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ORIGINAL RESEARCH

Sex and Race Differences in the Evaluation and Treatment of Young Adults Presenting to the Emergency Department With Chest Pain

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BACKGROUND: Acute myocardial infarctions are increasingly common among young adults. We investigated sex and racial differences in the evaluation of chest pain (CP) among young adults presenting to the emergency department.

METHODS AND RESULTS: Emergency department visits for adults aged 18 to 55 years presenting with CP were identified in the National Hospital Ambulatory Medical Care Survey 2014 to 2018, which uses stratified sampling to produce national estimates. We evaluated associations between sex, race, and CP management before and after multivariable adjustment. We identified 4152 records representing 29 730 145 visits for CP among young adults. Women were less likely than men to be triaged as emergent (19.1% versus 23.3%, respectively, $P<0.001$), to undergo electrocardiography (74.2% versus 78.8%, respectively, $P=0.024$), or to be admitted to the hospital or observation unit (12.4% versus 17.9%, respectively, $P<0.001$), but ordering of cardiac biomarkers was similar. After multivariable adjustment, men were seen more quickly (hazard ratio [HR], 1.15 [95% CI, 1.05–1.26]) and were more likely to be admitted (adjusted odds ratio, 1.40 [95% CI, 1.08–1.81]; $P=0.011$). People of color waited longer for physician evaluation (HR, 0.82 [95% CI, 0.73–0.93]; $P<0.001$) than White adults after multivariable adjustment, but there were no racial differences in hospital admission, triage level, electrocardiography, or cardiac biomarker testing. Acute myocardial infarction was diagnosed in 1.4% of adults in the emergency department and 6.5% of admitted adults.

CONCLUSIONS: Women and people of color with CP waited longer to be seen by physicians, independent of clinical features. Women were independently less likely to be admitted when presenting with CP. These differences could impact downstream treatment and outcomes.

Key Words: chest pain ■ emergency department ■ myocardial infarction ■ race ■ sex ■ triage ■ young adult

The number of acute myocardial infarctions (AMIs) occurring in young adults, particularly in young women (aged ≤55 years), is stagnating or even rising.[1,2] Young women with AMI present with greater comorbidity and have higher rates of in-hospital mortality compared with young men.[3] Chest pain is the most common symptom of AMI in men and women, but in the VIRGO (Variation in Recovery: Role of Gender on Outcomes of Young AMI Patients) study, it was less likely to be recognized as related to heart disease among women.[4] On a population level, women have worse outcomes after AMI compared with men.[5–8] Women are less likely than men to undergo cardiac testing when presenting with chest pain,[9–11] and once diagnosed with AMI, are less likely to undergo revascularization[12–14] or to be prescribed guideline-recommended

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CLINICAL PERSPECTIVE

What Is New?

- In a large, nationally representative database of young people presenting to the emergency department with chest pain (aged ≤55 years), women and people of color waited longer to be evaluated by a physician, independent of other clinical features, compared with men and White adults, respectively.
- Young women presenting to the emergency department with chest pain were less likely to be admitted to the hospital or to observation compared with young men.
- Acute myocardial infarction was diagnosed in 1.4% of all young adults in the emergency department and 6.5% of admitted adults upon hospital discharge. There were too few observations to evaluate differences in acute myocardial infarction diagnosis by sex and race.

What Are the Clinical Implications?

- Waiting longer to be evaluated for chest pain may reflect or contribute to downstream disparities seen in outcomes between young men and young women, as well as young adults of color versus young White adults.
- Sex differences in admission rates should be evaluated further to elucidate whether this represents differences in ultimate diagnosis, which this study was underpowered to evaluate, or differences in decision making based on patient characteristics.

Nonstandard Abbreviations and Acronyms

NHAMCS National Hospital Ambulatory Medical Care Survey

medications.[8,13] Similar trends are seen by race. Black adults have poorer outcomes than White adults after AMI.[5,8] They are less likely to undergo electrocardiography or cardiac enzyme testing when presenting with chest pain,[9,15,16] and once diagnosed with AMI, they are less likely to undergo revascularization compared with White adults.[12]

Using the National Institute of Minority Health and Health Disparities Research Framework, we sought to evaluate health care system factors that may influence the disparities in population health of young adults.[17] Our objective was to investigate sex and racial differences in the triage and management of nonspecific chest pain among young adults presenting to the emergency department (ED) in the United States.

METHODS

Data Source

The Centers for Disease Control and Prevention's National Hospital Ambulatory Medical Care Survey (NHAMCS)–Emergency Department from 2014 to 2018 was used for this analysis.[18] The NHAMCS is an annual, national probability sample of ambulatory visits made to nonfederal short-stay hospitals in the United States. The NHAMCS–Emergency Department is a subset of the NHAMCS that only includes visits to EDs. The NHAMCS uses a 3-stage probability design comprising (1) 112 geographically defined primary sampling units that are stratified by socioeconomic and demographic variables; (2) hospitals within primary sampling units; and (3) patient visits within all emergency service areas within sampled EDs. Therefore, the survey's primary unit of analysis was ED visit.

From 2014 to 2015, NHAMCS used an automated mode of data collection. Beginning in 2016, all data were abstracted from medical records by Census Bureau field representatives for each sampled visit. Data are collected on patient demographics, reason for visit, vital signs, diagnoses, diagnostic tests, procedures, medications, and disposition. Medical coding of patients' reason for visit and providers' diagnoses was conducted by contracted medical coders. The unweighted survey response rate was 70.8% to 75.5% between 2014 and 2018. The NHAMCS is approved annually by the National Center for Health Statistics Ethics Review Board. Requirements for informed consent were waived. The data are publicly available at: https://www.cdc.gov/nchs/ahcd/datasets_documentation_related.htm#data.

Study Population

Patients aged 18 to 55 years presenting to the ED with chest pain between 2014 and 2018 were identified. Chest pain was defined using the Reason for Visit Classification for Ambulatory Care (National Center for Health Statistics–Centers for Disease Control and Prevention). Up to 5 reasons for the visit can be listed for each ED visit. Records were included for analysis if chest pain, chest pain and related symptoms, chest discomfort, pressure, tightness, burning sensation in the chest, or heart pain were any of the listed reasons for visit, which is a previously validated approach.[11,16,19,20] Race was defined as White or people of color, of which 89% were non-Hispanic Black. Unfortunately, we could not analyze other racial or ethnic categories because of small numbers. Race was collected from the medical record. If >1 race was

listed, the person was categorized as >1 race. When race was not available in the chart, it was imputed via a model-based single, sequential regression method developed and validated by the NHAMCS.

Outcomes

The primary outcome was admission to the hospital or observation. Secondary outcomes included wait time, triage acuity, electrocardiography testing, cardiac biomarker testing, and administered medications. Triage level was defined by the NHAMCS on a 5-level system, similar to the Agency for Healthcare Research and Quality's Emergency Severity Index. Triage levels were defined by the recommended time frame for evaluation: immediate, emergent (1–14 minutes), urgent (15–60 minutes), semiurgent (1–2 hours), and nonurgent (>2 hours). Emergency rooms with a different numerical triage system (ie 3-tier or 4-tier system) were rescaled to a 5-tier system using methodology determined by the Centers for Disease Control and Prevention in consultation with subject-matter experts. An additional outcome was whether the patient was seen by a consulting physician in the ED; the survey does not provide information about the specialty of the consulting physician or consults outside of the ED. Medications were identified by therapeutic classification using the Cerner Multum's Lexicon Plus Drug Database, consistent with previously published methods.[21] Therapeutic classification was defined by Cerner Multum's 3-level nested category system, in which each drug may have up to 3 therapeutic categories, with increasing specificity from level 1 to level 3.[22] The most specific category code and description for each medication category is listed in Table S1.

