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Prehospital Time Disparities for Rural Patients with Suspected STEMI

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Abstract

Background: Rural patients with ST-elevation myocardial infarction (STEMI) may be less likely to receive prompt reperfusion therapy. This study's primary objective was to compare rural versus urban time intervals among a national cohort of prehospital patients with STEMI.

Methods: The ESO Data Collaborative (Austin, TX), containing records from 1,366 emergency medical services agencies, was queried for adult 9-1-1 responses with suspected STEMI from 1/1/2018–12/31/2019. The scene address for each encounter was classified as either urban or rural using the 2010 US Census Urban Area Zip Code Tabulation Area relationship. The primary outcome was total EMS interval (9-1-1 call to hospital arrival); a key secondary outcome was the proportion of responses that had EMS intervals under 60 minutes. Generalized estimating equations were used to determine whether rural versus urban differences in interval outcomes occurred when adjusting for loaded mileage (distance from scene to hospital) and patient and clinical encounter characteristics.

Results: Of 15,915,027 adult 9-1-1 transports, 23,655 records with suspected STEMI were included in the analysis. Most responses (91.6%, n=21,661) occurred in urban settings. Median EMS interval was 37.6 minutes (IQR 30.0–48.0) in urban settings compared to 57.0 minutes

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(IQR 46.5–70.7) in rural settings (p<0.01). Urban responses more frequently had EMS intervals <60 minutes (89.5%, n=19,130), compared to rural responses (55.5%, n=1,100, p<0.01). After adjusting for loaded mileage, age, sex, race/ethnicity, abnormal vital signs, pain assessment, aspirin administration, and IV/IO attempt, rural location was associated with a 5.8 (95%CI 4.2–7.4) minute longer EMS interval than urban, and rural location was associated with a reduced chance of achieving EMS interval < 60 minutes (OR 0.40; 95%CI 0.33–0.49) as compared to urban location.

Conclusion: In this large national sample, rural location was associated with significantly longer EMS interval for patients with suspected STEMI, even after accounting for loaded mileage.

Keywords

STEMI; EMS; prehospital; rural

Introduction

Every year, approximately 172,000 people in the United States have ST-elevation myocardial infarctions (STEMI).[1] Coronary artery disease continues to be among the leading causes of death worldwide.[2] Along the spectrum of acute coronary syndrome, STEMI is the most severe presentation and carries a 30-day mortality rate approaching 12%.[3] Reperfusion therapy is the mainstay of treatment for STEMI, either by percutaneous coronary intervention (PCI) or thrombolytics.[4] Since time to reperfusion is determinative of STEMI outcomes, the American College of Cardiology (ACC) and American Heart Association (AHA) established a 90-minute goal from first medical contact (FMC) to PCI.[1,5] For the 50 million Americans who live in rural areas and are therefore farther away from PCI centers, the 90-minute FMC-to-PCI time goal is more challenging to accomplish.

Over half of patients with STEMI have FMC with emergency medical services (EMS).[6] Thus, EMS plays a crucial role in the early recognition of STEMI, followed by pre-arrival activation of the hospital cardiac catheterization lab. Every 1-minute delay in calling 9-1-1 to PCI results in a 3% decreased chance of 1-year survival.[7] Prior studies have demonstrated that prehospital response intervals greater than 11 minutes, interval to 12-lead ECG greater than 8 minutes, on-scene interval greater than 15 minutes, and total prehospital interval greater than 60 minutes are all associated with significantly higher odds of failing to achieve the FMC-to-PCI goal.[8–10]

Rural patients are eight times less likely to receive timely definitive STEMI treatment compared to their urban counterparts.[10] However, it is unclear in the literature whether the delays in rural prehospital STEMI care are explained solely by increased distance to hospitals with catheterization labs or by other factors. There are multiple elements both at the patient and EMS practice levels that may be associated with increased prehospital intervals. In rural settings, EMS clinicians face extended drive times and must manage hemodynamically unstable patients over greater distances than their urban counterparts. The objective of this study was to compare rural versus urban care intervals and factors associated with these intervals among a large national cohort of prehospital patients with suspected STEMI.

