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# An Evaluation of Disparities Affecting Time from Emergency Department Door to Electrocardiogram in Patients with Chest Pain

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## Abstract

**Introduction:** For patients presenting to an emergency department with a chief complaint of chest pain, current American Heart Association guidelines recommend that time from emergency department arrival to completion of electrocardiogram be 10 minutes or less. The aim of this study is to evaluate if differences still exist amongst a diverse patient population presenting to a busy urban emergency department with a chief complaint of chest pain.

**Methods:** This retrospective study looked at 3,419 patients who presented to the Emergency Department with any complaint of chest pain during the medical screening examination. Arrival time and time of first electrocardiogram along with age, gender, race, ethnicity and primary language were extracted from electronic health records.

**Results:** For all patients, the mean time to electrocardiogram was 12.5 minutes (95% CI: 12.1-12.7) and 49.9% of all patients received an electrocardiogram within 10 minutes of arrival. Mean time for men was 11.6 minutes and for women 13.3 minutes ( $P<0.0001$ ); in addition 54% of men and 44.4% of women had electrocardiogram done within 10 minutes of arrival ( $P<0.0001$ ). No differences were found with regards to primary language, race or ethnicity of patients. Mean time to electrocardiogram for patients less than 40 years old was 14.6 minutes, which was significantly longer than patients equal or older than 40 years, who's mean time was 11.9 minutes ( $p<0.0001$ ). The effect of age was observed across gender, race, ethnicity and primary language spoken by the patients.

**Conclusions:** Patient presenting to the emergency department with chest pain are subject to several biases that potentially create health disparities. In this study we show that younger patients and women had a delay in time to electrocardiogram showing biases are still an issue.

**Keywords:** chest pain, electrocardiography, quality control

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## INTRODUCTION

Time from arrival in the Emergency Department to completion of electrocardiogram in patients presenting with a chief complaint of chest pain is so critical that the American Heart Association guidelines recommend 10 minutes or less.<sup>1</sup> This recommendation is based on the importance of early recognition of ST-elevation myocardial infarction. Delay in the electrocardiogram is associated with delay in reperfusion therapy and increased risk of adverse clinical outcomes.<sup>2-4</sup>

Prior studies have demonstrated that delays in obtaining electrocardiograms within 10 minutes of arrival have been attributed to biases with gender, race, age and limited English proficiency.<sup>5,6</sup> These delays in door-to-electrocardiogram time may partly explain the worse clinical outcomes found in these demographics.<sup>7</sup> Recent research has shown that even when women present with typical acute coronary syndrome symptoms, they still wait longer than men for an initial diagnostic electrocardiogram and in turn have poorer outcomes.<sup>8</sup>

Our emergency department is located in an urban setting on Miami Beach, Florida. From the 2018 U.S. Census Bureau, over 73% of the Miami-Dade population speaks Spanish as their primary language.<sup>9</sup> We are unaware of any large emergency department-based studies assessing for disparities in door-to- electrocardiogram times based on primary language spoken by the patient.

The aim of this study was to evaluate for adherence to the goal of door-to- electrocardiogram time of less than 10 minutes and to identify disparities based on race, ethnicity, age, gender, or primary language.

## METHODS

This was a retrospective analysis comparing emergency department arrival time to time of first electrocardiogram for all adult patients arriving with a complaint of chest pain during the medical screening examination. We reviewed all recorded eligible patient visits between January 2018 and December 2018. Patient information was taken directly from the electronic health records. We then analyzed the door-to- electrocardiogram times based on age, gender, race, ethnicity and primary language. We report the time from when the patient arrives in the Emergency Department to the first electrocardiogram completed. These times were synched with the electronic health record.

Mount Sinai Medical Center is a 500+ bed independent non-profit urban teaching hospital located in Miami Beach, Florida. Annual emergency department visits for calendar year 2018 were approximately 53,000 patient visits. During the study period, there were a total 54 emergency department beds. The emergency department is staffed 24 hours

per day with board-certified emergency medicine physicians, emergency medicine residents, rotating non-emergency medicine residents and fellows, and advanced practice providers. Mount Sinai has a cardiac catheterization suite that is open 24 hours per day that is staffed by board-certified interventional cardiologists and interventional cardiology fellows. Medical interpreters are available at Mount Sinai Medical Center to facilitate the communication between the physicians and non-English (Spanish) speakers.