For each visit, up to 5 *International Classification of Diseases, Ninth Revision* (*ICD-9*) or *Tenth Revision* (*ICD-10*) codes were recorded during the ED encounter and, if admitted, on hospital discharge. Between 2014 and 2015, diagnostic codes were identified using *ICD-9*, and from 2016 to 2018, codes were identified using *ICD-10*. The Agency for Healthcare Research and Quality Clinical Classification software was used to estimate the frequency of diagnoses of interest by race and sex (Table S2).[22]

Statistical Analysis

We compared patient and encounter characteristics by sex and by race within sex. Continuous variables were reported as mean with standard deviation and compared using the Wald test based upon the weighted survey design as recommended by Stata.[23] Categorical variables were reported as percentage with 95% CI adjusted for the survey sampling and compared using Pearson χ^2 test. Missing data were either (1) reported as unknown for categorical variables or (2) excluded for calculation of means of continuous variables, and sample size was specified. Point estimates and corresponding χ^2 *P* values were suppressed if they were based on <30 unweighted records, as specified by the NHAMCS, and are denoted by hyphens (-) in the supplemental tables.

Multivariable logistic regression was used to estimate adjusted odds of the primary outcome, admission to hospital or observation unit, and specified secondary outcomes of interest (electrocardiography testing, cardiac enzyme testing, and immediate/emergent triage) for women versus men. We also conducted multivariable logistic regression to compare outcomes between people of color and White adults. Each model was adjusted for age; the model for sex comparison included race and vice versa. Variables selected for inclusion in the least absolute shrinkage and selection operator regression were selected a priori. Least absolute shrinkage and selection operator penalized regression analysis was then used to determine the inclusion of the select comorbid conditions and visit characteristics for each model. Variables considered in the least absolute shrinkage and selection operator analysis and ultimately included in the final regression model are listed in Table S3. We assessed for interaction between race and sex on outcomes in modeling. Cox regression was used to compare wait time by sex and race and was adjusted using the variables selected by least absolute shrinkage and selection operator analysis.

Survey data were analyzed using sampled visit weight, which are adjusted by the National Center for Health Statistics for nonresponse within time of year, geographic region, urban/rural, and hospital ownership. Sampling errors, as measured by linearized standard deviations and confidence intervals, were estimated using Stata version 15.1, which takes into account the clustered study design.

RESULTS

Study Population

Between 2014 and 2018, we identified 101 372 ED visits, which represent an estimated 692 906 150 visits in the probability-matched national population. Among these, 4152 ED visits were for adults aged 18 to 55 years with chest pain, which represent an estimated 29 730 145 visits. Women comprised 56.8% of the chest pain ED visits, and people of color comprised 34.9%.

The mean age of women was lower than that of men (37.6 years versus 38.8 years, respectively, *P*=0.016; Table 1). Asthma/chronic obstructive pulmonary disease (21.0% versus 15.3%, respectively, *P*<0.001), depression (16.5% versus 8.6%, respectively, *P*<0.001), and obesity (8.6% versus 6.3%, respectively, *P*=0.044) were more common in women,

Table 1. Characteristics of Young Patients Presenting to the Emergency Department With Chest Pain by Sex*

	Women	Men	
Sample size	**n=2319**	**n=1833**	
National estimate	**n=16 880 659**	**n=12 849 486**	***P* value**
Age, y, mean±SD	37.6±10.6	38.8±10.7	0.016
Person of color, % (95% CI)†	37.3% (32.6%–42.3%)	31.6% (28.1%–35.4%)	0.026
Expected source of payment, % (95% CI)			0.014
Private insurance	37.3% (32.6%–42.3%)	31.6% (28.1%–35.4%)	
Private insurance	34.1% (31.4%–36.9%)	34.2% (30.7%–38.0%)	
Medicare	7.4% (6.1%–8.9%)	8.8% (6.8%–11.2%)	
Medicaid or CHIP or state-based program	32.8% (29.3%–36.4%)	25.9% (22.7%–29.3%)	
Self-pay or no charge/charity, % (95% CI)	11.6% (9.0%–14.7%)	15.8% (13.3%–18.8%)	
Other	3.2% (2.0%–4.9%)	3.5% (2.5%–5.0%)	
Unknown	11% (8.2%–14.7%)	11.8% (8.4%–16.3%)	
Arrival by ambulance, % (95% CI)			0.071
Yes	14.5% (12.2%–17.2%)	18.4% (15.8%–21.3%)	
No	82.5% (79.4%–85.2%)	78.7% (75.7%–81.4%)	
Unknown	3.0% (1.8%–5.0%)	2.9% (1.9%–4.3%)	
Episode of care, % (95% CI)			0.141
Initial visit	86.6% (82.3%–89.9%)	89.0% (86.1%–91.4%)	
Follow-up visit 72 hours	3.1% (2.1%–4.7%)	2.70% (1.9%–4.0%)	
Unknown	10.3% (7.1%–14.8%)	8.3% (6.0%–11.3%)	
Comorbidities, % (95% CI)			
Asthma or COPD	21.0% (18.7%–23.4%)	15.3% (13.0%–17.9%)	<0.001
Heart failure	3.6% (2.6%–4.9%)	4.5% (3.4%–6.0%)	0.27
Diabetes, type 1, type 2, unspecified, % (95% CI)	11.9% (10.4%–13.7%)	13.4% (11.7%–15.4%)	0.227
Hyperlipidemia	9.0% (7.4%–10.8%)	11.4% (9.3%–13.8%)	0.055
Hypertension	28.0% (25.7%–30.4%)	33.2% (30.2%–36.4%)	0.004
Obesity	8.6% (6.9%–10.8%)	6.3% (4.9%–8.2%)	0.044
Substance abuse	7.3% (4.8%–8.0%)	14.6% (9.3%–14.4%)	<0.001
Depression	16.5% (14.1%–19.2%)	8.6% (7.1%–10.4%)	<0.001
None of the listed comorbidities	38.7% (35.8%–41.8%)	37% (33.4%–40.7%)	0.397
Vitals before triage, mean±SD‡			
Heart rate, beats per minute	87.1±18.4	85.9±18.8	0.068
Respiratory rate, breaths per minute	18.6±5.5	18.2±3.4	0.023
Systolic BP, mm Hg	136.7±22.3	140.2±20.8	<0.001
Diastolic BP, mm Hg	81.8±14	85.1±13.7	<0.001
Pulse oximetry	98.0%±3.6%	97.2%±4.4%	<0.001

BP indicates blood pressure; CHIP, Children's Health Insurance Program; and COPD, chronic obstructive pulmonary disease.
*Percentages are based on national estimates.
†Eighty-nine percent of the people-of-color patients reported race and ethnicity as non-Hispanic Black.
‡Means calculated among those with values >0; estimated number of emergency department visits for which vital signs were available: heart rate (women: 16 037 871, men:12 178 818); respiratory rate (women: 16 050 610, men: 12 358 027); systolic BP (women: 16 357 118, men: 12 478 879); diastolic BP (women: 16 362 927, men:12 468 692); pulse oximetry (women: 16 059 599, men: 12 281 994).

whereas hypertension (28.0% versus 33.2%, respectively, *P*=0.004) and substance abuse (7.3% versus 14.6%, respectively, *P*<0.001) were more common in men. Women had lower initial mean recorded blood pressure compared with men (136.7/81.8 mm Hg versus 140.2/85.1 mm Hg, respectively, *P*<0.001). There were no statistically significant differences between women and men in the likelihood of arrival by ambulance or of another ED visit in the prior 72 hours.

