2020

TEXAS ST-ELEVATION MYOCARDIAL INFARCTION (STEMI) AND HEART ATTACK SYSTEM OF CARE REPORT

TEXAS Health and Human Services
Texas Department of State Health Services

Acknowledgement

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Contents

I. EXECUTIVE SUMMARY

The prevalence of heart attack in Texas has remained steady over the last few years, affecting about 4% of the adult resident population each year, from 2011 to 2018 (Table 1). In order to advance heart attack reduction efforts, it is important to analyze the system of care, specifically for ST-Elevation Myocardial Infarction (STEMI), by collecting and analyzing data. During the 83rd Regular Texas Legislative Session, funds were appropriated to advance heart attack and stroke reduction efforts throughout Texas. To inform such efforts, the Texas Department of State Health Services (DSHS) has launched a Heart Attack and Stroke Data Collection Initiative.

Utilizing the time to treatment goals for primary percutaneous coronary intervention (PCI) and standards of care, percentages and medians were calculated using data collected from a group of hospitals that agreed to voluntarily participate in this data collection initiative. The data were collected by the Chest Pain MI Registry (formerly the ACTION Registry), a program of the American College of Cardiology in partnership with the American Heart Association and other societies, from September 1, 2008 through December 31, 2019. Currently, 134 PCI-capable hospitals are participating in the Chest Pain MI Registry in Texas. In 2016-2019, when the highest number of hospitals were reporting for each measure, at most 43 out of these 134 PCI-capable hospitals were included (32.1%).

Substantial findings from the 2008-2019 Chest Pain MI Registry data are as follows:

- 43 hospitals, distributed across 30 cities in Texas, provided data on individual episodes of care for heart attack. Most participating hospitals were located in urban or suburban communities; only seven were located in rural communities (pgs. 13).
- 69,502 individual episodes of care for heart attack occurred among 68,736 patients at participating hospitals (pg. 13).
- Of the 69,502 episodes of care for heart attack that occurred:
    - 61.3% involved patients who either transported themselves or were transported by family to the hospital where they were first evaluated (pg. 13);
    - 37.7% arrived to the hospital by an ambulance (pg. 13);
        - More females (40.9%) than males (36.1%) were transported via ambulance (pg. 13);
        - More males (65.8%) than females (59.3%) received an electrocardiogram (ECG) prior to hospital arrival (pg. 13); and
        - Fewer White or Hispanic cases arrived by ambulance as compared with Black cases (36.5%, 33.3%, and 44.7%, respectively) (pg. 14);
    - 29.0% involved care for STEMI (pg. 12).
- The median length of hospital stay each year between 2008 and 2019 was three days. The mean length of hospital stay in 2019 was three days (pg. 13).
- Among patients who arrived by an ambulance between 2008 and 2019, only 63.0% had a pre-hospital electrocardiogram (ECG) performed. In 2019, among those who had pre-hospital ECG performed, 74.5% had their pre-hospital ECG performed within 10 minutes of first medical contact (pgs. 17-22)

- Between October 2008 and December 2019, the median time spent awaiting transfer from the STEMI referral hospital to the STEMI receiving hospital for PCI was 49 minutes for those who arrived by personal vehicle and 41 minutes for those who arrived by ambulance (pg. 23).
- Among directly-admitted STEMI cases, the annual median dwell time in the Emergency Department (ED) was, on average, 10-15 minutes longer for those arriving via personal vehicle than via ambulance (pg. 26).
- From 2011 to 2019, the median time from arrival at the referral hospital to primary PCI among STEMI transfer cases transported via private vehicle has increased by four minutes (99 minutes to 103 minutes). Among STEMI transfer cases transported via ambulance, the median time increased by 49 minutes over the same time period, from 70 minutes to 119 minutes (pgs. 28-32).
- In 2019, the median time from first medical contact to balloon was 82 minutes for directly-admitted cases and 138 minutes for transfer cases (pg. 34-35).
- Total ischemic time among STEMI transfer cases was calculated for 2011-2019:
    - Among those who arrived by ambulance at the first hospital, 17.3% had a total ischemic time of less than 120 minutes, while among those who arrived at the first hospital by personal vehicle, 11.6% had a total ischemic time of less than 120 minutes (pg. 36).
    - Among directly-admitted cases arriving by ambulance in 2019, 37.1% had a total ischemic time of less than 120 minutes, as compared with 21.9% who arrived by personal vehicle (pg. 39).
- In 2019, among 209 STEMI transfer cases who arrived at the first hospital either by a personal vehicle or by an ambulance, the catheterization lab was activated prior to arrival for 74.2% of cases (pg. 40).
- In 2019, among 550 directly-admitted STEMI cases who arrived at the hospital by ambulance, pre-catheterization lab activation occurred for 52.0% of cases (pg. 41-42).
- Between 2008 and 2019, the percentage of comorbidities among Myocardial Infarction (MI) cases was evaluated. Of the 69,502 MI cases having information on comorbidities, 78.0% were hypertensive, 59.2% were dyslipidemic, 42.0% were obese, 40.6% were diabetic, and 32.4% were current or recent smokers (pg. 45).
- Of 69,502 MI cases reported between 2008 and 2019, 95.0% were prescribed aspirin within the first 24 hours of either first medical contact or hospital arrival, 3.0% were not prescribed aspirin, and 2.0% had contraindications to aspirin use (pg. 50).
- Of 66,685 cases of MI alive upon discharge between 2008 and 2019, beta-blockers were prescribed for 82.2% at discharge, not prescribed for 4.8%, contraindicated for 5.5%, and data were missing for 7.5% of cases (pg. 52).
- Between 2008 and 2019, the unadjusted in-hospital mortality rates in STEMI patients ranged from as low as 5.2% in 2008 to as high as 7.4% in 2013; mortality rates for STEMI patients are consistently double those of non-STEMI patients (pg. 55).

II. INTRODUCTION

When blood flow through the heart's arteries is blocked, the heart is starved of oxygen and heart cells die. This is called a myocardial infarction (MI) or heart attack. [1] A STEMI is a serious type of heart attack that occurs when a heart's artery is completely blocked and a large part of the heart muscle is unable to receive blood. [1] This type of heart attack requires immediate treatment to restore blood flow to the heart.

III. BACKGROUND

In order to advance heart attack reduction efforts, it is important to analyze the system of care, specifically for STEMI, by collecting and analyzing data. During the 83rd Regular Texas Legislative Session, funds were appropriated to advance heart attack and stroke reduction efforts throughout Texas. To inform such efforts, the Texas Department of State Health Services (DSHS) has launched a Heart Attack and Stroke Data Collection Initiative. Through this initiative, hospitals are recruited to voluntarily share their data that focuses on pre-hospital and hospital data elements. This report includes de-identified, aggregate data for hospitals that have agreed to share Chest Pain MI Registry (formerly the ACTION Registry) data with DSHS. All data are intended to inform stakeholders about opportunities for collaboration and system enhancement. No hospital level data will be distributed, nor will any hospital name be identified in the report.

The objectives of the data collection are to gain an understanding of the prevalence of heart attack in Texas, to evaluate pre-hospital components of the systems of care, and assess treatment of heart attack patients. The findings will be used to assess policies and practices regarding delivery of care across the state and to identify areas of opportunity for quality improvement.

IV. HEART ATTACK IN TEXAS

The prevalence of heart attack in Texas has remained steady over the last few years, affecting about four in 100 adult residents each year from 2011 to 2018 (Table 1). In 2018, the prevalence of heart attack was significantly higher among non-Hispanic Black (5.7%; 95% CI: 3.3-9.7) and White (5.4%; 95% CI 4.3-6.7) adults as compared to Hispanic adults (1.9%; 95% CI: 1.4-2.8).

Table 1. Estimated number and percentage of adults in Texas, ages 18 years and older, who report ever having had a heart attack, by race/ethnicity, 2011-2018

	Estimated Cases		Race/Ethnicity % (95% CI)			
Year	(N)	% (95% CI)	White Only	Black Only	Hispanic	Other / Multiracial
2011	740,234	4.1 (3.6-4.5)	4.6 (4.0-5.2)	4.6 (2.4-6.7)	2.9 (2.2-3.7)	4.2 (2.1-6.2)
2012	718,735	3.8 (3.3-4.2)	4.3 (3.7-4.9)	4.3 (2.7-5.9)	2.4 (1.7-3.1)	4.9 (2.3-7.5)
2013	763,932	3.9 (3.4-4.5)	4.4 (3.7-5.2)	6.2 (3.9-8.5)	2.6 (1.9-3.3)	--
2014	729,812	3.7 (3.2-4.1)	4.7 (4.1-5.4)	4.1 (2.2-6.0)	2.4 (1.8-3.0)	--
2015	862,314	4.3 (3.7-4.8)	5.0 (4.2-5.9)	5.3 (2.8-7.9)	2.9 (2.2-3.7)	--
2016	741,515	3.6 (3.0-4.2)	4.9 (4.0-5.8)	--	1.9 (1.2-2.6)	--
2017	814,543	3.9 (3.2-4.6)	5.4 (4.3-6.7)	5.7 (3.3-9.7)	1.9 (1.4-2.8)	--
2018	1,054,523	4.9 (4.1-5.9)	5.4 (4.4-6.7)	4.5 (2.6-8.0)	4.5 (3.0-6.7)	--

Abbreviations: CI, confidence interval.
-- indicates data are not reportable due to small sample size.

