1.08-1.45)	.003
No insurance	1.41 (1.20-1.66)	<.001
Adjusted for variables above plus baseline CAD health status and social and psychological factors		
Insured without financial concerns	1 [Reference]	
Insured with financial concerns	1.21 (1.05-1.41)	.01
No insurance	1.38 (1.17-1.63)	<.001

Abbreviations: CAD, coronary artery disease; CI, confidence interval; OR, odds ratio.

^aThe OR reflects the cumulative probabilities of a hospital presentation time of greater than 6 hours vs 6 hours or less and greater than 2 hours vs 2 hours or less.

ery 5 patients were uninsured or were insured but reported financial concerns in accessing care. These patients, in turn, were more likely to delay seeking emergency care for an AMI, even after extensive adjustment for clinical, social, and psychological factors. These findings underscore important consequences from inadequate health care insurance coverage for the substantial number of individuals in the United States experiencing AMIs. The data also suggest that efforts to reduce prehospital delay times may have limited impact without first ensuring that access to health insurance is improved and financial concerns are addressed in patients who seek emergency care.

To our knowledge, this study is the first to demonstrate an association between the lack of health care insurance and prehospital delays during AMI. While this observation may seem intuitive, uninsured patients have not been found to have higher rates of prehospital delays in other studies.^{31,32} Our findings on insurance status may have differed from earlier studies because of a higher proportion of uninsured patients in this contemporary registry. Moreover, our study's use of patient interviews (rather than administrative data) allowed us to adjust for patients' health status and important social and psycho-

logical confounders to better clarify the independent association of insurance status with prehospital delays in AMI.

Perhaps most importantly, our study was also able to evaluate the impact of financial concerns in accessing medical care among those with insurance who had delays in seeking care. Through detailed, structured interviews, we identified individuals who reported financial burdens related to the use of health care services despite the presence of insurance. This process used a patient's perspective as a data source and is a significant advance from the use of coarse administrative data sources. Remarkably, more than half of all insured patients with financial concerns in our study had fee-for-service (preferred provider organization) or health maintenance organization insurance plans. Thus, having private health care insurance did not guarantee use of health care services that were essential for these patients, perhaps because they perceived them as unaffordable in the face of competing financial demands.

Several studies have described patients who forego routine medical treatment because of high cost burden as the underinsured.^{15-17,19,33} Such avoidance of care due to costs was associated with more angina, poorer health status, and higher rates of rehospitalization.^{19,33}