Methods

We conducted an analysis of prehospital electronic patient care records from the de-identified research database maintained by ESO, Inc. (Austin, TX). ESO is a large provider of prehospital electronic health record software in the United States. The ESO prehospital electronic health record software facilitates the collection of comprehensive clinical information, including event dispatch data, patient demographic characteristics, clinical presentation and course, intervention and treatment, and outcome at transfer of care. Data elements collected within the ESO software are compliant with the National EMS Information System standard.[11] The institutional review board at Wake Forest School of Medicine determined that this study was exempt from full review.

A subset of ESO prehospital electronic health record software users participates in the ESO Data Collaborative, allowing their de-identified records to be used for research and benchmarking. Each year a standard public use research dataset is constructed. These annual datasets are made available to researchers following a research proposal process. The 2018 and 2019 annual ESO research datasets used for the present study contained 15,915,027 de-identified records from 1,366 EMS agencies. For this analysis, emergency (9-1-1) responses for adult patients (≥18 years old) with documented EMS clinician primary or secondary impressions of STEMI were included. Interfacility transports were excluded from the analyses.

The scene address for each EMS response was classified as either urban or rural using the 2010 US Census Urban Area Zip Code Tabulation Area relationship.[12] This classification was performed in June of 2019 for the 2018 dataset and June of 2020 for the 2019 dataset (https://www.census.gov/geographies/reference-files/time-series/geo/relationship-files.2010.html#par_textimage_674173622 [census.gov]). The US census urban and rural classifications consist of three categories: 1) urbanized areas consistent of populations of 50,000 or more; 2) urban clusters consisting of at least 2,500 inhabitants but less than 50,000; and 3) rural, which encompasses all population not included within an urban area or urban cluster..[13]

The primary outcome of this study was total EMS interval, defined as 9-1-1 call to arrival at destination hospital in minutes. Given that the median door-to-balloon interval for patients with pre-arrival STEMI alerts is ~40 minutes,[14] a total EMS interval of less than 60 minutes is essential to achieving FMC-to-PCI within 90 minutes.[15,16] Using this metric, a key secondary outcome was the proportion of responses that had total EMS intervals under 60 minutes. Additional secondary outcome measures were activation interval, response interval, on-scene interval, and transport interval. Activation interval was defined as the period from receipt of the 9-1-1 call by the telecommunications center to the time the EMS unit was dispatched by radio with response information. Response interval was defined as the period from when EMS was dispatched to arrival on scene. On-scene interval was the period from EMS arrival on scene to EMS departure from scene. ECG interval was the period from EMS arrival to first 12-lead ECG performed. Transport interval was the period from EMS departure from scene to arrival at destination. Based on prior literature and stakeholder organization recommendations, categorical activation interval of 1 minute, response interval of 8 minutes, ECG interval of 10 minutes, and on-scene interval of 15 minutes were used for categorical analysis.[8,15]

Patient and clinical encounter characteristics were measured, and differences between rural and urban encounters were described. Patient demographic variables included age, sex, and race/ethnicity. Clinical factors included documentation of pain scale scores, aspirin administration, intravenous or intraosseous attempts, and initial prehospital vital signs, including systolic blood pressure, heart rate, and oxygen saturation. Loaded mileage was defined as the distance from the incident scene to hospital destination. The ESO software calculates the loaded mileage based on the starting and ending odometer readings entered by the EMS clinicians, or a Google-powered estimation based on the scene and destination address entered by the EMS clinicians or computer aided dispatch system.

Descriptive statistics were calculated and stratified by urban and rural response addresses. Categorical variables were summarized using frequencies and percentages. Continuous variables were summarized using medians and interquartile ranges. We compared patient and clinical encounter characteristics between urban and rural responses using Wilcoxon rank sum tests and chi-square tests.

For key prehospital intervals, we compared differences between urban and rural responses using linear generalized estimating equations to account for clustering within EMS agency. Similarly, we compared categorical time goals between urban and rural responses using logistic generalized estimating equations.