However, using MI hospitalization rates as an approximation of the incidence of disease, the overall rate of MI has decreased since 2008, from 17.6 per 10,000, to 15.0 per 10,000 in 2018, with a similar trend among White and Black MI cases (Table 2). Hospital discharge rates among Hispanics have fluctuated over time but have increased annually since 2015. The MI hospitalization rate among Hispanics was significantly lower as compared to other race/ethnic groups, each year through 2016. In 2017, however, the Hispanic rate was significantly higher than for Whites and Blacks and remained higher in 2018. MI hospitalization rate for "other" race has fluctuated over the years, reaching a peak in 2012.

Table 2. Annual age-adjusted hospitalization rate (per 10,000) for heart attack among persons of all ages in Texas, by race/ethnicity, 2008-2018

			Race/Ethnicity % (95% CI)			
Year	N	Age-adjusted Rate (95% CI)	White	Black	Hispanic	Other
2008	36,983	17.6 (17.4-17.8)	18.0 (17.8-18.2)	17.8 (17.2-18.4)	14.7 (14.3-15.0)	35.0 (33.7-36.4)
2009	34,606	16.1 (15.9-16.2)	16.4 (16.2-16.6)	16.3 (15.8-16.9)	13.4 (13.1-13.8)	28.7 (27.6-29.9)
2010	35,675	16.0 (15.8-16.1)	16.0 (15.8-16.2)	16.2 (15.7-16.8)	14.2 (13.9-14.5)	30.7 (29.4-31.9)
2011	35,878	15.5 (15.4-15.7)	15.9 (15.7-16.1)	16.1 (15.6-16.7)	13.0 (12.7-13.3)	25.9 (24.9-27.0)
2012	37,911	15.9 (15.7-16.0)	15.1 (14.9-15.9)	15.4 (14.9-15.9)	13.9 (13.6-14.2)	40.1 (38.9-41.4)
2013	37,287	15.2 (15.0-15.3)	15.1 (14.9-15.3)	15.4 (14.9-15.9)	13.5 (13.2-13.8)	25.6 (24.7-26.6)
2014	38,304	14.7 (14.6-14.9)	14.6 (14.4-14.7)	15.0 (14.6-15.5)	13.5 (13.2-13.8)	25.6 (24.6-26.5)
2015	41,901	15.6 (15.4-15.7)	15.6 (15.4-15.8)	16.1 (15.6-16.6)	14.8 (14.5-15.1)	21.6 (20.8-22.5)
2016	44,005	15.8 (15.6-15.9)	15.5 (15.3-15.7)	15.9 (15.5-16.4)	15.1 (14.8-15.4)	25.7 (24.8-26.6)
2017	44,898	15.6 (15.4-15.7)	14.9 (14.7-15.0)	14.8 (14.3-15.2)	16.6 (16.3-16.9)	24.2 (23.3-25.0)
2018	44,706	15.0 (14.9-15.2)	13.8 (13.6-14.0)	12.7 (12.3-13.1)	17.5 (17.2-17.8)	23.2 (22.5-24.1)

Abbreviations: CI = confidence interval.

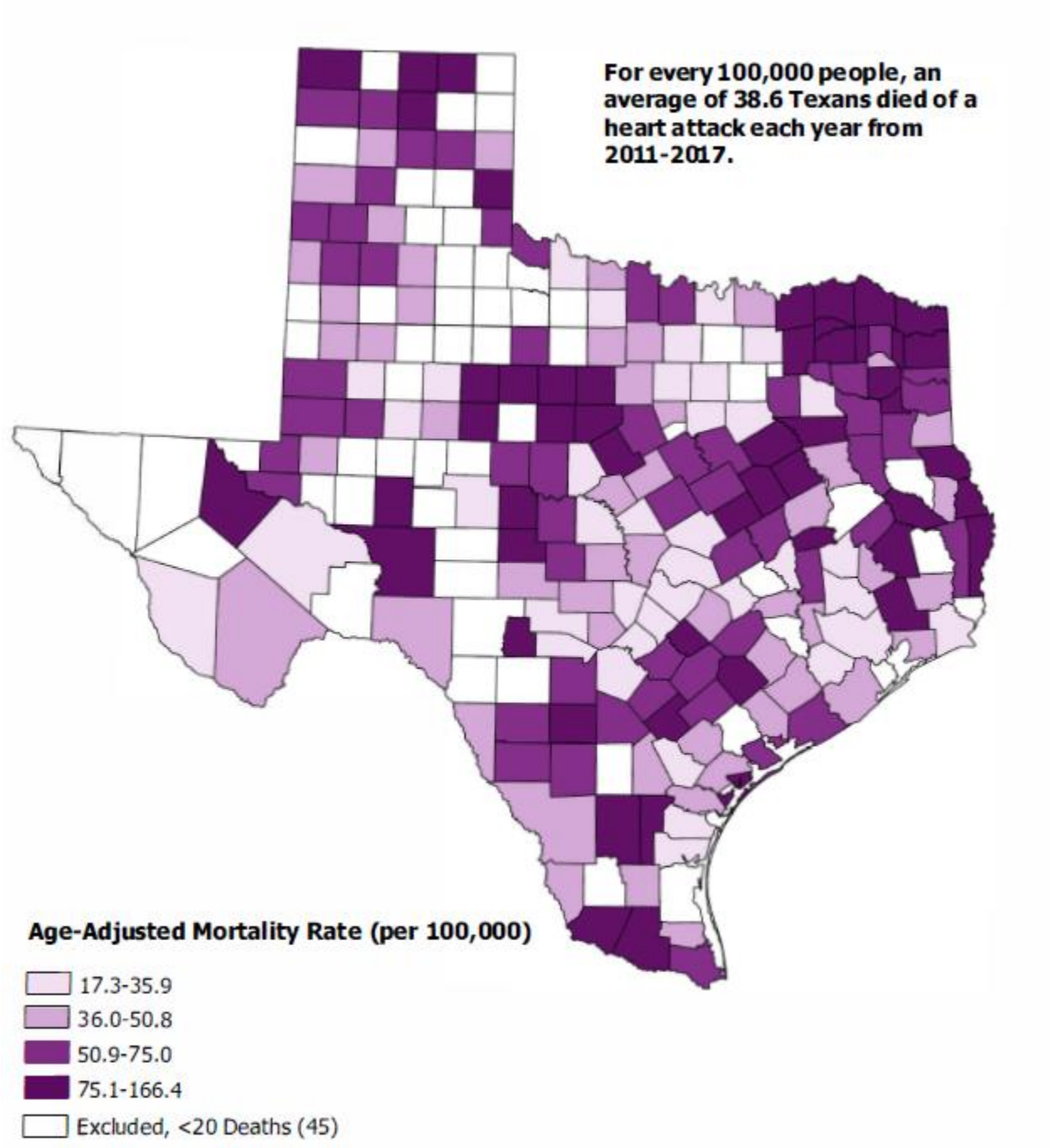

Figure 1. Age-adjusted average annual number of deaths due to heart attack, per 100,000 people of all ages, by county, Texas, 2011-2017

In 2017, the age-adjusted heart attack mortality rate in Texas was 36.5 per 100,000 (95% CI: 35.8-37.2). Mortality rates were significantly higher among Blacks (39.7; 95% CI: 37.3-42.1) and Whites (38.3; 95% CI: 37.4-39.3) compared with Texas overall, while rates for Hispanics (34.0; 95% CI: 32.6-35.4) and "Other" (21.4; 95% CI: 18.9-23.9) were significantly lower than for Texas overall. Looking at the geographic distribution of age-adjusted MI death rates over time (2011-2017), the highest rates are dispersed across the state, with a higher concentration in counties located in east and northeast Texas (Figure 1)

V. EVALUATING HOSPITAL CARE FOR HEART ATTACK IN TEXAS

Percutaneous coronary intervention, PCI, is the preferred reperfusion strategy for STEMI patients. There are approximately 146 PCI-capable hospitals in Texas with a catheterization lab ready to perform PCI, 24 hours a day, 7 days a week. [2] These are often called "STEMI receiving hospitals." Hospitals that do not have this capability are often referred to as "STEMI referral hospitals"; STEMI patients who initially present at these hospitals must be transferred to a PCI-capable, STEMI receiving hospital. STEMI patients who first present to a STEMI receiving hospital are referred to as directly-admitted patients in this report, and STEMI patients who first report to a STEMI referral hospital and are then transferred to a STEMI receiving hospital are referred to as transfer patients. Figure 2 illustrates the time to treatment goals for primary PCI for directly-admitted and for STEMI transfer patients. [3]