Patient characteristics by race among sex are shown in Table S4 and S5. The mean age of women of color was lower than that of White women (36.6 years versus

Table 2. Triage and Assessment of Young Patients Presenting to the Emergency Department With Chest Pain by Sex*

Sample size National estimate	Women n=2319 n=16 880 659	Men n=1833 n=12 849 486	*P* value
Triage level, % (95% CI)			<0.001
Immediate/emergent	19.1% (15.8%–22.8%)	23.3% (19.3%–27.9%)	
Urgent	38.0% (33.6%–42.8%)	39.6% (34.9%–44.6%)	
Semiurgent/nonurgent	12.8% (10.0%–16.3%)	7.5% (5.5%–10.1%)	
No triage	30.1% (23.4%–37.8%)	29.5% (23.5%–36.3%)	
Diagnostic testing, % (95% CI)			
BNP	6.6% (5.2%–8.3%)	8.7% (7.0%–10.8%)	0.032
Cardiac enzymes	20.6% (16.8%–25.1%)	22.9% (18.8%–27.5%)	0.203
D-dimer	16.6% (14.2%–19.4%)	11.9% (9.8%–14.3%)	0.005
X-ray	71.4% (68.0%–74.6%)	75.6% (72.8%–78.2%)	0.041
Electrocardiography	74.2% (71.0%–77.2%)	78.8% (76.1%–81.3%)	0.024
Cardiac monitor	24.9% (21.7%–28.5%)	30.0% (25.8%–34.5%)	0.004
CT chest	8.9% (7.6%–10.5%)	8.2% (6.8%–9.9%)	0.447
Toxicology screen	3.9% (2.9%–5.2%)	7.3% (5.9%–9.0%)	<0.001
No testing	24.6% (21.2%–29.0%)	22.3% (18.9%–26.3%)	0.058
Seen by consulting physician	8.5% (6.8%–10.5%)	12.3% (9.8%–15.0%)	0.001
Wait time to see provider, min, mean±SD†	48.1±82.1	37.2±61.8	<0.001

BNP indicates B-type natriuretic peptide; and CT, computed tomography.
*Percentages based on national estimates.
†Means calculated among those with values >0; estimated number of emergency department visits for wait times were available: women: 14 706 262; men: 11 181 998.

38.2 years, respectively, *P*=0.003), but there was no significant age difference by race among men. Women of color were more likely to have history of hypertension (34.7% versus 24.0%, respectively, *P*<0.001) and obesity (11.0% versus 7.2%, respectively, *P*=0.014) than White women. Hyperlipidemia (7.0% versus 13.4%, respectively, *P*=0.002) and depression (4.9% versus 10.3%, respectively, *P*=0.003) were less common among men of color than White men. There was no statistically significant difference in initial mean recorded blood pressure between people of color and White adults presenting with chest pain. There were no significant differences by race in ambulance arrivals or recent prior ED visits.

Sex Differences in Evaluation and Treatment of Young Adults Presenting With Chest Pain

Women presenting to the ED with chest pain were less likely to be triaged as immediate/emergent compared with men (19.1% of chest pain encounters versus 23.3%, respectively, *P*=0.011), and waited longer to be seen by a provider (48.1 versus 37.2 minutes, respectively, *P*<0.001; Table 2). After multivariable adjustment, men were more likely to be seen than women at any given time (hazard ratio [HR] 1.15 [95% CI, 1.05–1.26], *P*=0.004). During the ED visit, electrocardiography testing (74.2% versus 78.8%, respectively, *P*=0.024) was less frequently ordered for women with chest pain than men, but D-dimer testing (16.6% versus 11.9%, respectively, *P*=0.005) was more frequently ordered for women. After multivariable adjustment, there were no significant differences in electrocardiography (adjusted odds ratio [aOR], 1.08 [95% CI, 0.87–1.34]; *P*=0.493), cardiac enzyme testing (aOR, 1.03 [95% CI, 0.85–1.24]; *P*=0.790), or emergent triage (aOR, 1.23 [95% CI, 1.00–1.50]; *P*=0.050) by sex. Additionally, women were less likely to be seen by a consulting physician (8.5% versus 12.3%, respectively, *P*=0.001) while in the ED as compared with men. During the ED visit, women were less likely to be prescribed antiplatelet agents (17.1% versus 21.7%, respectively, *P*=0.004; Table 3) and antianginal medications (8.0% versus 11.2%, respectively, *P*=0.002) (Figure).

Chest pain encounters for young women were less likely to result in admission to the hospital or observation unit from the ED (12.4% versus 17.9% of encounters for men, *P*<0.001; Table 4). This association remained statistically significant after multivariable adjustment (aOR, 1.40 [95% CI, 1.08–1.81]; *P*=0.011).

Racial Differences in the Evaluation and Treatment of Young Adults Presenting With Chest Pain

Women of color waited longer than White women for initial evaluation by a provider (57.8 versus 42.7 minutes,

Table 3. Medications Administered to Young Patients in ED Presenting With Chest Pain by Sex*

	Women, % (95% CI)	Men, % (95% CI)	
Sample size	**n=2319**	**n=1833**	
National estimate	**n=16 880 659**	**n=12 849 486**	***P* value**
Medications prescribed in ED or at discharge	66.8% (63.7%–69.7%)	69.3% (65.2%–73.0%)	0.202
Antiplatelets	17.1% (14.4%–20.1%)	21.7% (18.4%–25.6%)	0.004
Antianginal	8.0% (6.3%–10.1%)	11.2% (9.1%–13.7%)	0.002
Gastroenterological agents	8.1% (6.7%–9.7%)	9.1% (7.1%–11.6%)	0.354
Narcotic analgesics	15.6% (13.1%–18.6%)	15.2% (13.1%–17.5%)	0.78
Benzodiazepines	9.1% (7.5%–11.0%)	6.9% (5.3%–8.8%)	0.052
NSAIDs	17.6% (15.6%–19.8%)	16.6% (14.1%–19.5%)	0.566

Note that anticoagulants could not be analyzed because of <30 unweighted records among women and men. ED indicates emergency department.
*Percentages are based on national estimates.

respectively, *P*=0.006). Men of color also waited longer than White men for initial evaluation by a provider (44.0 versus 34.0 minutes, respectively, *P*=0.006). On multivariable regression, people of color were less likely to be seen by a provider at any given time (HR, 0.82 [95% CI, 0.73–0.93]; *P*=0.001) compared with White adults. The *P* value for interaction between sex and race on wait time was 0.37.