We then used linear generalized estimating equations to calculate univariable and multivariable changes in mean EMS interval (primary outcome) by location urbanicity and patient and clinical encounter characteristics while controlling for clustering at the EMS agency level. Similarly, for the dichotomous outcome variable of EMS interval under 60 minutes (key secondary outcome), we used logistic generalized estimating equations to estimate univariable and multivariable odds of meeting this goal by location urbanicity, patient and clinical encounter characteristics. Age was included in the multivariable model due to possible mobility limitations that may extend EMS time. Sex was included, because the increased incidence of atypical presentations in female patients could affect evaluation times. Race/ethnicity was included to evaluate for previously documented race- and ethnic-specific health disparities within the rural setting.[17] Loaded mileage was included as a key data point when comparing rural and urban encounters. The clinical factors included are used as markers for increased clinical severity that may influence paramedics' decision making.[18–20] Documentation of aspirin administration and vascular access attempts represented high-quality data points within the dataset that represent typical interventions in prehospital STEMI encounters that could affect EMS intervals. All analyses were performed using Stata version 15.1 (StataCorp LLC; College Station, TX).

Results

Our analysis included 23,655 EMS patient encounters with suspected STEMI. Of these, 1,994 (8.4%) responses occurred in rural areas (Figure 1). The median ages of patients with suspected STEMI from rural and urban areas were 66 versus 65 years old, respectively. The majority of patients were male (65.7%), with no differences by rural/urban location (p = 0.65). In urban areas, there was a significantly higher proportion of patients who were documented as belonging to minority racial/ethnic groups compared to rural areas (24.7% vs. 10.3%, respectively; p < 0.01). The regional distribution of patients was 54.9% (12,986) from the south, 20.3% (4,803) Midwest, 11.5% (2,722) West, and 3.5% (820) Northeast, with 9.8% (2,324) missing. The evaluation of key hemodynamic indicators showed that systolic blood pressure was slightly more likely to be less than 90 mmHg in the urban cohort compared to the rural cohort (9.0% vs. 7.7%; p = 0.05). Meanwhile, initial oxygen saturations were more likely to be <95% in the rural group compared to the urban group (28.0% vs. 24.1%; p < 0.01). There was no significant difference in bradycardia or tachycardia among groups (p = 0.11). The median loaded mileage was 16.7 miles higher for EMS responses in rural settings compared to urban (Table 1).

Overall, prehospital intervals were significantly longer for rural patients, with the exception of activation interval, which was slightly shorter for rural responses (median 0.65 minutes versus urban 0.95) (Table 2). The frequency of patients experiencing EMS intervals >60 minutes was 44.5% for rural patients, compared to 10.5% for urban patients. Response intervals for rural patients were nearly twice as long at 12.0 minutes compared to 6.6 minutes for urban patients. Response interval was under 8 minutes for 27.4% of responses in rural settings compared to 63.5% of responses in urban settings. For rural patients, the median on-scene interval (16.6 versus 15.4 minutes) and interval to 12-lead ECG (7.7 versus 6.6 minutes) was significantly longer than for urban patients. The median transport interval was more than twice as long (26.0 versus 11.9 minutes) for rural patients (Table 2) (Figure 2).

Univariable and multivariable linear generalized estimating equation models with EMS interval as the outcome are presented (Table 3). Rural scene location was associated with a 18.9 minute (95%CI: 16.7–21.0) longer EMS interval as compared to urban scene location in the unadjusted analysis. After accounting for loaded mileage as well as other clinically relevant variables, rural scene location was associated with a 5.8 minute (95%CI: 4.2–7.4) longer average EMS interval. Age, female sex, black non-Hispanic race/ethnicity, tachycardia, and increased loaded mileage were all also associated with longer EMS intervals.

Univariable and multivariable logistic generalized estimating equation models are presented in Table 4, where the dichotomous variable for EMS interval < 60 minutes was the outcome. Rural scene location was much less likely to be associated with achieving EMS interval <60 minutes (OR 0.14; 95% CI 0.12–0.18) when considered in univariable analysis. After adjusting for loaded mileage and other clinically important variables, rural scene location was associated with 60% lower odds of meeting the goal of EMS interval <60 minutes (OR 0.40; 95%CI 0.33–0.49).