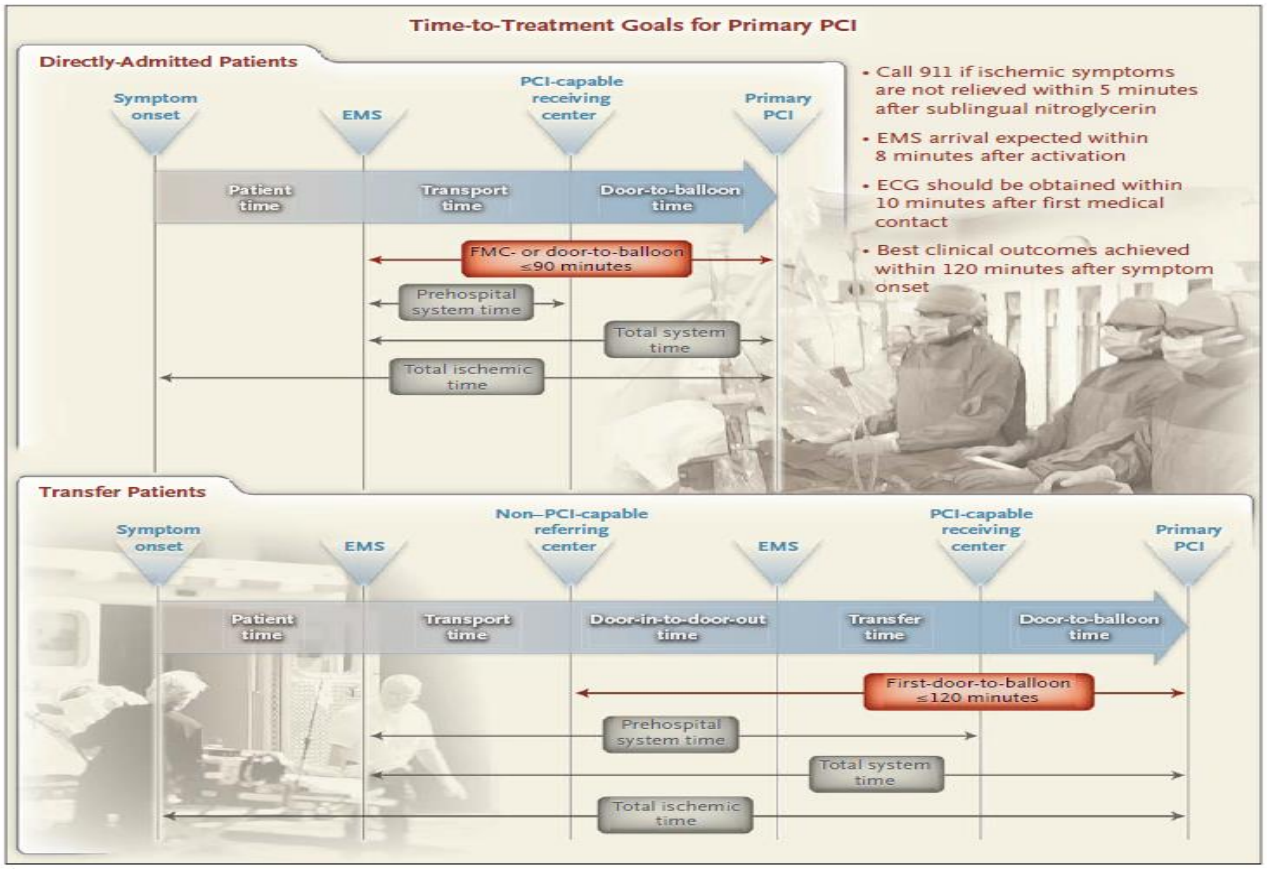

Figure 2. Time to treatment goals for primary PCI [3]

Utilizing the time to treatment goals for primary PCI and standards of care, percentages and medians were calculated using data collected from a group of hospitals that volunteered to participate in this data collection initiative. The data were collected by the Chest Pain MI Registry from September 1, 2008 through December 31, 2019. Currently 134 PCI-capable hospitals are participating in the Chest Pain MI Registry. At the most (2016-2019), 43 out

of these 134 PCI-capable hospitals (32.1%) provided information included in this report. General findings from this report are as follows:

- 43 participating hospitals between years 2008 and 2019, distributed across 30 cities in Texas, provided data on individual episodes of care for heart attack.
- The majority (n=36; 86.0%) of participating hospitals were located in urban or suburban communities; only seven participating hospitals (16.3%) were located in rural communities.
- 69,502 individual episodes of care for heart attack occurred among 68,736 patients at participating hospitals.
- Of the 69,502 episodes of care for heart attack that occurred:
    - 61.3% involved cases who either transported themselves or were transported by family to the hospital where they were first evaluated;
    - 29.0% (n=19,885) involved care for STEMI;
    - 86.4% had health insurance;
    - 96.0% were alive at discharge.

Table 3 shows the number of participating hospitals and the number of reported MI cases from 2008 to 2019. The number of participating hospitals ranged from as few as 1 in 2008 to a high of 43 in 2016-2019. The number of reported heart attack cases has increased from a low of 112 in 2008 to a high of 9,429 in 2019.

Table 3. Participating hospitals and number of reported myocardial infarction (MI) cases, 2008-2019

Year	Participating Hospitals (N)	Reported MI Cases (N)
2008	1	112
2009	6	807
2010	19	2887
2011	23	4482
2012	30	5656
2013	32	6231
2014	38	7033
2015	41	7609
2016	43	8525
2017	43	8271
2018	43	8460
2019	43	9429

Table 4 displays the distribution of reported MI cases by subtype (STEMI vs non-STEMI). From 2008-2019, STEMI cases accounted for 29 in every 100 reported MI cases (29.0%). Among MI cases, indicator of STEMI versus non-STEMI status was missing for 140 cases.

Table 4. Distribution of reported MI cases, by subtype, 2008-2019

Heart Attack Type	N= 69,362	%
STEMI	19,885	29.0
Non-STEMI	49,477	71.0

Table 5 shows the demographic characteristics of the 69,502 MI cases reported between 2008 and 2019. Median age of all MI cases was 63 years. Almost two-thirds of the cases (64.3%) in the database were male (n=44,683)

Table 5. Demographic characteristics of heart attack cases in Texas, 2008-2019

Characteristics	N (%)
Age (years)	
Median (Interquartile Range)	63 (18)
Gender	
Male	44,683 (64.3)
Female	24,819 (35.7)
Race	
White	57,280 (82.4)
Black	9,350 (13.5)
Asian	1,858 (2.7)
American Indian	453 (0.7)
Native Hawaiian / Pacific Islander	300 (0.4)
Missing	261 (0.4)
Ethnicity	
Hispanic	17,028 (24.5)
Non-Hispanic	52,223 (75.1)
Missing	251 (0.3)
Health Insurance Status	
Health insurance	60,054 (86.4)
No health insurance	9,448 (13.6)

Table 6 shows the number of hospitals and MI cases by urban vs. rural setting. With almost 84% of participating hospitals being in an urban setting, it is not surprising that most of the reported heart attack and STEMI cases were in the urban areas.

Table 6. Number of hospitals and MI cases, urban vs rural settings, 2008-2019

Hospital setting	Reporting hospitals N	Overall MI cases		STEMI cases	
		N	%	N	%
Urban	36	59,806	86.0	17,127	86.1
Rural	7	9,696	14.0	2,758	13.9
Total	43	69,502	100.0	19,885	100.0

Table 7 shows the number of heart attack cases by hospitals' patient bed capacity, by setting (urban vs. rural). Almost half of MI cases (n=32,475) were admitted to hospitals with patient beds '100-349'. Hospitals having 350 or more patient beds were found only in urban regions.

Table 7. Number of MI cases by hospital beds, by setting (urban, rural), 2008-2019

Hospital beds	Overall MI cases (n)	STEMI cases (n)	Reporting Hospitals (n)
< 100	9,848	3,278	7 (6 urban, 1 rural)
100 -349	31,865	8,750	22 (16 urban, 6 rural)
350 -699	24,488	6,790	13 (urban)
≥ 700	3,301	1,067	1 (urban)
Total	69,502	19,885	43

The median length of hospital stay (LOS) was 3 days, each year, between 2008 and 2014. The mean LOS was 3 days, each year, between 2015 and 2019.

Arrival Method

According to the 2013 Texas Behavioral Risk Factor Surveillance System (BRFSS) survey, an estimated 86.9% of adults in Texas said they would call 911 if they thought someone was having a heart attack or stroke. The remaining 13.1% of adults said they would take other action such as taking the person to the hospital, telling them to call their doctor, call their spouse or family member, or do something else**.**

However, per the Chest Pain MI Registry data, 61.3% of heart attack patients transported themselves, or were transported by family/friend, via private vehicle, to the hospital, while 37.7% were transported by an ambulance. Among those who were transported by ambulance, only 63.3% had a pre-hospital ECG performed.

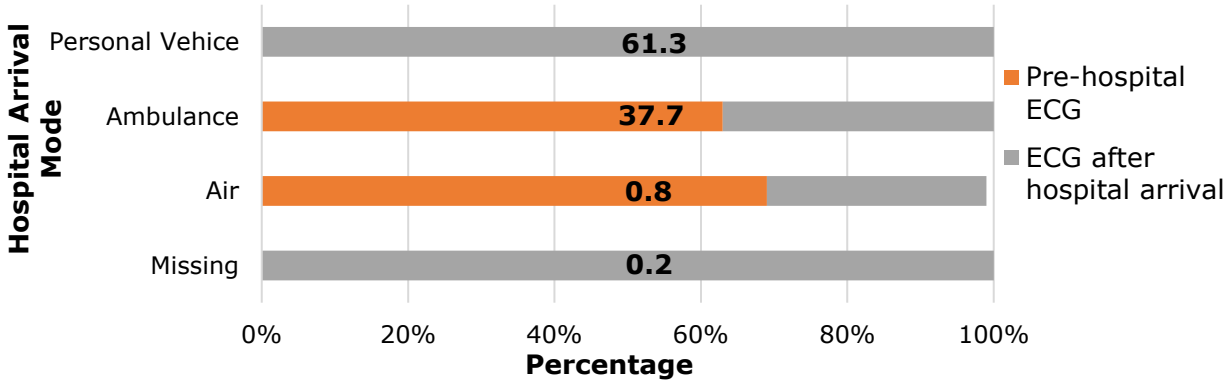

Figure 3. Modes of hospital arrival among all MI cases, and percentage of cases receiving an ECG before vs. after hospital arrival, 2008-2019. Bars sum to 100%.