There were no significant differences by race for either women or men in triage level, electrocardiography testing, or cardiac enzyme testing (Tables S6 and S7). There were no significant differences in the odds of electrocardiography testing (aOR, 0.81 [95% CI, 0.63–1.04]; *P*=0.095) or cardiac enzyme testing (aOR, 1.06 [95% CI, 0.78–1.44]; *P*=0.692), emergent triage (aOR, 0.80 [95% CI, 0.59–1.07]; *P*=0.133) for people of color versus White adults on multivariable analysis.

Women of color were less likely to be prescribed antiplatelet agents (10.6% of chest pain encounters versus 20.9%, respectively, *P*<0.001), narcotic analgesics (11.5% versus 18.1%, respectively, *P*=0.002), or benzodiazepines (10.8% versus 6.3%, respectively, *P*=0.019) compared with White women. Men of color were less likely to receive antianginal medications (5.8% versus 13.6%, respectively, *P*<0.001), narcotics (11.5% versus 16.9%, respectively, *P*=0.013) than White men, but were more likely to receive NSAIDs in the ED (20.8% versus 14.6%, respectively, *P*=0.038; Tables S8 and S9). There were no statistically significant racial differences in the proportion of encounters resulting in admission to the hospital or observation (Tables S10 and S11).

Sex and Racial Differences in Diagnoses of Young Adults Presenting With Chest Pain

Prespecified ED and discharge diagnoses of interest by race and sex are shown in Table S12. The most common of these diagnoses was the ED

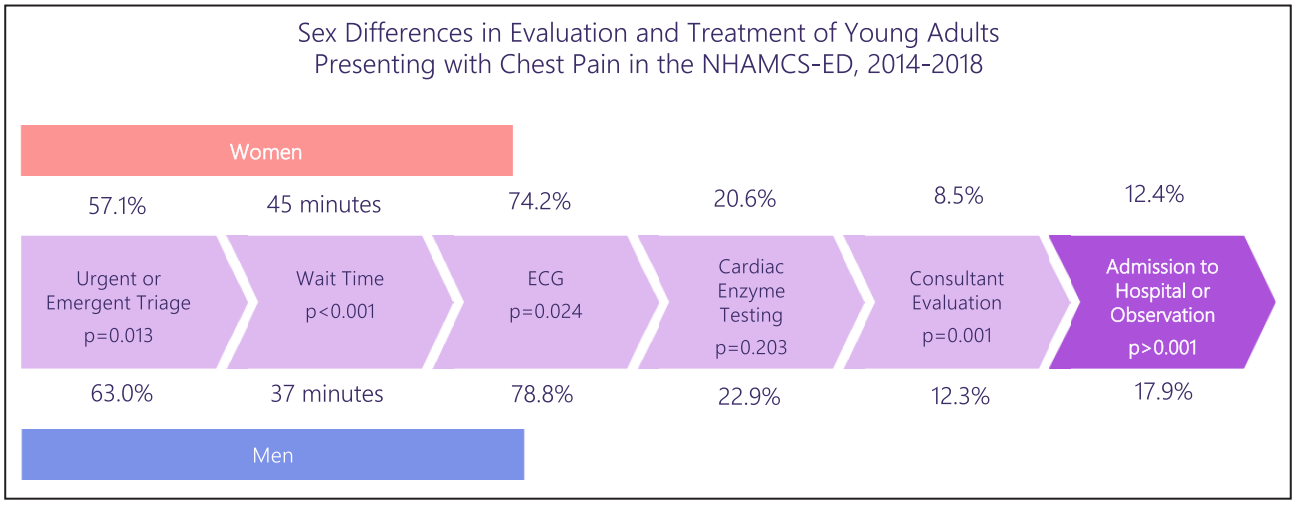

Figure. Sex differences in evaluation and treatment of young adults presenting with chest pain in the National Hospital Ambulatory Medical Care Survey–Emergency Department, 2014 to 2018.
Unadjusted results are shown.

Table 4. Disposition of Young Patients Presenting to the Emergency Department With Chest Pain by Sex*

	Women, % (95% CI)	Men, % (95% CI)	
Sample size	**n=2319**	**n=1833**	
National estimate	**n=16 880 659**	**n=12 849 486**	***P* value**
No follow-up	5.6% (3.8%–8.1%)	7.1% (5.2%–9.7%)	0.223
Return to care	74.7% (70.9%–78.2%)	66.7% (62.9%–70.3%)	<0.001
Transfer to other hospital	1.2% (0.7%–2.0%)	2.3% (1.5%–3.4%)	0.008
Admit	12.4% (10.1%, 15.1%)	17.9% (15.3%–20.8%)	<0.001
Admitted to observation	3.9% (2.8%–5.5%)	5.5% (3.9%–7.9%)	0.026
Admitted to hospital	8.7% (6.7%–11.3%)	13.4% (11.5%–15.7%)	<0.001
Other disposition	3.7% (1.5%–3.8%)	5.5% (1.6%–4.0%)	0.081
Unknown	1.2% (0.7%–1.8%)	0.7% (0.3%–2.0%)	0.35
Left early	3.5% (3.9%–8.1%)	3.9% (4.6%–9.0%)	0.694

*Percentages are based on national estimates.

discharged diagnosis of other chest pain in 42.2% of ED visits. AMI was diagnosed in 1.4% of all adults in the ED. Women were less likely to be diagnosed with hypertensive diseases (10.1% versus 13.8%, respectively, *P*=0.011) or coronary atherosclerosis and other heart disease (1.9% versus 3.3%, respectively, *P*=0.044) in the ED. There were no observed differences by race.

Among those admitted, the most common of the prespecified hospital discharge diagnoses was other chest pain (57.3%, Table S13). AMI was diagnosed in 6.5% of admitted adults upon hospital discharge. There were too few observations to evaluate differences by race and sex in the diagnosis of AMI.

DISCUSSION

In this national sample representing 29 million ED visits, we observed several differences related to sex and race in the evaluation and management of young adults aged 18 to 55 years presenting with chest pain. Young women with chest pain were less likely to be triaged as immediate/emergent, experienced longer wait times, and were less likely to undergo electrocardiography testing compared with young men. Young women were less likely to be admitted to the hospital or to observation compared with young men, and were prescribed medications used to treat acute coronary syndrome less frequently while in the ED. Sex differences in wait time and hospital admission persisted after multivariable adjustment. People of color waited longer for physician evaluation, but did not experience differences in triage, testing, consultant evaluation, or disposition. Diagnosis of AMI in the ED among young patients with chest pain was rare, occurring in 1.4% of visits, and the most common discharge diagnosis was other chest pain, reflecting the difficulty in making a specific diagnosis for chest pain complaints in young patients.

Obtaining an electrocardiography test within 10 minutes of arrival to the ED is a Class I recommendation for patients with chest pain, because electrocardiography testing can aid in the early diagnosis and treatment of AMI.[24] Delays in evaluation and electrocardiography testing can lead to delays in treatment, and increase the risk of morbidity and mortality. Although AMIs in young adults are rare, they are increasingly common, likely as a consequence of more prevalent multimorbidity. Moreover, a missed diagnosis of AMI means a missed opportunity at secondary prevention in a population of patients with a long lifespan and infrequent interaction with the medical system.