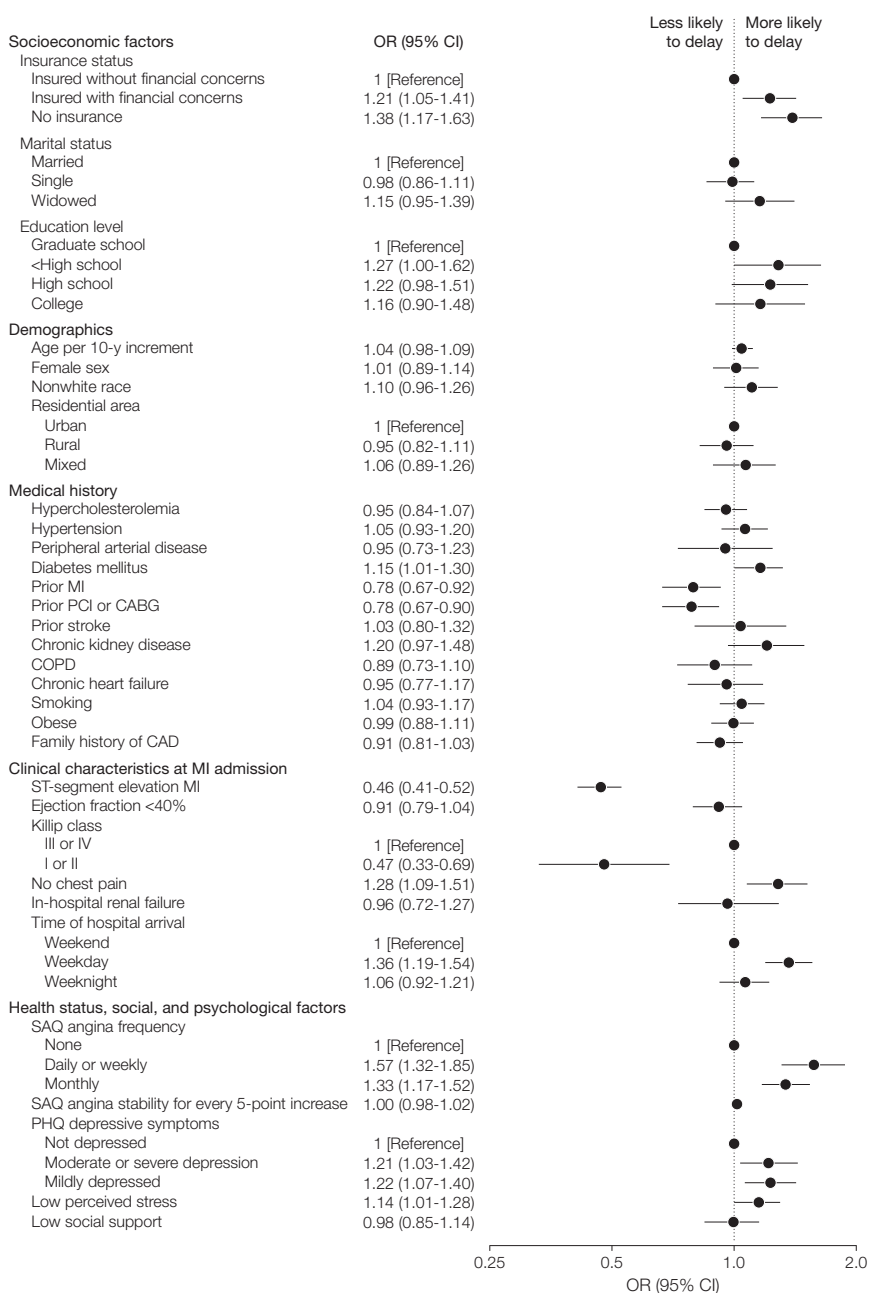
While underinsurance has not been well studied to date, this group represents a growing US patient population susceptible to disparities in care for emergent conditions like AMI. In this study, we were able to show an association between financial concerns in accessing care among insured patients and delays

to hospital presentation. However, we did not have sufficiently detailed information on patients' health insurance plans or preferences in decision making to determine whether perceived financial concerns were due to underinsurance or personal choices to forego broader insurance plans for lower premiums. To further inform health-policy decision making, additional studies are required to determine whether and which aspects of underinsurance—high out-of-pocket health care costs (copayments, coinsurance, deductibles), low lifetime health benefit ceilings, or lack of catastrophic or stop-loss provisions—may be responsible for perceived cost burden.

The finding that uninsured and insured patients with financial concerns about accessing medical treatment delay seeking care for potentially fatal but treatable medical conditions raises particular concerns because the majority of these families in the United States are classified as the working poor (often with 2 full-time workers in the household).^{1,4,34} The inability to address patients' concerns about costs of emergency care may, in part, explain the failure of prior intervention studies to reduce prehospital delay times during AMI.^{14,35} Moreover, because black and female patients are more likely to have financial concerns about accessing medical care despite having insurance coverage or be uninsured,¹⁹ addressing insurance coverage has the potential to reduce disparities in care for these vulnerable populations. In fact, we found that previously described associations between race, age, and sex—which are largely nonmodifiable demographic characteristics—with prehospital delays^{7,9} were substantially attenuated after adjustment for insurance status and other social, psychological, and clinical variables in this study.

It is likely that uninsured patients and insured patients with financial concerns about accessing care not only delayed seeking care for AMI, but also delayed care for other common medical conditions, such as stroke, pneumonia, and appendicitis.³⁶ As a result, interventions that broaden and ensure the

Figure. Adjusted Cumulative Probabilities for Covariates in Final Multivariable Model for Prehospital Delays



CABG indicates coronary artery bypass grafting; CAD, coronary artery disease; CI, confidence interval; COPD, chronic obstructive pulmonary disease; MI, myocardial infarction; OR, odds ratio; PCI, percutaneous coronary interventions; PHQ, Patient Health Questionnaire; SAQ, Seattle Angina Questionnaire. Error bars indicate 95% CIs. The ORs in the model represent cumulative probabilities between a predictor variable and each combination of higher risk vs lower risk outcome categories (eg, >6 hours vs ≤6 hours and >2 hours vs ≤2 hours).