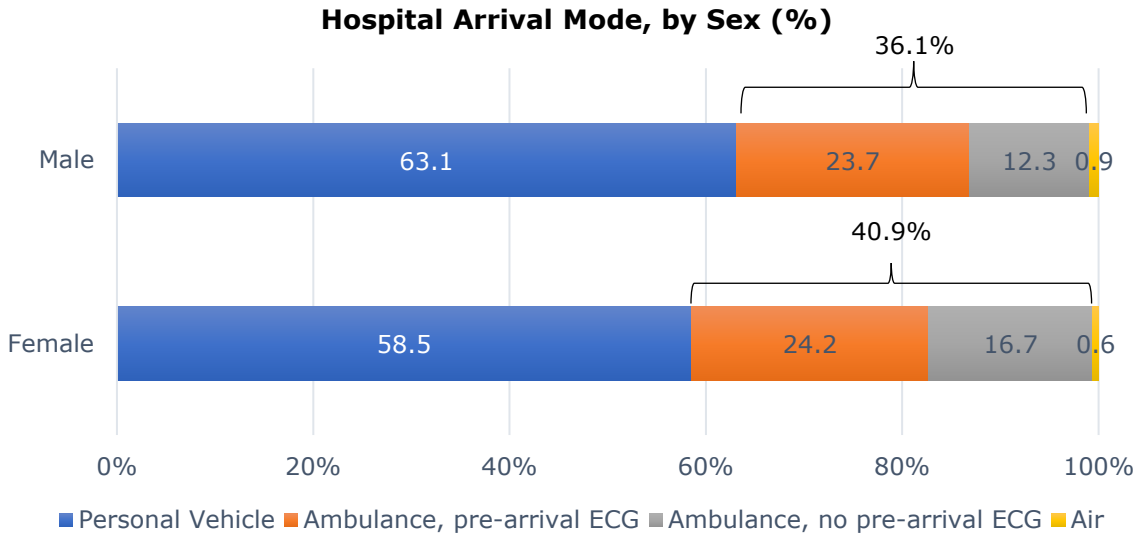

Figure 4. Modes of hospital arrival among heart attack cases, by sex, and among those transported by ambulance, percentage of cases receiving an ECG before vs. after hospital arrival, 2008-2019. Percentages for each bar total 100%.

Of the 44,431 male heart attack cases reported, 63 in 100 (63.1%) were transported to the hospital by personal vehicle. Almost four in 10 male heart attack cases (36.1%) arrived by ambulance, with 65.8% having an ECG performed prior to hospital arrival.

Of the 24,650 female heart attack cases reported, 59 in 100 (58.5%) were transported by personal vehicle. Roughly four in ten female heart attack cases (40.9%) arrived by ambulance. While this was similar to the percentage of male cases transported by ambulance, fewer females (59.3%) had an ECG performed prior to hospital arrival.

Hospital transport by air was uncommon for either gender (0.6% female, .9% male). Mode of hospital transport was missing for 0.2% of male or female cases.

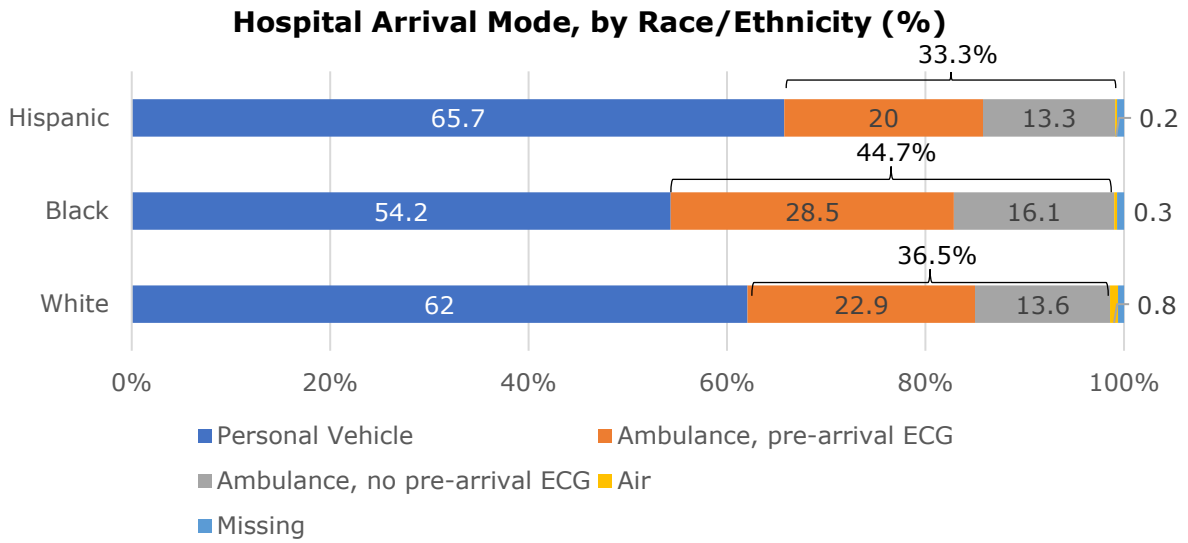

Figure 5. Modes of hospital arrival among heart attack cases, by race/ethnicity, and among those transported by ambulance, percentage of cases receiving an ECG before vs. after hospital arrival, 2008-2019. Percentages for each bar total 100%.

When comparing modes of hospital arrival among heart attack cases by race/ethnicity, over half of all cases arrived by private vehicle (62.0% White only, 54.2% Black only, and 65.7% Hispanic). Fewer White or Hispanic cases arrived by ambulance as compared with Black cases (36.5%, 33.3%, and 44.7%, respectively). Heart attack cases transported by ambulance who received a pre-hospital arrival ECG were overall similar: 62.8% of White, 63.9% of Black, and 60.0% of Hispanic cases. Mode of hospital transport was missing for 0.6% of White, 0.7% of Hispanic cases and 0.8% of Black cases.

The graphs and tables that follow display either numbers (N) and percentages (%) or median values for specific measures of effective care for heart attack. When presenting data by mode of hospital arrival, data with more than 100 cases reported for each mode of hospital arrival are displayed by year, using ten full years of data, from the first quarter of 2009 through the fourth quarter of 2019 (January 2009-December 2019). For measures with less than 100 cases reported for each mode of hospital arrival, the data are cumulative, using all available data from the fourth quarter of 2008 through the fourth quarter of 2019 (October 2008-December 2019). Data may also be stratified by patient type, that is, whether the patient was transferred in from another hospital (STEMI referral) or presented directly to a PCI-capable hospital (STEMI receiving). The measures include:

1. Pre-hospital ECG within 10 minutes of first medical contact
2. Time from first hospital arrival to first ECG
3. First ECG within 10 minutes of first hospital arrival
4. Dwell time in the emergency department (ED)
    a. Dwell time in the ED of referral hospital

    b. Dwell time in the ED of receiving hospital
5. First door-to-needle time for transfer patients
6. Door-to-needle time within 30 minutes for transfer patients
7. Door-to-balloon time for directly-admitted patients
    a. Median time from hospital arrival to primary PCI (in minutes)
    b. Primary PCI within 90 minutes of hospital arrival
8. First door-to-balloon time for transfer patients
    a. Median time from first hospital arrival to primary PCI (in minutes)
    b. Primary PCI within 120 minutes of arrival to first hospital
    c. Primary PCI within 90 minutes of arrival to first hospital
9. Median time from first medical contact to balloon time
10. Total ischemic time for STEMI transfer patients
11. Total ischemic time for STEMI directly-admitted patients
12. Activation of catheterization lab prior to arrival among transfer patients
13. Activation of catheterization lab prior to arrival among directly-admitted patients
14. Referral to rehabilitation
15. Percentage of comorbidities among all MI patients
16. Smoking cessation advice at discharge
17. Medications administered within first 24 hours
18. Medications prescribed at discharge

Additional information, including data sources, inclusion criteria, and exclusion criteria, can be found in the Appendix.

PRE-HOSPITAL ECG WITHIN 10 MINUTES OF FIRST MEDICAL CONTACT, ALL MI CASES

The ability to diagnose a STEMI early is an initial, and perhaps most important, step that impacts MI survival. An Emergency Medical Services (EMS) unit equipped with 12-lead equipment (i.e., 12-lead ECG capability) can identify a STEMI patient and communicate with the receiving hospital, leading to activation of the catheterization lab and a more efficient system of care. In an optimal system of care, a pre-hospital ECG will allow an MI patient to bypass the emergency department (ED) and advance directly to treatment in the catheterization lab. The sooner EMS staff can perform an ECG and accurately interpret the findings, the timelier the communication of results to the receiving hospital, and the more time the receiving hospital has to prepare for the incoming patient.