Discussion

Using a large multiyear national prehospital patient care record database, we identified that rural scene location was associated with significantly longer EMS intervals for patients with suspected STEMI when compared to urban counterparts, even when other factors, such as loaded mileage, were included in the model. This rural time disparity could translate to an increased annual mortality of 17.4% using evidence from Studnek et al.[7] Our results suggest that there is potential to modify the approach to factors (e.g., response to tachycardia, age, sex) that increase EMS interval beyond the distance from the tertiary care center. Additionally, we found significant rural STEMI EMS disparities in other prehospital time metrics. Specifically, response interval, interval to first 12-lead ECG, on-scene interval, and transport interval were all significantly longer for rural patients. Altogether, patients in rural environments had 60% lower odds of meeting the 60 minute or less time benchmark to PCI center arrival compared to their urban counterparts. Given that increased time to PCI (door-to-balloon or 9-1-1 call-to-PCI) is associated with increased mortality and adverse events, the delays in definitive care represent a critical disparity in rural versus urban health care.[7,21,22]

This study provides insight into specific targets for improving timely definitive care for patients with STEMI. We found that on-scene interval and interval to 12-lead ECG were both are both statistically significantly longer for rural patients, but the modest difference was approximately one minute each. The ACC/AHA recommends a benchmark FMC to ECG time of 10 minutes for patients with chest pain.[23] In our study, over one-third of rural cases did not meet this benchmark. This represents an important barrier to timely recognition of STEMI, which contributes to delays to definitive care. The 15-minute on-scene interval benchmark was not met by the majority of all patients, but rural patients were even more likely to miss this goal than their urban counterparts. System-based quality improvement should be implemented to improve these metric delays by protocolizing FMC to ECG time and expediting initiation of transport for patients with STEMI. Close monitoring of these metrics with associated objective feedback on a case-by-case and systems basis may improve outcomes.

In this analysis, the interval with the largest gap by rurality was the transport interval. This difference was associated with a median transport distance difference of 16.7 miles. Transport interval is largely dependent on the fixed distance from the scene to the nearest PCI center, which makes it the least intervenable. Increasing the number of PCI-capable hospitals may decrease transport interval for rural patients; however, previous investigations have shown that new PCI centers are more likely to be opened in areas that already have PCI programs, rather than expanding to underserved areas.[13,24] Investigations of helicopter transport to improve FMC to PCI intervals have shown promise in Denmark and New Zealand[25,26]; however, a US-based investigation of patients transferred from non-PCI hospitals to PCI centers by helicopter did not commonly achieve FMC to PCI within 90 minutes.[27] Response interval is also distance-dependent and was nearly twice as long for rural patients. Improvements in response interval could be made with increased ambulance base availability and staffing. However, resources are often limited in rural EMS agencies.

Rural patients were more likely to have oxygen saturations less than 90% upon presentation, less likely to be hypotensive, and showed no difference in heart rate extremes. Intuitively, STEMI patients who present with abnormal vital signs may have more prehospital interventions than their stable counterparts and may therefore have delayed initiation of transport to the hospital in anticipation that they may become unstable during transport. This concern has a tendency to lengthen on-scene intervals, but only tachycardia was associated with a modest increase in EMS interval in our analysis. Our IV/IO access analysis was limited by not differentiating if performed before or after transport was initiated, but the risks and benefits of placing peripheral intravenous catheters while the ambulance is moving should be considered.[28] Some EMS agencies have disallowed interventions such as this while transporting to reduce the incidence of accidental clinician needle sticks and to improve first-attempt success rate. These benefits need to be balanced with STEMI patient morbidity and mortality.

EMS services that are frequently unable to achieve the established 90-minute benchmark for STEMI may consider a prehospital thrombolytic administration protocol. This dataset did not evaluate the use of prehospital thrombolytics, but a meta-analysis found a 17% reduction in hospital-mortality for patients who received prehospital thrombolysis compared to patients who received it in a hospital.[29] The most profound benefit was found in patients presenting within 2 hours of symptom onset. Pooled data from two trials demonstrated improved 1-year mortality for patients receiving prehospital thrombolytic within 2 hours of symptom onset over primary PCI.[30] The 44.5% of rural patients who did not meet the 60 minute time goal in our cohort may have benefitted from thrombolytics rather than transport for PCI. It is imperative that EMS agencies take a critical look at the decision to transport for PCI on a case-by-case basis because a “one size fits all” approach results in a large portion of patients that do not meet the established time benchmarks, which are linked to improved outcomes.