Sex Differences in ED Evaluation and Management of Chest Pain

Our study demonstrates differences between sexes in the evaluation of chest pain among young adults in the ED despite documentation of higher risk of mortality for women versus men with myocardial infarction in younger age groups.[1] These findings are particularly concerning given that cardiovascular mortality among young women has been stagnating, or even rising, in recent years.[1,25–28] However, ED visits for chest pain have increased in number between 2006 and 2016, whereas admissions for chest pain declined, and those admitted were increasingly older and men.[29] The reasons for these observed differences are likely multifactorial, including both true sex-based clinical differences and underrecognition of heart disease in women.

Possible sex-based clinical differences that could explain our study findings include the higher prevalence of AMI among young men versus young women, or more clinically severe presentations among men that led higher triage acuity, medication use, and rates of admission. The higher prevalence of traditional

cardiovascular risk factors and disease in men may have informed testing, given that differences in electrocardiography testing were no longer significant after multivariable adjustment.[25]

Although sex-based clinical differences may have played a role in producing our study outcomes, we also know that historically, there has been an underrecognition of cardiovascular disease in women by physicians, and by women themselves.[30–32] Although studies have attributed sex differences in the evaluation of chest pain to atypical AMI symptoms among women,[33,34] these differences persist when controlling for symptom presentation, and the present analysis was restricted to patients with chest pain.[35] Limited studies show that AMI is more commonly missed among women, Black adults, and young adults, and a missed AMI is associated with higher mortality as compared with prompt myocardial infarction diagnosis.[36,37] Most young women with AMI experience chest pain, but women are more likely than men to present with myocardial infarction without chest pain, and there is a greater heterogeneity in associated symptoms among women.[34,38] This heterogeneity may introduce diagnostic uncertainty, translating into diagnostic delays or missed diagnoses, which is likely heightened among young adults, the age group at the lowest risk of AMI.

Racial Differences in ED Evaluation and Management of Chest Pain

We observed longer wait times for people of color as compared with White adults despite similar triage status, which persisted after multivariable adjustment. Prior studies in older adults with AMI have demonstrated longer wait times among Black adults compared with White adults.[39] This difference in wait time most likely reflects a disparity within the domain of the health care system at both the organizational and community level. For example, differences in wait time may be related to differences in medical decision by providers, given that standardized tools, such as the History EKG Age Risk-Factors Troponin pathway, commonly underestimate the risk of people of color.[40,41] Additionally, there may be differences in the availability of resources among hospitals that serve a larger share of Black patients versus a large proportion of White patients, such as differences in availability of staff to assess patients in a timely manner.[42,43] We also found that women of color were less likely to receive AMI treatment with antiplatelet agents, and women of color were less likely to receive antianginals or narcotic pain medications in the ED. The finding that antiplatelet medications were prescribed less frequently during chest pain encounters by women of color is surprising, given that cardiovascular disease is common in women of color, and they have a higher risk of adverse outcomes.[44] These findings may reflect differences in overprescription of antiplatelets for noncardiovascular causes in White adults, as has been previously described, differences in final chest pain diagnosis (which we were underpowered to study), or undertreatment of ischemic heart disease in women of color.[45] Racial differences in the administration of narcotics in the ED have previously been reported,[46,47] although a recent study observed narcotic prescriptions are now equally common among White and Black adults,[48] which may be related to changing demographics of the opioid epidemic. Our findings may reflect differences in severity or quality of pain, false beliefs about biological race differences in the perception of pain,[49] or to historical differences in the opioid epidemic, which manifest as overprescription of narcotics to White adults.

Limitations

Data on testing or treatment performed by emergency medical services before hospital presentation or after hospital admission, such as electrocardiography or aspirin administration, were not available in this data set. Therefore, estimations of test use in the ED, such as electrocardiography, may underestimate the true prevalence of testing. The standardized NHAMCS survey form records only select comorbid conditions and diagnostic tests. Some cardiovascular risk factors particularly salient to young women, such as hypertensive diseases of pregnancy and autoimmune disorders, could not be analyzed. The survey also relies on documented medical history and therefore cannot ascertain comorbid conditions that have not been diagnosed, and comorbidity may be underestimated in adults who have less contact with the medical system or did not undergo testing in the ED. We did not have information on oral contraceptive use. We only analyzed visits associated with chest pain, but some patients with AMI present with symptoms other than chest pain. The number of diagnosed AMIs was small, and therefore it was not possible to assess sex or racial differences in triage, test use, or wait time within encounters ultimately resulting in diagnosis of AMI. Because of the low number of encounters in the NHAMCS among young patients with race other than White or Black, and the Centers for Disease Control and Prevention's guidance not to analyze subgroups below a specified size in the NHAMCS, we were not able to analyze racial differences in detail or to analyze ethnicity. The NHAMCS does not link encounters over time by the same patient, so we cannot assess revisits after the chest pain ED visit, but there was no difference in the proportion of ED visits that were categorized as revisits within 72 hours across sex or racial groups. Given limitations in the data, we were unable to assess severity of illness upon presentation

and were unable to include this in our multivariable model.

CONCLUSIONS

In this analysis of a large, nationally representative database, young women (aged <55 years) presenting to the ED with chest pain waited longer to be evaluated by a physician, and were less likely to be triaged as emergent, to undergo electrocardiography testing, be seen by a specialist, be given medications for AMI, or be admitted to the hospital or to observation than young men. Sex differences in wait time and hospital admission persisted after multivariable adjustment. Young adults of color experienced longer wait times despite similar triage status compared with White adults after multivariable adjustment. Differences by sex and race in the early evaluation and management of chest pain warrant further study to evaluate their association with clinical outcomes and to identify opportunities for improvement in clinical care.

ARTICLE INFORMATION

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Supplemental Material

Tables S1–S13

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Supplemental Material

Table S1. Cerner Multum's therapeutic classification categories used to define medication administration, most specific.

Medication category	Therapeutic classification
Anti-platelets	Category 3: 062 – Salicylates OR Category level 3: 211 – platelet aggregation inhibitors
Anti-anginal	Category level 2: 045 – antianginal agents OR Category level 2: 053 - vasodilators
Gastroenterological agents	Category level 2: 272 - proton pump inhibitors OR Category level 2: 094 - H2 antagonists OR Category level 2: 088 - antacids
Narcotic analgesics	Category level 2: 060 – narcotic analgesics
Benzodiazepines	Category level 2: 067 – benzodiazepines
NSAIDs	Category Level 3: 061 – Non-steroidal anti-inflammatory agents

Table S2. ICD-10 code and corresponding CCS codes used for identification of diagnoses of interest.