Figure 6 and Table 8, below, display the percentage of eligible episodes of care for heart attack in which patients received their first ECG within 10 minutes of first medical contact. The cases included in this measure arrived at the hospital by an ambulance equipped to perform pre-hospital ECGs.

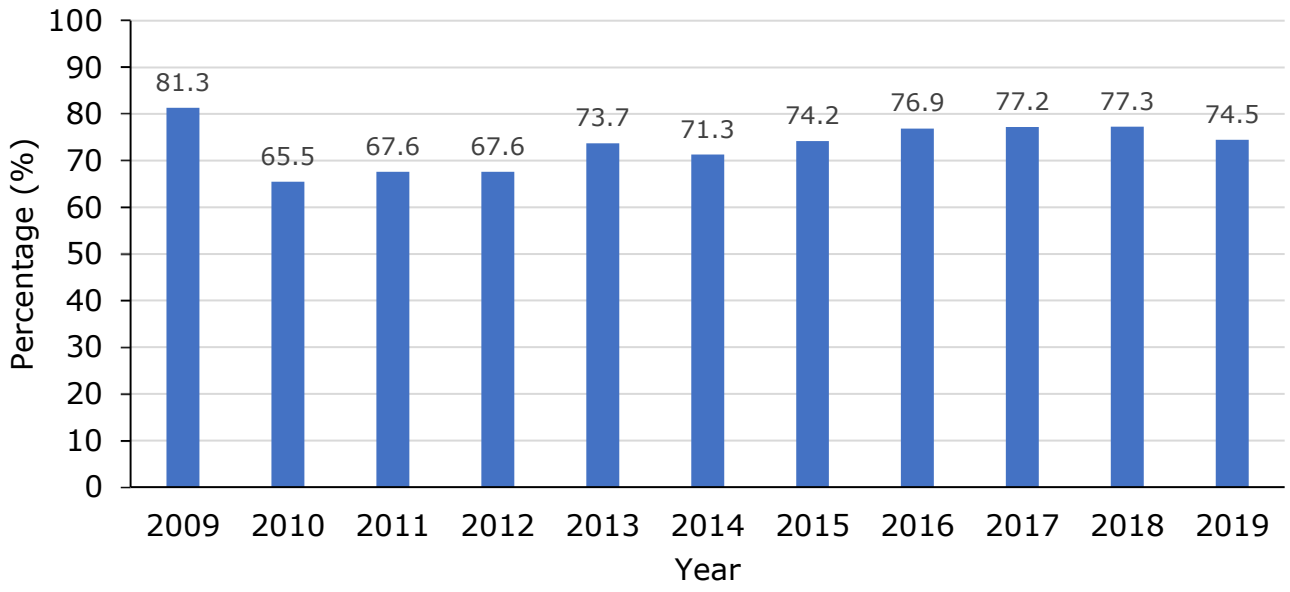

Figure 6. Pre-Hospital ECG within 10 minutes of first medical contact among all heart attack cases arriving by ambulance, by year, 2009-2019

Table 8. Pre-hospital ECG within 10 minutes of first medical contact among all heart attack cases arriving by ambulance, by year, 2009-2019

	Cases with pre-hospital ECG	Cases with pre-hospital ECG within 10 minutes of first medical contact		Reporting hospitals
Year	(n)	(n)	%	(n)
2009	139	113	81.3	6
2010	414	271	65.5	19
2011	855	578	67.6	23
2012	1,162	796	68.5	30
2013	1,328	979	73.7	32
2014	1,601	1,142	71.3	38
2015	1,814	1,346	74.2	41
2016	2,228	1,713	76.9	43
2017	2,093	1,615	77.2	43
2018	2,334	1,803	77.3	43
2019	1,726	1,285	74.5	43

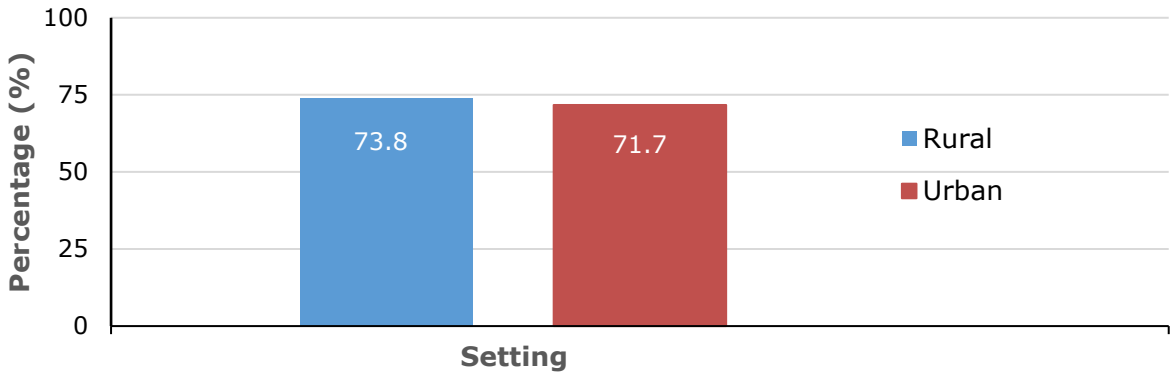

Figure 7. Pre-Hospital ECG within 10 minutes of first medical contact among all MI cases who arrived by ambulance and had a pre-hospital ECG performed, by urban / rural setting, 2008–2019

In 2019, 3 out of 4 MI cases who received a pre-hospital ECG had their ECG done within 10 minutes of first medical contact. The percentage of cases receiving their ECG within 10 minutes of first medical contact was slightly higher for those in rural vs. urban settings (73.8 vs. 71.7%, respectively).

There is an opportunity to increase the percentage of patients with pre-hospital ECG. In order to improve EMS performance in this measure, it is important to first consider ECG capability among the responding EMS units. Possessing the equipment to perform an ECG, and transmit the results, greatly affects the timeliness of care for MI patients. For ambulances having 12-lead equipment, implementation of a standard EMS protocol for care of suspected MI patients should include performance of an ECG within 10 minutes of first medical contact.

TIME FROM HOSPITAL ARRIVAL TO FIRST ECG AMONG TRANSFER CASES

Performing an ECG is the first step in heart attack care within the hospital, and not having one performed in a timely manner can have a detrimental effect on the patient's outcome. The national standard for hospital ECG performance time is within 10 minutes of hospital arrival. [4] Rapid ECG performance and interpretation can lead to reduced dwell time in the ED for a heart attack patient, and to timely activation of the catheterization lab.

Figure 8 and Table 9, below, display the median time (in minutes) elapsed from hospital arrival to performance of first ECG among transfer cases with eligible episodes of care for heart attack, by mode of arrival to the first hospital, by year. Episodes of care in which a patient received an ECG prior to arriving at the hospital were excluded.

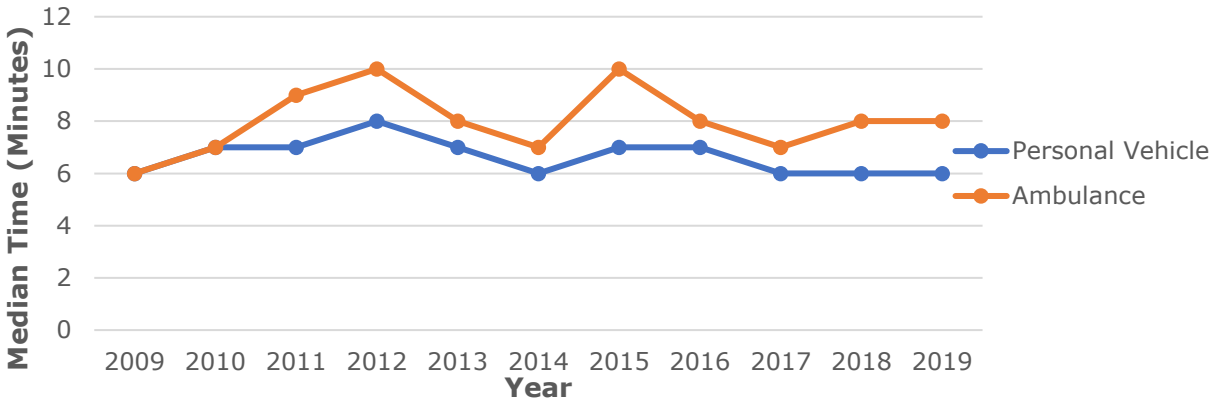

Figure 8. Median time (minutes) from first hospital arrival to first ECG among transfer cases, by mode of arrival to first hospital, by year, 2009-2019

Table 9. Median time (minutes) from first hospital arrival to first ECG among transfer cases, by mode of arrival to first hospital, by year, 2009-2019

	Mode of arrival to STEMI referral hospital				
	Personal vehicle		Ambulance		
Year	Cases with ECG (n)	Minutes (Median)	Cases with ECG (n)	Minutes (Median)	Reporting hospitals (n)
2009	271	6	78	6	6
2010	535	7	174	7	15
2011	768	7	213	9	21
2012	911	8	205	10	27
2013	1,094	7	220	8	30
2014	1,067	6	188	7	36
2015	1,362	7	198	10	39
2016	1,391	7	188	8	40
2017	1,328	6	161	7	40
2018	1,250	6	165	8	41
2019	1,225	6	160	8	41

The median time to first ECG for transferred cases who arrived by personal vehicle to the hospital ranged from a low of six minutes in 2009, 2014, 2017-2019 to a high of eight minutes in 2012. The median time for those who arrived by ambulance ranged from a low of six minutes in 2009 to a high of 10 minutes in 2012 and 2015. Each year since 2011, the median time from first hospital arrival to first ECG was roughly 1-3 minutes longer for those arriving by ambulance than by personal vehicle.