This study analyzed a database of patients from EMS systems that use a single electronic medical record provider and have agreed to share their de-identified data for the purposes of research and benchmarking. This could bias results as successful agencies may be more likely to agree to report data than poorly run EMS agencies. The data in this convenience sample are heavily focused in the southern US and may not be generalizable to STEMI patients in all EMS systems. These data are also observational, and therefore inferences of causality are limited. Patients in this study were suspected of STEMI by their prehospital clinicians and not confirmed STEMI patients, therefore we were unable to determine a false positive rate. Likewise, our analyses were limited to available data, and other confounding variables such as use of helicopterEMS, EMS staffing and experience, and accuracy of documentation could not be assessed. We were not able to specifically exclude patients transported to non-PCI centers for thrombolytics in “drip and ship” care pathways based on available data. The time metrics are based on the transporting units. Non-transporting units may have arrived on scene first, which would result in an underestimation of intervals based on FMC. Some of the time differences that were found to be statistically significant are small and may not be clinically significant. Hospital and downstream outcomes such as cardiovascular death and recurrent myocardial infarction are not available. However, these can be inferred based on extensive data supporting improved morbidity and mortality with more timely care contained with the STEMI literature. Finally, door to PCI time was estimated in this study, and our analysis relied on established national averages to discuss the 90-minute STEMI benchmark. Some times may have been imported from agency computer assisted dispatch software, but ultimately the EMS clinician is responsible for the reliability of the times entered and they are not confirmed by GIS trackers.

This analysis of a large national sample of suspected STEMI patients encountered by EMS demonstrated that rural location was associated with significantly longer total EMS interval, even after accounting for loaded mileage. These results suggest systems-based interventions may improve time metrics for patients with STEMI who are cared for by EMS professionals in rural settings. Based on our data, improving response interval, interval to ECG, and on-scene interval may be the most obvious targets for interventions. However, further research to identify the root causes of rural EMS STEMI time disparities and to develop and test interventions are needed.

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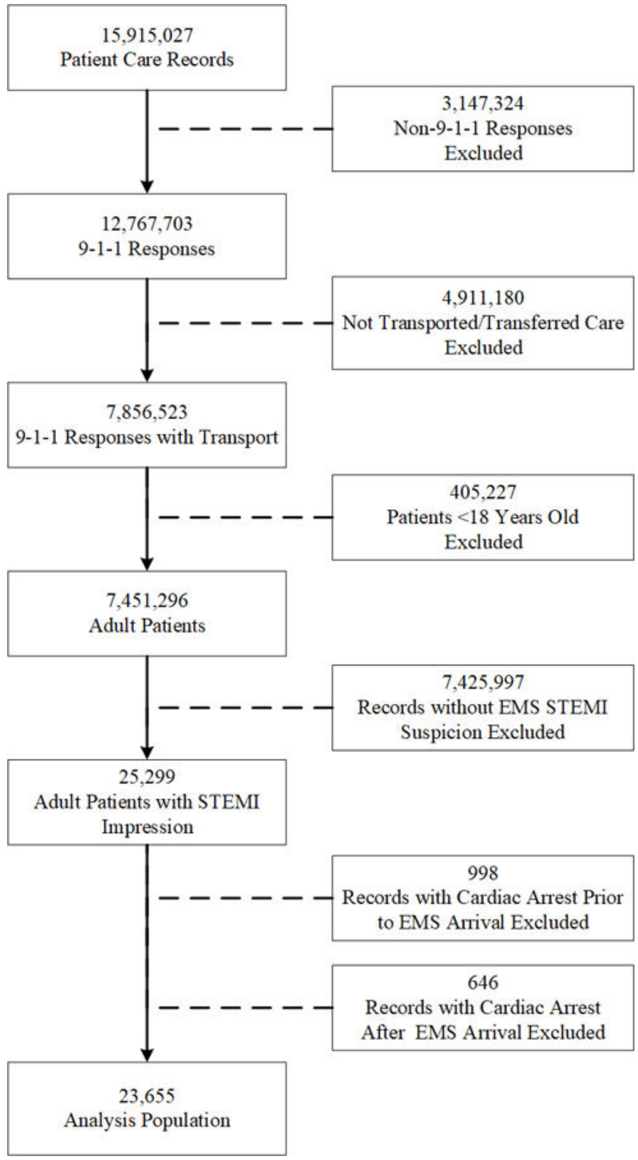