Diagnosis	ICD-10 code	ICD-9 code	CCS code
Acute myocardial infarction	I210-I2229	4100, 41000, 41001, 41002, 4101, 41010, 41011, 41012, 4102, 41020, 41021, 41022, 4103, 41030, 41031, 41032, 4104, 41040, 41041, 41042, 4105, 41050, 41051, 41052, 4106, 41060, 41061, 41062, 4107, 41070, 41071, 41072, 4108, 41080, 41081, 41082, 4109, 41090, 41091, 41092	100
Coronary atherosclerosis and other heart disease	I20-I209, I240, I248-I249, I2510-I252, I255-I259	4110, 4111, 4118, 41181, 41189, 412, 4130, 4131, 4139, 4140, 41400, 41401, 41406, 4142, 4143, 4144, 4148, 4149, V4581, V4582	101
Arrythmia	I470-I4892, I491-I499	4270, 4271, 4272, 42731, 42732, 42760, 42761, 42769, 42781, 42789, 4279, 7850, 7851	106
Essential hypertension, hypertension with complications and secondary hypertension, and hypertension complication pregnancy, childbirth and the puerperium	I10-I110, I119-I130, I1310-I32, II150-I169, 010111-O169, H35037-H35033, I674, I973	4011, 4019, 4010, 40200, 40201, 40210, 40211, 40290, 40291, 4030, 40300, 40301, 4031, 40310, 40311, 4039, 40390, 40391, 4040, 40400, 40401, 40402, 40403, 4041, 40410, 40411, 40412, 40413, 4049, 40490, 40491, 40492, 40493, 40501, 40509, 40511, 40519, 40591, 40599, 4372, 64200, 64201, 64202, 64203, 64204, 64210, 64211, 64212, 64213, 64214, 64220, 64221, 64222, 64223, 64224, 64230, 64231, 64232, 64233, 664240, 64241, 64242, 64243, 64244, 64250, 64251, 64252, 64253, 64254, 64260, 64261, 64262, 64263, 64264, 64270, 64271, 64272, 64273, 6427, 64290, 64291, 64292, 64293, 64294	98, 99, 183
Congestive heart failure, non-hypertensive	I0981, I110, I130, I501-I509, I97130, I97131, O29121-029129, ,Z95811, Z95812	39891, 4280, 4281, 42820, 42821, 42822, 42823, 42830, 42831, 42832, 42833, 42840, 42841, 42842, 42843, 4289	108
Peri-; endo-; and myocarditis; cardiomyopathy	A3681-A3950, A3952, B2682, B3320, B3322, B3324, B5881, D8685, I1012, I090, I255, I400-I43, I514, J1082, J1182, O903	03282, 03640, 03641, 03642, 03643, 07420, 07421, 07422, 07423, 11281, 11503, 11504, 11513, 11514, 11593, 11594, 1303, 3910, 3911, 3912, 3918, 3919, 3920, 393, 3980, 39890, 39899, 4200, 42090, 42091, 42099, 4210, 4211, 4219, 4220, 42290, 42291, 42292, 42293, 4229, 4230, 4231, 4232, 4233, 4238, 4239, 4250, 4251, 42511, 42518, 4252, 4253, 4254, 4257, 4258, 4259, 4290	97
Non-specific chest pain	R072, R0789, R079	78650, 78651, 78659	102
Pulmonary heart disease	I2601-I289	4150, 4151, 41512, 41513, 41519, 4160, 4161, 4162, 4168, 4169, 4170, 4171, 4178, 4179, V1255	103

Table S3. Variables considered in the LASSO regression and included in the final multivariable regression model after LASSO analyses.

Outcome	Covariates included in LASSO	Covariates included in final model
Admission to hospital or observation	Sex, race, age, diabetes, hypertension, hyperlipidemia, substance abuse, asthma or COPD, obesity, depression, heart failure, arrival by ambulance, expected source of payment, triage level, cardiac enzyme testing, ECG testing, any diagnostic testing, evaluation by consulting physician	Sex, race, age, diabetes, hyperlipidemia, obesity, heart failure, arrival by ambulance, triage level, ECG testing, cardiac enzyme testing, evaluation by consulting physician
ECG testing	Sex, race, age, diabetes, hypertension, hyperlipidemia, substance abuse, asthma or COPD, obesity, depression, heart failure, arrival by ambulance, expected source of payment, triage level, evaluation by consulting physician	Sex, age, race, hypertension, asthma or COPD, heart failure, arrival by ambulance, triage level, evaluation by consulting physician
Cardiac enzyme testing	Sex, race, age, diabetes, hypertension, hyperlipidemia, substance abuse, asthma or COPD, obesity, depression, heart failure, arrival by ambulance, expected source of payment, triage level, evaluation by consulting physician	Sex, age, race, hypertension, heart failure, triage level, evaluation by consulting physician
Wait time	Sex, race, age, diabetes, hypertension, hyperlipidemia, substance abuse, asthma or COPD, obesity, depression, heart failure, arrival by ambulance, expected source of payment, triage level, evaluation by consulting physician	Sex, age, race, obesity, arrival by ambulance, expected source of payment, triage level
Emergency Triage	Sex, race, age, diabetes, hypertension, hyperlipidemia, substance abuse, asthma or COPD, obesity, depression, heart failure, arrival by ambulance, expected source of payment	Sex, age, race, depression, heart failure, arrival by ambulance

Table S4. Characteristics of young women presenting to the ED with chest pain, by race*

Sample size **National estimate**	**White women** 1,514 10,578,600	**Women of color** 805 6,302,059	
	Mean ± SD	**Mean ± SD**	**p-value**
Age	38.2 ± 11.0 years	36.6 ± 9.8 years	0.003
Expected source of payment	**Percent**	**Percent**	0.013
Private insurance	38.5% [35.4, 41.7%]	26.7% [21.5, 32.5%]	
Medicare	7.5% [5.8, 9.6%]	7.3% [5.2, 10.0%]	
Medicaid or CHIP or state-based program	30.1% [26.9,33.5%]	37.2% [31.1, 43.7%]	
Self-pay or no charge/charity	10.3% [7.8, 13.4%]	13.7% [9.6, 19.3%]	
Other/Unknown	13.6% [10.5, 17.4%]	15.2% [10.6, 21.2%]	
Arrival by ambulance (Estimated visits: White women: 10,186,904 Women of color: 6,183,416)			0.807
Yes	14.1% [12.0, 17.2%]	15.1% [10.9, 20.6%]	
No	82.2% [78.7, 85.1%]	83.0% [77.4, 87.5%]	
Episode of care			
Initial visit	86.0% [81.3, 89.6%]	87.6% [82.2, 91.5%]	0.473
Clinical Comorbidities			
Asthma/COPD	20.2% [17.5, 23.3%]	22.3% [18.7, 26.3%]	0.385
Heart Failure	3.4% [2.3, 5.1%]	4.0% [2.4, 6.5%]	0.644
Diabetes (Type 1, type2, unspecified)	10.4% [8.8, 12.3%]	14.5% [11.0, 18.7%]	0.056
Hyperlipidemia	9.3% [7.6, 11.5%]	8.4% [5.3, 13.2%]	0.71
Hypertension	24.0% [21.5, 26.8%]	34.7% [30.3, 39.3%]	<0.001
Obesity	7.2% [5.4, 9.5%]	11.0% [8.3, 14.5%]	0.014
Substance abuse	6.8% [5.3, 8.7%]	5.2% [3.5, 7.8%]	0.192
Depression	17.5% [14.9, 20.5%]	14.8% [11.4, 19.1%]	0.21
None	40.1% [36.3, 44.0%]	36.4% [32.1, 40.9%]	0.128
Vitals before triage	**Mean ± SD****	**Mean ± SD****	
Heart rate	87.3 ± 19.9 bpm	86.7 ± 15.7 bpm	0.567
Respiratory rate	18.8 ± 6.6 bpm	18.4 ± 3.2 bpm	0.1
Systolic BP	136.0 ± 22.6 mmHg	138.0 ± 21.7 mmHg	0.218
Diastolic BP	81.3 ± 13.8 mmHg	82.7 ± 14.0 mmHg	0.16
Pulse Oximetry	97.9 ± 3.7 %	98.3 ± 3.5 %	0.029

* Percentages based on national estimates

** Means calculated among those with values > 0 ; estimated number of ED visit for which vital signs were available: heart rate (white women: 10,124,358; women of color: 5,913,513), respiratory rate (white women: 10,021,039, women of color: 6,029,571), systolic BP (white women: 10,230,731, women of color: 6,126,387), diastolic BP (white women: 10,236,951, women of color: 6,125,976), pulse oximetry (white women: 10,138,233, women of color: 5,921,365).