TIME FROM HOSPITAL ARRIVAL TO FIRST ECG AMONG DIRECTLY-ADMITTED CASES

Figure 9 and Table 10, below, display the median time (in minutes) elapsed from hospital arrival to performance of first ECG among directly-admitted cases with eligible episodes of care for heart attack, by mode of arrival to the hospital, by year. Episodes of care in which a patient received an ECG prior to arriving at the hospital were excluded.

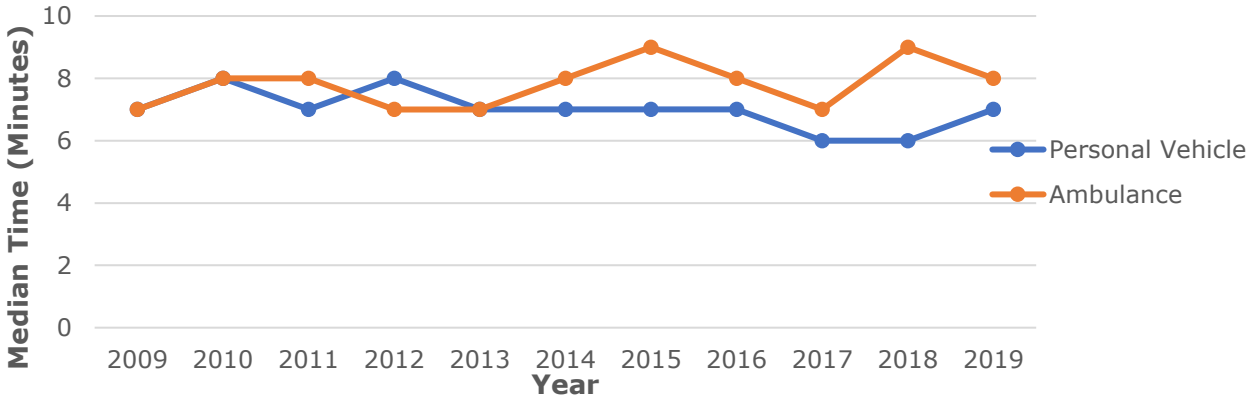

Figure 9. Median time from first hospital arrival to first ECG among directly-admitted cases, by mode of arrival to hospital, by year, 2009-2019

Table 10. Median time from hospital arrival to first ECG among directly-admitted cases, by mode of arrival to hospital, by year, 2009-2019

	Mode of arrival to first hospital				
	Personal vehicle		Ambulance		
Year	Cases with ECG (n)	Minutes (Median)	Cases with ECG (n)	Minutes (Median)	Reporting hospitals (n)
2009	205	7	85	7	6
2010	1,023	8	479	8	19
2011	1,731	8	689	8	23
2012	2,321	7	840	7	30
2013	2,504	7	1,017	7	32
2014	3,089	7	917	8	38
2015	3,263	7	768	9	41
2016	3,733	7	665	8	43
2017	3,709	6	649	7	43
2018	3,830	6	479	9	43
2019	4,709	7	952	8	43

The median time to first ECG for directly-admitted cases who arrived by personal vehicle to the hospital ranged from a low of six minutes (2016 through 2018) to a high of seven minutes all other reporting years. The median time for those who arrived by ambulance ranged from a low of seven minutes to a high of nine minutes in 2018.

HOSPITAL ECG WITHIN 10 MINUTES OF ARRIVAL AMONG TRANSFER CASES

Figure 10 and Table 11, below, display the percentage of eligible episodes of care for heart attack in which transfer patients received an ECG within 10 minutes of arriving at the first hospital to which they presented, by mode of arrival to the first hospital, by year. Episodes of care in which a patient received an ECG prior to arriving at the hospital were excluded.

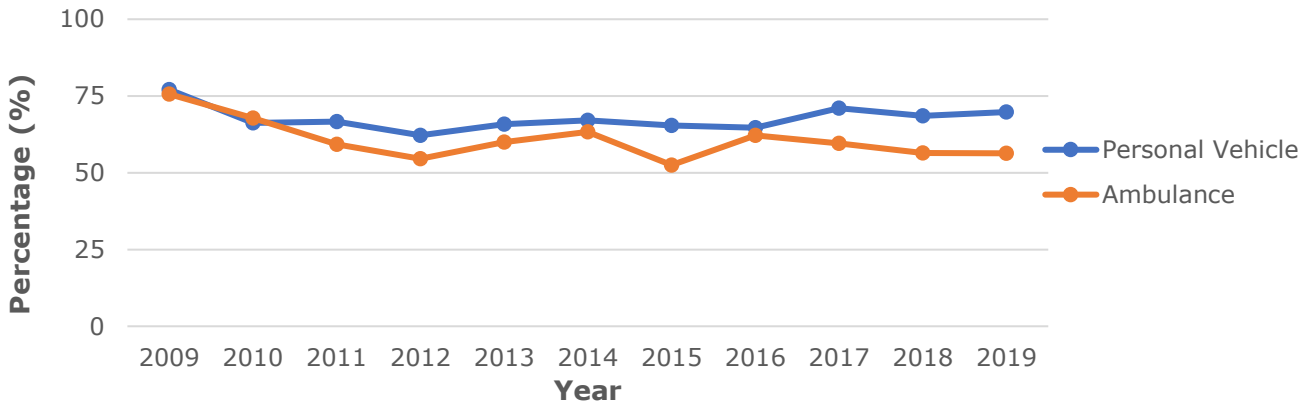

Figure 10. Hospital ECG within 10 minutes of first hospital arrival among transfer cases, by mode of arrival to first hospital, by year, 2009-2019

Table 11. Hospital ECG within 10 minutes of first hospital arrival among transfer cases, by mode of arrival to first hospital, by year, 2009-2019

	Mode of arrival to first hospital						
	Personal vehicle			Ambulance			
	Cases with ECG	Cases with ECG within 10 minutes of hospital arrival		Cases with ECG	Cases with ECG within 10 minutes of hospital arrival		Reporting hospitals
Year	(n)	(n)	%	(n)	(n)	%	
2009	271	209	77.1	78	59	75.6	6
2010	535	354	66.2	174	118	67.8	16
2011	768	512	66.7	213	126	59.2	21
2012	911	567	62.2	205	112	54.6	27
2013	1,094	720	65.8	220	132	60.0	31
2014	1,067	716	67.1	188	119	63.3	37
2015	1,362	891	65.4	198	104	52.5	39
2016	1,391	900	64.7	188	117	62.2	41
2017	1,328	943	71.0	161	96	59.6	43
2018	1,250	856	68.5	165	93	56.4	43
2019	1,225	855	69.8	160	90	56.3	43

In 2019, of all MI cases with an ECG performed at a STEMI referral hospital, a greater percentage of those arriving by personal vehicle had their ECG performed within 10 minutes of arriving at the hospital as compared with those arriving by ambulance (70 in 100 vs. 56 in 100, respectively). This general trend is seen for the 10-year time period (except 2010). There is opportunity for improvement in this vital component of care. Implementing appropriate protocols within the hospital ED can lead to more efficient care and improved times for first in-hospital ECG.

HOSPITAL ECG WITHIN 10 MINUTES OF ARRIVAL AMONG DIRECTLY-ADMITTED STEMI CASES

Figure 11 and Table 12 display the percentage of eligible episodes of care for MI in which directly-admitted patients received an ECG within 10 minutes of arriving at the hospital, by mode of arrival to the hospital, by year. Episodes of care in which a patient received an ECG prior to arriving at the hospital were excluded.