Figure 1.

Flow diagram of prehospital patient care records included for analysis.

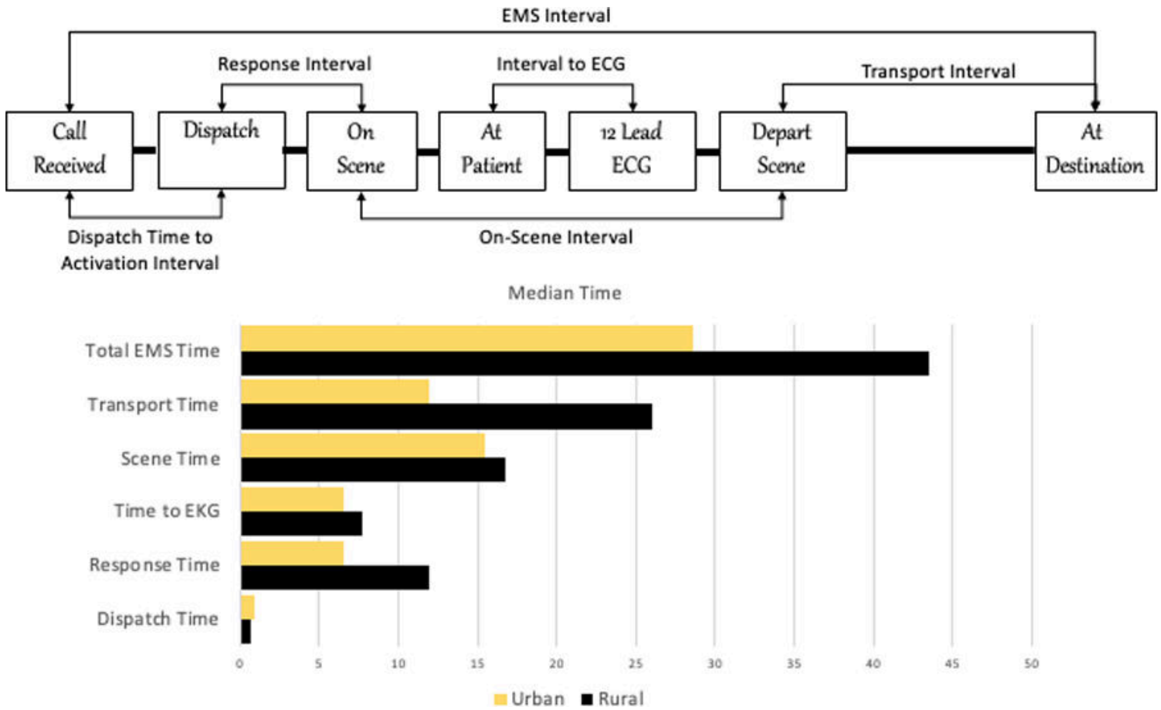

Figure 2.

EMS timeline and urban vs. rural median measured time segments.

Table 1.