Table 4. Effect of Time to Hospital Presentation on Subsequent Treatment in Patients With Acute ST-Elevation Myocardial Infarction^a

	PCI			Thrombolysis			PCI or Thrombolysis		
	No. (%)	RR (95% CI)	P Value	No. (%)	RR (95% CI)	P Value	No. (%)	RR (95% CI)	P Value
Prehospital delay, h									
≤2 (n = 749)	680 (90.8)	1 [Reference]		116 (15.5)	1 [Reference]		700 (93.5)	1 [Reference]	
>2-6 (n = 400)	356 (89.0)	1.00 (0.95-1.04)	.83	59 (14.8)	0.93 (0.63-1.36)	.69	370 (92.5)	1.00 (0.97-1.04)	.88
>6 (n = 527)	430 (81.6)	0.90 (0.84-0.95)	<.001	39 (7.4)	0.61 (0.48-0.77)	<.001	442 (83.9)	0.91 (0.85-0.96)	.002

Abbreviations: CI, confidence interval; PCI, percutaneous coronary interventions; RR, relative risk.

^aAdjusted for study site, age, sex, race, residential area, comorbidities, clinical characteristics, baseline coronary artery disease health status, and psychosocial factors.

affordability of health insurance coverage in the United States may reduce times to presentation for all emergent medical conditions. Such policy interventions are particularly important in light of a recent analysis that found that as many as 45 000 deaths annually in the United States are attributable to lack of health insurance alone.³⁷ These interventions would also address critics of US Emergency Medical Treatment and Active Labor Act, who argue that the legislation's unfunded mandate over the past 2 decades has imposed undue economic burdens on hospitals and paradoxically decreased the availability of emergency care services that the law was intended to promote.^{38,39}

Finally, our study also provides insights into other novel, and potentially modifiable, patient characteristics associated with prehospital delays during AMI that are distinct from previously described but often nonmodifiable predictors, such as age, sex, race, diabetes mellitus, and absence of chest pain. Specifically, we found an association between prehospital delays and lower educational level, more frequent recent angina, and depressive symptoms. In contrast, high levels of perceived stress were associated with shorter times to hospital presentation. Because large community-based education programs for AMI in the United States have not been previously successful in reducing times from symptom onset to hospital presentation,^{14,35,40} future educational public health efforts may need to address these specific predictors (in addition to insurance status) in developing new interventions.

Our study should be interpreted in the context of the following limitations. Delay times were not documented in the

medical records in 12% of patients and we did not have a mechanism to validate delay times reported in the medical records. However, documenting delay times by patients' recall has been widely used in other studies; rates of missing delay times in this study did not differ from prior studies.^{7,9} Importantly, rates of missing delay times were similar across insurance groups and were accounted for in our propensity-weighted analyses.

Second, while our models adjusted for an extensive number of demographic, social, clinical, and psychological factors, we did not have information on other factors that may have influenced prehospital delay times, including the use of emergency medical services for hospital transport, geographical distance from site of ischemic symptom occurrence to presenting hospital, and traffic patterns in urban and rural areas. Moreover, we did not have information on each patient's annual hospital expenditures, deductibles, medical copayments, and covered medical benefits to directly assess underinsurance. We also did not have information on annual household income and expenses to determine the extent to which perceived financial concerns about accessing care were due to limited disposable income rather than patients' choices to forego broad insurance coverage in exchange for lower premiums. Nevertheless, because the goal of insurance is to ensure access to care and treatment without having to bear the undue financial burden of obtaining care, our definition is consistent with the concept of underinsurance.

Third, while we found that uninsured patients and insured patients with financial concerns were associated with delays, nearly 2 in 5 insured patients without financial concerns also had de-

lays to hospital presentation exceeding 6 hours. This suggests that other patient factors accounted for prehospital delays; improving health insurance coverage, while important, is but one component in a comprehensive strategy to reduce times to hospital presentation during AMI. Fourth, our cohort was drawn from a sample of 24 urban hospitals throughout the United States and may not be generalizable to other sites or regions. Lastly, our study cohort does not include patients who never sought care or who died before hospitalization. Because we found that uninsured and insured patients with financial concerns had greater delays in seeking treatment, our estimates may represent conservative estimates of the association between insurance status and prehospital delay for AMI.

In conclusion, in this large multicenter registry, we found that uninsured patients and insured patients with financial concerns about accessing medical treatment were each more likely to delay seeking emergency care for AMI, a commonly occurring condition. Efforts to reduce prehospital delays for AMI and other emergency conditions may have limited benefit unless US health care insurance coverage is extended and improved.

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Author Contributions: Dr Chan had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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