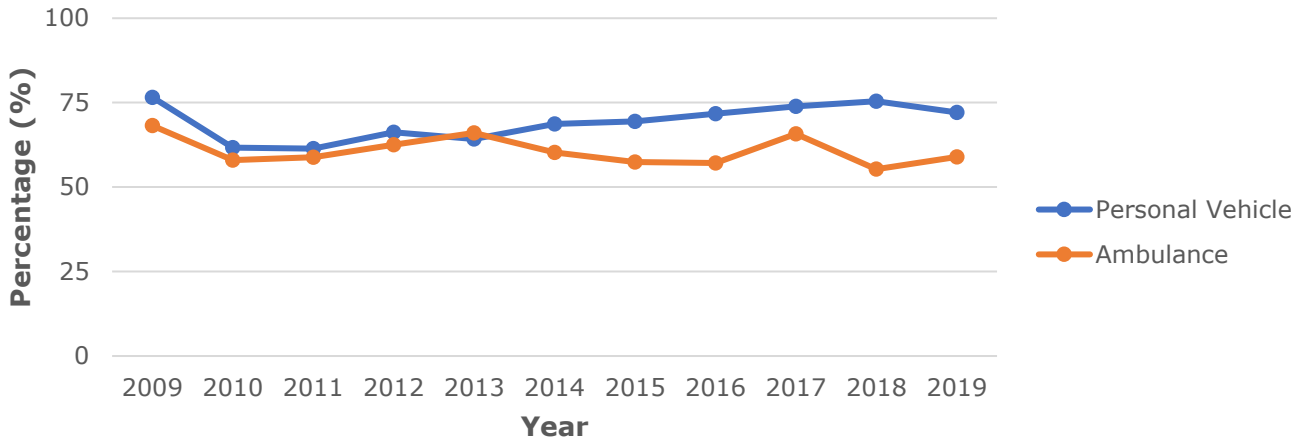

Figure 11. Hospital ECG within 10 minutes of arrival among directly-admitted MI cases, by mode of arrival to hospital, by year, 2009-2019

Table 12. Hospital ECG within 10 minutes of arrival among directly-admitted MI cases, by mode of arrival to hospital, by year, 2009-2019

	Mode of arrival to STEMI receiving hospital						
	Personal vehicle			Ambulance			
	Cases with ECG	Cases with ECG within 10 minutes of hospital arrival		Cases with ECG	Cases with ECG within 10 minutes of hospital arrival		Reporting hospitals
Year	(n)	(n)	%	(n)	(n)	%	(n)
2009	205	157	76.6	85	58	68.2	6
2010	1,023	631	61.7	479	278	58.0	19
2011	1,731	1,062	61.4	689	405	58.8	23
2012	2,321	1,537	66.2	840	525	62.5	30
2013	2,504	1,607	64.2	1,017	671	66.0	32
2014	3,089	2,122	68.7	917	553	60.3	38
2015	3,263	2,267	69.5	768	441	57.4	41

2016	3,733	2,677	71.7	665	380	57.1	43
2017	3,709	2,740	73.9	649	427	65.8	43
2018	3,830	2,887	75.4	479	265	55.3	43
2019	4,709	3,396	72.1	952	561	58.9	43

In 2019, among directly-admitted cases who received their first ECG at a STEMI receiving hospital, a greater percentage of those arriving by personal vehicle had their ECG performed within 10 minutes of arriving at the hospital as compared with those arriving by ambulance. While there was not much difference in these percentages from 2010-2013, the percentages have diverged more noticeably as of 2014. Hospital ECG within 10 minutes of arrival is recommended both in transfer and directly-admitted patients, irrespective of their mode of arrival. Even though this report shows that a higher number of patients arriving by a personal vehicle had a hospital ECG within 10 minutes of arrival, it is always recommended that MI patients arrive by ambulance. This is primarily to allow for recognition of STEMI when ECG is performed in the ambulance, leading to timely activation of cardiac catheterization lab. This can decrease the patients' total ischemic time and improve clinical outcomes.

DWELL TIME IN THE EMERGENCY DEPARTMENT OF REFERRAL HOSPITAL

The standard of care for time from arrival at first hospital to PCI, including transfer time, is 120 minutes. [3] The transfer process adds another component that must be evaluated as part of the STEMI system of care. The time spent in the referral facility is critical in this transfer process. It is an element that can be improved upon through streamlined processes and protocols, whereas transport time is more difficult to address due to other factors, such as distance to the nearest STEMI receiving hospital.

Figure 12 and Table 13 display the median time (in minutes) STEMI cases spent awaiting transfer (from the STEMI referral hospital to the STEMI receiving hospital) for PCI, among eligible episodes of care, by mode of arrival to the referral hospital.

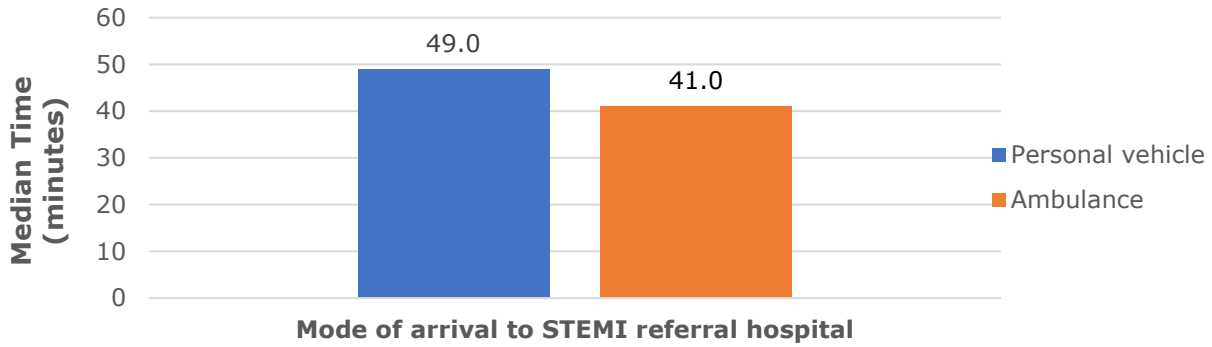

Figure 12. Median time spent in the emergency department (ED) of the STEMI referral hospital, by mode of arrival to first hospital, 2008-2019

Table 13. Median time spent in the emergency department (ED) of the STEMI referral hospital, by mode of arrival to first hospital, 2008-2019

	Mode of arrival to first hospital				
	Personal vehicle		Ambulance		
Patient Type	STEMI cases (n)	Minutes (Median)	STEMI cases (n)	Minutes (Median)	Reporting hospitals (n)
Transfer from referral hospital	329	49	238	41	11

The median time spent awaiting transfer from the STEMI referral hospital to the STEMI receiving hospital for PCI was 49.0 minutes among those who arrived by personal vehicle and 41.0 minutes among those who arrived by ambulance. For referral hospitals, there should be protocols in place for identifying, transferring, and transporting a STEMI patient to a receiving hospital. Implementing such a protocol requires rapid performance and interpretation of ECG as well as communication to the receiving hospital for activation of its catheterization lab.

DWELL TIME IN THE EMERGENCY DEPARTMENT OF RECEIVING HOSPITAL AMONG TRANSFER CASES

Figure 13 and Table 14 display the median time (in minutes) STEMI cases spent waiting in the ED of the STEMI receiving hospital among transfer cases with eligible episodes of care for STEMI, by mode of arrival to first hospital, by year.

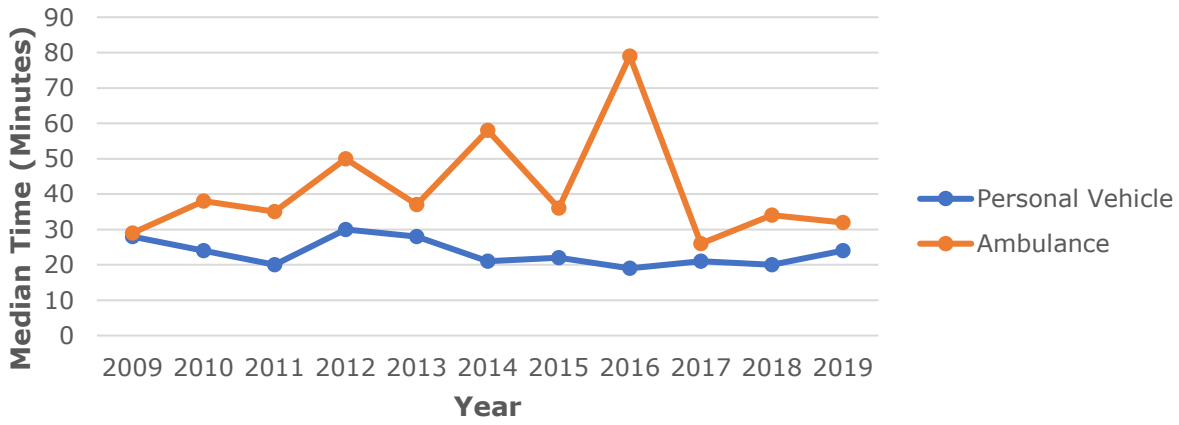

Figure 13. Median time spent in the Emergency Department of the STEMI receiving hospital among transfer cases, by mode of arrival to first hospital, by year, 2009-2019

Table 14. Median time spent in the Emergency Department of the STEMI receiving hospital among transfer cases, by mode of arrival to first hospital, by year, 2009-2019

	Mode of arrival to first hospital				
	Personal vehicle		Ambulance		
Year	STEMI cases (n)	Minutes (Median)	STEMI cases (n)	Minutes (Median)	Reporting hospitals (n)
2009	23	28	5	29	2
2010	43	24	34	38	10
2011	78	20	20	35	13
2012	81	30	25	50	16
2013	87	28	13	37	17
2014	80	21	22	58	20
2015	93	22	18	36	25
2016	139	19	25	79	27
2017	117	21	23	26	24
2018	126	20	26	34	28
2019	130	24	19	32	28

STEMI transfer cases arriving via private vehicle spend less time in the STEMI receiving hospital's ED as compared with those arriving via ambulance. In 2019, the median dwell time was 8 minutes longer for those arriving by ambulance than by personal vehicle. There is opportunity for establishing protocols and improving communication between STEMI receiving and STEMI referral hospitals that could reduce patients' dwell time in the ED of the STEMI receiving hospital.

DWELL TIME IN THE EMERGENCY DEPARTMENT OF RECEIVING HOSPITAL AMONG DIRECTLY-ADMITTED CASES

Figure 14 and Table 15 display the median time (in minutes) spent waiting in the ED of STEMI receiving hospital among directly-admitted STEMI cases with eligible episodes of care for STEMI, by mode of arrival to hospital, by year.