Study Population Characteristics Stratified by Urban/Rural Responses

	Overall N=23,655	Urban 91.6% (21,661)	Rural 8.4% (1,994)	p-value
Age, years median (IQR)	65 (56–75)	65 (55–76)	66 (57–75)	0.08
Sex				0.65
Female	34.3% (8,062)	34.4% (7,391)	33.8% (671)	
Male	65.7% (15,440)	65.7% (14,128)	66.2% (1,312)	
Race/ethnicity				<0.01
White, non-Hispanic	76.5% (17,231)	75.3% (15,486)	89.8% (1,745)	
Black, non-Hispanic	16.0% (3,606)	16.8% (3,463)	7.4% (143)	
Hispanic	6.0% (1,347)	6.3% (1,305)	2.2% (42)	
Other	1.5% (336)	1.6% (322)	0.7% (14)	
First systolic blood pressure category				0.05
<90 mmHg	8.9% (2,089)	9.0% (1,937)	7.7% (152)	
90+ mmHg	91.1% (21,424)	91.0% (19,597)	92.3% (1,827)	
First pulse rate category				0.11
<60 bpm	13.3% (3,059)	13.1% (2,776)	14.6% (283)	
60–100 bpm	61.7% (14,245)	61.7% (13,044)	61.8% (1,201)	
>100 bpm	25.0% (5,779)	25.2% (5,320)	23.6% (459)	
First SpO_2 category				<0.01
<95%	24.5% (5,575)	24.1% (5,025)	28.0% (550)	
≥95%	75.5% (17,201)	75.9% (15,790)	72.0% (1,411)	
Pain scale documented				<0.01
Yes	81.4% (19,250)	80.7% (17,470)	89.3% (1,780)	
No	18.6% (4,405)	19.3% (4,191)	10.7% (214)	
Aspirin documented				<0.01
Yes	67.8% (16,468)	67.6% (15,027)	70.0% (1,441)	
No	32.2% (7,833)	32.4% (7,217)	30.0% (616)	
Vascular access attempted				<0.01
Yes	90.5% (21,415)	90.2% (19,537)	94.2% (1,878)	
No	9.5% (2,240)	9.8% (2,124)	5.8% (116)	
Loaded mileage (scene to destination)				<0.01
Median (IQR)	7.8 (3.9–16.9)	7.0 (3.7–14.5)	23.7 (15.3–34.0)	

Table 2.

Prehospital Intervals Stratified by Urban/Rural Response

	Urban N=21,661	Rural N=1,994	p-value
Total EMS interval, minutes (Call received to at destination)			
Median (IQR)	37.6 (30.0–48.0)	57.0 (46.5–70.7)	<0.01
EMS interval category			<0.01
<60 minutes - % (n)	89.5% (19,130)	55.5% (1,100)	
Activation interval, minutes (call received to dispatch)			
Median (IQR)	0.95 (0.32–1.80)	0.65 (0.00–1.70)	<0.01
Activation interval category			<0.01
<1 minute - % (n)	51.2% (10,897)	55.7% (1,102)	
Response Interval, minutes (Dispatch to on-scene)			
Median (IQR)	6.6 (4.6–9.4)	12.0 (7.4–17.8)	<0.01
Response interval category			<0.01
<8 minutes - % (n)	63.5% (13,742)	27.4% (546)	
Interval to First ECG, minutes (At patient to 12-lead ECG)			
Median (IQR)	6.6 (4.1–10.7)	7.7 (4.7–12.4)	<0.01
12-Lead ECG interval category			<0.01
<10 minutes - % (n)	71.7% (12,244)	63.2% (982)	
On-scene Interval, minutes (On-scene to depart scene)			
Median (IQR)	15.4 (11.7–20.0)	16.6 (12.0–22.0)	<0.01
On-scene interval category			<0.01
<15 minutes - % (n)	46.4% (10,054)	39.2% (781)	
Transport Interval, minutes (Depart scene to at destination)			
Median (IQR)	11.9 (7.5–19.0)	26.0 (17.8–35.4)	<0.01
Transport interval category			<0.01
<15 minutes - % (n)	63.0% (13,639)	17.5% (349)	
15–44 minutes - % (n)	35.2% (7,628)	71.3% (1,421)	
45+ minutes - % (n)	1.8% (390)	11.2% (224)	

Table 3.