Results are shown as means  $\pm$  standard error of mean (SEM), number of observations or percentages as needed. Differences in mean time to electrocardiogram were assessed by either Student t-test (for gender, and ethnicity) or ANOVA (for race and primary language). Categorical variables were evaluated with the Fisher Exact test. The relationships between independent variables (gender, age, race, ethnicity, and primary language) and time to ECG (dependent variable) was assessed by multiple regression analysis. Statistics were analyzed with the IBM SPSS Statistics 26 software.

Ethical approval was obtained from the Institutional Review Board (IRB) of the Mount Sinai Medical Center on January 9, 2019 under the Federalwide Assurance number [FWA00000176].

## RESULTS

A total of 3,419 patients were included in study. For all patients, the mean time to electrocardiogram was 12.5 minutes (95% CI: 12.1-12.7) and 49.9% of all patients received an electrocardiogram within 10 minutes of arrival (Table 1). Mean time for those who received an electrocardiogram within 10 min of arrival was 6.7 minutes and for those who received an electrocardiogram after 10 min of arrival was 18.2 minutes. Age was inversely associated with time to electrocardiogram, with longer electrocardiogram times in younger patients ( $p < 0.0001$ ). Mean time to electrocardiogram for patients less than 40 years old was 14.6 minutes and for patients equal or older than 40 years of age the mean time was 11.9 minutes. The effect of age was observed across gender, race, ethnicity and primary language spoken by the patients (Table 1). Gender

**Table 1** Time to electrocardiogram (ECG) based on age, gender, race, ethnicity and primary language

	Patient Number (%)	Time to ECG in min (mean $\pm$ SEM)	Time to ECG $\leq$ 10 min N (%)	Time to ECG $>$ 10 min N (%)	P-value of differences between $\leq$ 10 and $>$ 10 min groups
Age					
< 40 y		14.6 $\pm$ 9.1	266 (36.8%)	457 (63.2%)	<0.0001
>40 y		11.9 $\pm$ 8.9	1439 (53.4%)	1257 (46.6%)	
Gender					
Men	1943 (56.8%)	11.6 $\pm$ 7.9	1050 (54%)	893 (46%)	<0.0001
<40 y	367 (18.9%)		145 (13.8%)	222 (24.9%)	
>40 y	1576 (81.1%)		905 (86.2%)	671 (75.2%)	
Women	1476 (43.2%)	13.3 $\pm$ 9.3	655 (44.4%)	821 (55.6%)	
<40 y	356 (24.1%)		121 (18.9%)	235 (28.6%)	
>40 y	1120 (75.9%)		534 (81.1%)	586 (71.4%)	
Race					
White/Caucasian	2316 (67.7%)	12.4 $\pm$ 8.7	1177 (50.8%)	1139 (49.2%)	0.386
<40 y	409 (17.7%)		147 (12.5%)	262 (23%)	
>40 y	1907 (82.3%)		1030 (87.5%)	877 (77%)	
Black/African-American	639 (18.7%)	12.8 $\pm$ 8.3	304 (47.6%)	335 (52.4%)	
<40 y	195 (30.5%)		70 (23%)	125 (37.3%)	
>40 y	444 (69.5%)		234 (77%)	210 (62.7%)	
Multiracial + other	464 (13.6%)	12.6 $\pm$ 8.7	224 (48.3%)	240 (51.7%)	
<40 y	119 (25.7%)		49 (21.9%)	70 (29.2%)	
>40 y	345 (74.3%)		175 (78.1%)	170 (70.8%)	
Ethnicity					
Hispanic	1537 (44.9%)	12.7 $\pm$ 9.1	759 (49.4%)	778 (50.6%)	0.493
<40 y	299 (19.5%)		105 (13.8%)	194 (24.9%)	
>40 y	1238 (80.5%)		684 (86.2%)	584 (75.1%)	
Non-Hispanic	1882 (55.1%)	12.3 $\pm$ 8.2	946 (50.3%)	963 (49.7%)	
<40 y	424 (22.5%)		161 (17%)	263 (28%)	
>40 y	1458 (77.5%)		785 (83%)	673 (72%)	
Primary language					
English	2582 (75.5%)	12.5 $\pm$ 8.5	1284 (49.7%)	1298 (50.3%)	0.815
<40 y	655 (25.4%)		242 (18.9%)	413 (31.8%)	
>40 y	1927 (74.6%)		1040 (81.1%)	885 (68.2%)	
Spanish	790 (23.1%)	12.4 $\pm$ 8.9	396 (50.1%)	394 (49.9%)	
<40 y	60 (7.6%)		19 (4.8%)	41 (10.4%)	
>40 y	730 (92.4%)		377 (95.2%)	353 (89.6%)	
Other	47 (1.4%)	11.9 $\pm$ 7.5	25 (53.2%)	22 (46.8%)	
<40 y	8 (17%)		5 (20 %)	3 (13.6%)	
>40 y	9 (83%)		20 (80%)	19 (86.4%)	
Total	N = 3419	12.5 $\pm$ 8.6	1705 (49.9%)	1714 (50.1%)	