Table S5. Characteristics of young men presenting to the ED with chest pain, by race*

Sample size National estimate	**White Men** 1,266 8,787,519	**Men of color** 567 4,061,967	
	Mean ± SD	**Mean ± SD**	**p-value**
Age	39.2 ± 10.8 years	37.9 ±10.4 years	0.050
Expected source of payment	**Percent [95% CI]**	**Percent [95% CI]**	0.193
Private insurance	37.0% [32.6, 41.6%]	28.2% [23.1,33.9%]	
Medicare	8.8% [6.5, 12.0%]	8.7% [5.4,13.6%]	
Medicaid or CHIP or state-based program	24.6% [20.9,28.6%]	28.7% [23.8, 34.1%]	
Self-pay or no charge/charity	15.4% [12.1,19.2%]	16.9% [12.9, 21.8%]	
Other/Unknown	14.3% [10.6,18.9%]	17.6% [12.5, 24.3%]	
Arrival by ambulance (Estimated visits: White men: 8,566,321 Men of color:3,911,390)			0.748
Yes	18.8% [15.5, 22.6%]	17.7% [14.0, 22.1%]	
No	78.7% [74.8, 82.2%]	78.6% [74.3, 82.4%]	
Episode of care			0.892
Initial visit	88.9% [85.6, 91.5%]	89.2% [83.8, 93.0%]	
Clinical Comorbidities			
Asthma/COPD	14.4% [11.8,17.5%]	17.2% [13.4, 21.7%]	0.256
CHF	4.6% [3.3, 6.5%]	4.4% [2.4, 8.0%]	0.914
Diabetes (Type 1, type2, unspecified)	13.0% [11.1,15.3%]	14.3% [10.6, 19.0%]	0.616
HLD	13.4% [10.7, 16.6%]	7.0% [4.8, 10.1%]	0.002
HTN	32.3% [28.9, 35.9%]	35.3% [30.3, 40.6%]	0.306
Obesity	6.2% [4.5, 8.5%]	6.7% [4.3, 10.3%]	0.764
Substance abuse	12.4% [9.5, 16.1%]	9.8% [6.9, 13.9%]	0.278
Depression	10.3% [8.5, 12.4%]	4.9% [3.0, 8.0%]	0.003
None	36.6% [32.8, 40.7%]	37.7% [31.9, 43.8%]	0.922
Vitals before triage	**Mean ± SD ****	**Mean ± SD****	**p-value**
Heart rate	86.5 ± 19.9 bpm	84.5 ± 16.1 bpm	0.064
Respiratory rate	18.3 ± 3.6 bpm	17.9 ± 3.0 bpm	0.074
Systolic BP	139.9 ± 20.9 mmHg	140.9 ± 20.6 mmHg	0.520
Diastolic BP	85.2 ± 13.5 mmHg	85.0 ± 14.1 mmHg	0.835
Pulse Oximetry	97.2 ± 4.4%	97.2 ± 4.4 %	0.977

* Percentages based on national estimates

** Means calculated among those with values > 0 ; estimated number of ED visit for which vital signs were available: heart rate (white men: 8,395,385; men of color: 3,783,433); respiratory rate (white men: 8,475,973; men of color: 3,882,054); systolic BP (white men: 8,561,969; men of color: 3,916,911); diastolic BP (white men: 8,559,234 men of color: 3,909,458); pulse oximetry (white men: 8,408,171, men of color: 3,873,823)

Table S6. Triage and assessment of young women presenting to the Emergency Room with chest pain by race*

	White women	**Women of color**	
Sample size	1,514	805	
National estimate	10,578,600	6,302,059	
	Percent [95% CI]	**Percent [95% CI]**	**p-value**
Triage level			0.352
Immediate/Emergent	20.1% [16.5,24.3%]	17.3%[12.5,23.5%]	
Urgent	38.9% [35.0,43.1%]	36.5%[29.1,44.7%]	
Semi-urgent/Non-urgent	13.4% [10.9,16.5%]	11.8% [7.5,18.0%	
No triage	27.5% [22.3,33.5%]	34.4% [23.2,47.7%]	
Diagnostic testing			
BNP	7.0% [5.2,9.4%]	5.9% [4.1,8.3%]	0.461
Cardiac enzymes	19.2% [15.8,23.2%]	23.0% [16.7,30.7%]	0.244
D-Dimer	17.9% [14.7,21.5%]	14.5% [11.0,18.9%]	0.211
X-ray	73.6% [70.1,76.8%]	67.8% [61.7,73.3%]	0.051
ECG	76.1% [72.6,79.2%]	71.0% [65.3,76.2%]	0.084
Cardiac Monitor	27.8% [24.2,31.8%]	20.1% [15.4,25.9%]	0.018
CT chest	8.7% [7.0,10.8%]	9.3% [7.0,12.3%]	0.757
Toxicology screen	4.4% [3.0,6.3%]	3.2% [2.1,4.8%]	0.255
No testing	25.6% [69.5,77.2%]	23.0% [68.8,81.6%]	0.692
Seen by consulting physician	8.6% [6.7, 10.9%]	8.4% [5.9,11.8%]	0.909
	Mean ± SD**	**Mean ± SD****	**p-value**
Wait time to see provider	42.7 ± 74.7 min	57.8 ± 92.2 min	0.0183

* Percentages based on national estimates

** Means calculated among those with values > 0 ; estimated number of ED visit for wait times were available: White women: 9,380,487 ; women of color: 5,325,775.