Linear generalized estimating equation modeling for EMS interval

	Univariable Coefficient (95% CI)	Multivariable† Coefficient (95% CI)
Community type		
Urban	Referent	Referent
Rural	18.9 (16.7, 21.0) *	5.8 (4.2, 7.4) *
Age, 10-year increase	0.68 (0.39, 0.97) *	0.7 (0.5, 0.9) *
Sex		
Female	Referent	Referent
Male	−1.7 (−2.2, −1.2) *	−1.4 (−1.8, −1.0) *
Race/ethnicity		
White, non-Hispanic	Referent	Referent
Black, non-Hispanic	−1.4 (−3.7, 0.8)	3.0 (1.1, 4.9) *
Hispanic	−3.6 (−7.6, 0.4)	0.6 (−3.5, 4.7)
Other	−3.9 (−6.1, −1.6) *	−1.0 (−3.0, 0.9)
First systolic blood pressure category		
<90 mmHg	0.8 (−2.0, 0.5)	0.28 (−0.7, 1.3)
90+ mmHg	Referent	Referent
First pulse rate category		
<60 bpm	−1.2 (−2.4, 0.0)	−0.9 (−1.8, 0.5)
60–100 bpm	Referent	Referent
>100 bpm	0.85 (0.2, 1.5) *	1.2 (0.5, 1.9) *
First SpO_2 category		
<90%	0.4 (−0.6, 1.5)	0.4 (−0.5, 1.2)
≥90%	Referent	Referent
Loaded mileage, 10-mile increase	9.6 (8.9, 10.3) *	9.3 (8.5, 10.0) *
Pain scale assessed		
No	Referent	Referent
Yes	3.4 (1.9, 5.0) *	0.5 (−0.7, 1.7)
Aspirin documented		
No	Referent	Referent
Yes	−1.4 (−2.2, −0.5) *	−0.5 (−1.2, 0.2)
Vascular access attempted		
No	Referent	Referent
Yes	0.7 (−1.1, 2.6)	−0.1 (−1.7, 1.5)

* p<0.05

† Multivariable model included: community type, age, sex, race/ethnicity, first systolic blood pressure category, first pulse rate category, first SpO_2 category, loaded mileage, pain scale assessed, aspirin documented, and vascular access attempted.

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Table 4.

Logistic generalized estimating equation analysis of factors influence on EMS interval under 60 minutes.

	Univariable OR (95% CI)	Multivariable[†] OR (95% CI)
Community type		
Urban	Referent	Referent
Rural	0.14 (0.12–0.18) *	0.40 (0.33, 0.49) *
Age, 10-year increase	0.93 (0.90, 0.96) *	0.89 (0.86, 0.93) *
Sex		
Female	Referent	Referent
Male	1.17 (1.08, 1.26) *	1.25 (1.13, 1.38) *
Race/ethnicity		
White, non-Hispanic	Referent	Referent
Black, non-Hispanic	1.46 (1.14, 1.88) *	0.75 (0.60, 0.94) *
Hispanic	1.90 (1.25, 2.89) *	1.09 (0.58, 2.04)
Other	1.81 (1.26, 2.59) *	1.27 (0.69, 2.34)
First systolic blood pressure category		
<90 mmHg	1.00 (0.86, 1.15)	0.83 (0.69, 1.00)
90+ mmHg	Referent	Referent
First pulse rate category		
<60 bpm	1.01 (0.90, 1.14)	1.02 (0.87, 1.18)
60–100 bpm	Referent	Referent
>100 bpm	0.92 (0.84, 1.00)	0.86 (0.76, 0.97) *
First SpO_2 category		
<90%	0.91 (0.80, 1.04)	0.86 (0.73, 1.01)
≥90%	Referent	Referent
Loaded mileage, 10 mile increase	0.30 (0.26, 0.34) *	0.31 (0.27, 0.35) *
Pain scale assessed		
No	Referent	Referent
Yes	0.61 (0.50,0.75) *	0.95 (0.78,1.15)
Aspirin documented		
No	Referent	Referent
Yes	1.15 (1.03, 1.28) *	1.03 (0.90, 1.17)
Vascular access attempted		
No	Referent	Referent
Yes	0.91 (0.74,1.13)	1.09 (0.85, 1.40)

*p<0.05

†Multivariable model included: community type, age, sex, race/ethnicity, first systolic blood pressure category, first pulse rate category, first SpO_2 category, loaded mileage, pain scale assessed, aspirin documented, and vascular access attempted.