SEM: standard error of the mean; p values  $<$ 0.05 are considered statistically significant.

was also associated with time to electrocardiogram, with women showing significantly longer times to electrocardiogram ( $p < 0.0001$ ). The effect of gender was still observed after correcting for by age ( $p < 0.008$ ). Mean time for men was 11.6 minutes and 54% had an electrocardiogram done within 10 minutes of arrival. Mean time for women was 13.3 minutes and 44.4% had an electrocardiogram within 10 minutes of arrival (Table 1). Patients that listed Spanish as their primary language had mean time to electrocardiogram of 12.4 minutes and 50.1% had an electrocardiogram within 10 minutes of arrival verses those patients that listed English as primary language had mean time to ECG of 12.5 minutes and 49.7% had an electrocardiogram done within 10 minutes of arrival ( $P = 0.815$ ). The most common language preference was English and that accounted for 2582 patient encounters. This was followed by Spanish, which accounted for 709 patient encounters. The remaining 47 patient encounters consisted of various languages including Haitian Creole, Russian, and Portuguese. There were no significant differences between the patients' race ( $p = 0.386$ ) and or ethnicity ( $p = 0.493$ ) and the time to ECG (Table 1).

## DISCUSSION

Disparities in the delivery of emergent cardiac care are well documented despite the existence of clear guidelines.<sup>6,7,10</sup> Women wait longer than men to receive their first electrocardiogram. Excuses for this have been that women present with atypical symptoms for acute coronary syndrome such as lightheadedness or weakness, creating a delay in identifying a cardiac pathology as a cause of the patient's complaint thus delaying the time to electrocardiogram. In our study this phenomenon was reproduced with women with a specific complaint of chest pain having their time to electrocardiogram 15% longer than their age-adjusted male counterparts. Another explanation for delay in time to electrocardiogram has been that women overall present at a younger age than men with complaints of chest pain, therefore it is the age, rather than gender, which accounts for delays. Our data does not support this theory. We corrected for age and disparities for gender are still present.

Another trend identified in our review was that younger patients consistently waited longer than older patients. Patients less than 40 years of age on average waited 18% longer than patients equal or greater than 40 years of age for their electrocardiogram. This fits with previously reported disparities in door-to-electrocardiogram times favoring older patients. This discrepancy has previously been reported and is generally attributed to the lower rate of acute coronary syndrome in the patients under the age of 40 years old and the higher likelihood of a non-emergent diagnosis in this population.

No identifiable disparity in door-to-electrocardiogram time for non-English speaking patients was found. A lack of English language proficiency has previously been noted as a potential explanation for delays in providing emergent cardiac care to patients arriving to the Emergency Department.<sup>5</sup>

The ten-minute door to completion of electrocardiogram can be argued to be an arbitrary number. But the complaint of chest pain on arrival to the emergency department may lead to a final diagnosis of ST-elevation myocardial infarction where tissue perfusion is time sensitive and thus every minute matters. Delays in electrocardiograms lead to delays in further treatment and outcome<sup>8</sup>. For this reason, we believe the statistically significant findings are also clinically significant. For the purposes of our study, specific clinical consequences due to delays in electrocardiograms were neither sought nor identified.

This study is based on data from a single urban emergency department located in a multi-ethnic community that regularly treats a large number of local residents as well as international visitors. Information was taken directly from electronic health records.

## CONCLUSION

Adherence to door-to- electrocardiogram times of less than 10 minutes continues to be a major problem even in a diverse, urban community. Primary language did not contribute to delays in electrocardiogram. Unfortunately, patients

who are younger and/or female continue to wait longer for their initial ECG after arriving to the emergency department with a complaint of chest pain. Acknowledging barriers exist is the first step towards breaking them down.

**Conflict of Interest:** The authors declare no conflicts of interest or sources of funding.

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