Table S7. Triage and assessment of young men presenting to the Emergency Room with chest pain by race*

	White Men	**Men of color**	
Sample size	1,266	567	
National estimate	8,787,519	4,061,967	
	Percent	**Percent [95% CI]**	**p-value**
Triage level			0.111
Immediate/Emergent	25.5% [21.3,30.4%]	18.6% [13.9, 24.5%]	
Urgent	38.0% [33.3,42.9%]	43.2% [35.9, 50.9%]	
Semi-urgent/Non-urgent	7.2% [5.2,10.0%]	8.1% [5.4, 12.0%]	
No triage	29.2% [23.5,35.7%]	30.1% [21.6, 40.2%]	
Diagnostic testing			
BNP	8.8% [6.8,11.2%]	8.6% [6.2, 11.8%]	0.930
Cardiac enzymes	24.0% [19.3,29.5%]	20.4% [14.8, 27.3%]	0.329
D-Dimer	12.8% [10.5,15.4%]	10.0% [7.0, 14.6%]	0.220
X-ray	75.5% [72.1,78.6%]	75.9% [70.2, 80.8%]	0.908
ECG	79.6% [76.5,82.4%]	77.2% [71.9, 81.7%]	0.388
Cardiac Monitor	32.8% [28.2,37.7%]	23.9% [18.2, 30.7%]	0.012
CT chest	9.1% [7.3,11.3%]	6.3% [4.4, 9.1%]	0.097
Toxicology screen	6.2% [4.7,8.2%]	9.8% [7.1, 13.4%]	0.037
No testing	23.1% [72.4,80.1%]	20.4% [72.8, 84.6%]	0.497
Seen by consulting physician	12.2% [9.7,15.3%]	12.3% [8.6, 17.5%]	0.956
	Mean ± SD (sample size)**	**Mean ± SD (sample size)****	**p-value**
Wait time to see provider	34.0 min ± 58.5 (1,010)	44.0 min ± 67.8 (469)	0.0365

* Percentages based on national estimates

** Means calculated among those with values > 0 ; estimated number of ED visit for wait times were available: White men: 7,573,251 ; men of color: 3,608,747

Table S8. Medications administered to young women in ED presenting with chest pain by race*

	White women	Women of color	
Sample size	1,514	805	
National estimate	10,578,600	6,302,059	
	Percent	**Percent**	**p-value**
Medications prescribed in ED or at discharge	65.7% [62.1, 69.2%]	68.5% [63.8, 72.9%]	0.312
Anti-platelets	20.9% [17.6, 24.7%]	10.6% [7.7, 14.4%]	<0.001
Anti-anginal	9.1% [6.9, 11.9%]	6.0% [4.0, 9.1%]	0.093
Gastroenterological agents	8.4% [7.0, 10.3%]	7.5% [5.3, 10.6%]	0.549
Narcotic analgesics	18.1% [14.9, 21.8%]	11.5% [8.8, 15.0%]	0.002
Benzodiazepines	10.8% [8.7, 13.3%]	6.3% [4.2, 9.3%]	0.019
NSAIDS	17.0% [14.7, 19.6%]	18.7% [15.2, 22.7%]	0.459

* Percentages based on national estimates
Note that anticoagulants could not be analyzed due to <30 unweighted records among women and men

Table S9. Medications administered to young men in ED presenting with chest pain by race*

	White Men	Men of color	
Sample size	1,266	567	
National estimate	8,787,519	4,061,967	
	Percent	**Percent**	**p-value**
Medications prescribed in ED or at discharge	70.0% [65.5,74.1%]	67.7% [61.1, 73.7]	0.506
Anti-platelets	22.7% [18.6,27.3%]	19.8% [15.7, 24.5%]	0.2939
Anti-anginal	13.6% [11.0,16.7%]	5.8% [4.1, 8.3%]	<0.001
Gastroenterological agents	9.3% [7.1,12.0%]	8.9% [5.6, 13.7%]	0.861
Narcotic analgesics	16.9% [14.3,19.8%]	11.5% [8.6, 15.0%]	0.013
Benzodiazepines	8.3% [6.2,11.0%]	-	-
NSAIDS	70.0% [12.0,17.7%]	20.8% [15.7, 27.0%]	0.038

* Percentages based on national estimates
Note that anticoagulants could not be analyzed due to <30 unweighted records among women and men

Table S10. Disposition of young women presenting to the Emergency Room with chest pain by race*

	White women	**Women of color**	
Sample size	1,514	805	
National estimate	10,578,600	6,302,059	
	Percent	**Percent**	**p-value**
No follow up	4.9% [3.4, 7.1%]	6.7% [3.5,12.4%]	0.4
Return to care	75.1% [71.0, 78.9%]	74.0% [66.8,80.1%]	0.770
Transfer to other hospital	-	-	-
Admit	13.2% [10.0, 17.2]	11.1% [8.1,15.2%]	0.452
Admit to observation	3.4% [2.4, 4.8%]	4.8% [2.8,8.4%]	0.277
Admitted to hospital	9.9% [7.2, 13.5%]	6.8% [4.5,10.0%]	0.138
Other Disposition	4.3% [2.8,6.5%]	-	-
Unknown	-	-	-
Left Early	5.4% [3.5, 8.2%]	-	-

*Percentages based on national estimates

Table S11. Disposition of young men presenting to the Emergency Room with chest pain by race*

Sample size National estimate	**White Men** 1,266 8,787,519	**Men of color** 567 4,061,967	
	Percent	**Percent**	**p-value**
No follow up	6.5% [4.5, 9.3%]	8.6% [5.4, 13.5%]	0.3
Return to care	66.3% [62.1, 70.3%]	67.4% [61.0, 73.3%]	0.752
Transfer to other hospital	2.50% [1.6, 3.9%]	-	-
Admit	18.4% [15.6, 21.5%]	16.7% [12.7, 21.8%]	0.503
Admit to observation	5.1% [3.3, 7.6%]	6.6% [4.0, 10.6%]	0.332
Admitted to hospital	14.3% [11.9, 17.0%]	11.7% [8.8, 15.2%]	0.2077
Other Disposition	6.3% [4.6, 8.7%]	-	-
Unknown	-	-	-
Left Early	7.0% [4.7,10.2%]	-	-

*Percentages based on national estimates

Table S12. ED diagnoses of all young adults presenting to the ED with chest pain.

	Women	Men	p-value	White	People of color	p-value	Total
Sample size	2,319	1,833		2,780	1,372		
National estimate	16,880,659	12,849,486		19,366,119	10,364,026		
Other chest pain	40.8%	44.0%	0.151	43.4%	40.0%	0.172	42.2%
Hypertensive diseases	10.1%	13.8%	0.011	11.5%	12.0%	0.747	11.7%
Arrhythmia	3.2%	4.9%	0.057	4.8%	-	-	3.9%
Coronary atherosclerosis and other heart disease	1.9%	3.3%	0.044	2.8%	-	-	2.5%
Heart failure & Cardiomyopathy	1.4%	1.7%	0.611	1.4%	1.8%	0.544	1.6%
Acute myocardial infarction	-	2.2%		1.8%	-	-	1.4%
Pulmonary heart disease	-	-		-	-	0.465	1.0%

Table S13. Hospital discharge diagnoses of young adults who presented to the ED with chest pain and were admitted to the hospital.

	Women	Men	p-value	White	People of color	p-value	Total
Sample size	299	318		429	188		
National estimate	2,093,591	2,294,069		3,006,144	1,381,517		
Other chest pain	59.7%	55.1%	0.495	58.8%	53.9%	0.36	57.3%
Hypertensive diseases	12.5%	14.7%	0.552	15.5%	-	-	13.6%
Arrhythmia	-	-	-	-	-	-	-
Coronary atherosclerosis and other heart disease	-	-	-	-	-	-	-
Heart failure & Cardiomyopathy	-	-	-	-	-	-	5.8%
Acute myocardial infarction	-	-	-	7.1%	-	-	6.5%
Pulmonary heart disease	-	-	-	-	-	-	-