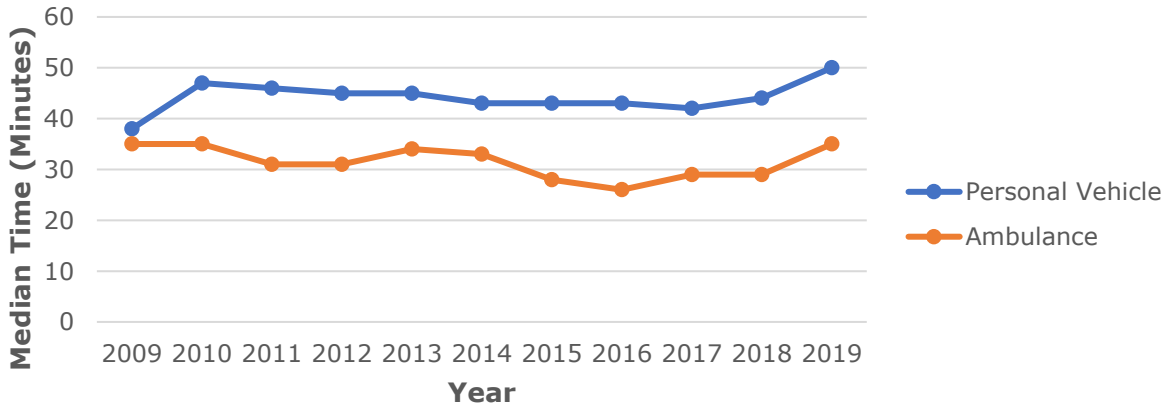

Figure 14. Median time spent in the Emergency Department of STEMI receiving hospitals among directly-admitted STEMI cases, by mode of arrival to hospital, 2009-2019

Table 15. Median time spent in the Emergency Department of STEMI receiving hospitals among directly-admitted STEMI cases, by mode of arrival to hospital, 2009-2019

	Mode of arrival to STEMI receiving hospital				
	Personal vehicle		Ambulance		Reporting hospitals (n)
Year	STEMI Cases (n)	Minutes (Median)	STEMI Cases (n)	Minutes (Median)	
2009	67	38	68	35	6
2010	236	47	232	35	19
2011	368	46	420	31	23
2012	473	45	490	31	30
2013	514	45	669	34	32
2014	639	43	686	33	38
2015	670	43	753	28	41
2016	739	43	899	26	43
2017	728	42	901	29	43
2018	700	44	901	29	43
2019	675	50	842	35	43

Among directly-admitted STEMI cases, those arriving via private vehicle spend more time in the hospital's ED as compared with those arriving via ambulance. In 2019, the median dwell time was 15 minutes longer for those arriving by personal vehicle than by ambulance. This further supports that MI cases should consider transport via ambulance over personal vehicle, as this could reduce dwell time in the ED of the STEMI receiving hospital.

FIRST DOOR-TO-NEEDLE TIME AMONG TRANSFER PATIENTS

Fibrinolysis, or use of a clot-dissolving drug to restore blood flow, can be used by hospitals that are not PCI-capable and cannot transfer a patient to receive PCI within the recommended time. It is also an option for patients who are ineligible for PCI. Fibrinolytic therapy should be administered within 30 minutes of hospital arrival. [4]

Figure 15 and Table 16 display the median time (in minutes) elapsed from arrival at first hospital to receipt of fibrinolytic therapy as the primary reperfusion treatment at the same hospital, among eligible episodes of care for STEMI, by mode of arrival to first hospital. The patients included in this measure were later transferred to another hospital. It is important to note the number of eligible patients for this measure was less than 110.

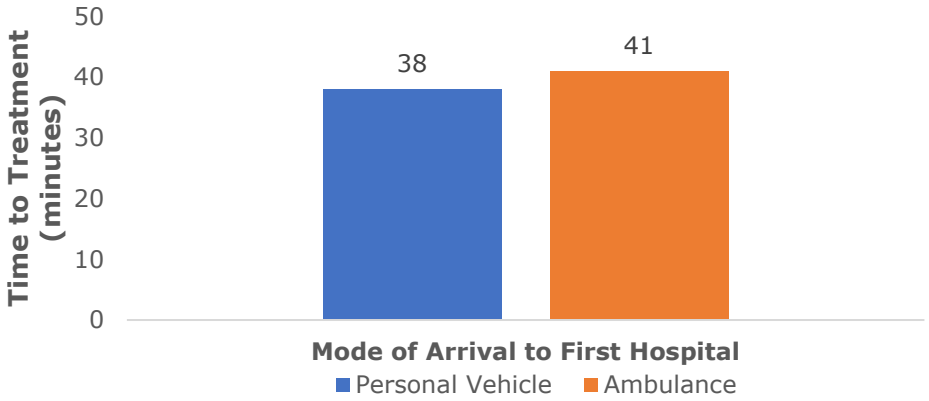

Figure 15. Median time from arrival to primary fibrinolysis at first hospital among STEMI transfer patients, by mode of arrival to first hospital, from 2008 -2019

Table 16. Median time from arrival at first hospital to primary fibrinolysis among STEMI transfer patients, by mode of arrival to first hospital, from 2008 -2019

	Mode of arrival to first hospital				
	Personal Vehicle		Ambulance		
Patient Type	Cases receiving fibrinolysis at first hospital (N)	Minutes (Median)	Cases receiving fibrinolysis at first hospital (N)	Minutes (Median)	Reporting hospitals (N)
Transfer	85	38	31	41	16

Among patients who arrived at the first hospital by personal vehicle, the median time from hospital arrival to fibrinolytic therapy was 38 minutes, compared to a median time of 41 minutes for those arriving to the first hospital by ambulance.

DOOR-TO-NEEDLE TIME WITHIN 30 MINUTES AMONG TRANSFER PATIENTS

Figure 16 and Table 17 display the percentage of eligible STEMI cases receiving primary fibrinolysis as the primary reperfusion strategy within 30 minutes of arrival at first hospital, by mode of arrival to first hospital. The patients included in this measure were later transferred to another hospital. It is important to note the number of eligible patients for this measure was less than 150.

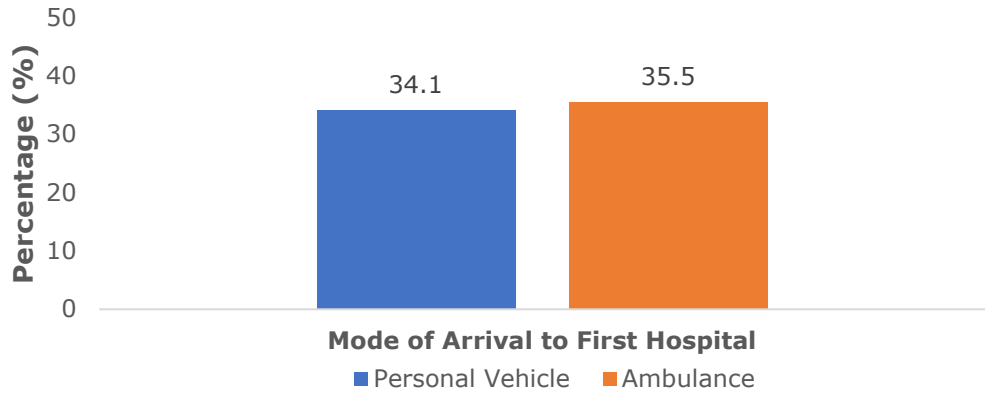

Figure 16. Fibrinolysis within 30 minutes of first hospital arrival among transfer patients, by mode of arrival to first hospital, from 2008-2019

Table 17. Fibrinolysis within 30 minutes of first hospital arrival among transfer patients, by mode of arrival to first hospital, from 2008 -2019

	Mode of arrival to STEMI referral hospital						
	Personal vehicle			Ambulance			
Patient Type	Cases receiving fibrinolysis at STEMI referral hospital	Cases receiving fibrinolysis within 30 minutes of arrival at STEMI referral hospital		Cases receiving fibrinolysis at STEMI referral hospital	Cases receiving fibrinolysis within 30 minutes of arrival at STEMI referral hospital		Reporting hospitals
	N	n	%	N	n	%	N
Transfer	85	29	34.1	31	11	35.5	16

The recommended door-to-needle time in STEMI referral hospitals is no more than 30 minutes. [5] In Texas, between 2008 and 2019, less than four out of every ten STEMI cases who arrived to the referral hospital by personal vehicle (34.1%) or by ambulance (35.5%) were treated to this standard of care. More rapid performance of ECG and protocols to reduce dwell times in the ED of the referral hospitals can improve this measure.

DOOR-TO-BALLOON TIME FOR DIRECTLY-ADMITTED PATIENTS

The standard of care for time from hospital arrival to PCI (or "device activation") is commonly referred to as "door-to-balloon time", and should be no more than 90 minutes. [5] Figure 17 and Table 18 display the median time (in minutes) elapsed among directly-admitted cases from time of arriving at a STEMI receiving hospital to primary PCI among eligible episodes of care for STEMI, by mode of arrival, by year. This measure is significant because it encompasses all the previous steps that are required for care of STEMI patients, from their arrival at the hospital, their time in the ED, their arrival in the catheterization lab, and device activation.

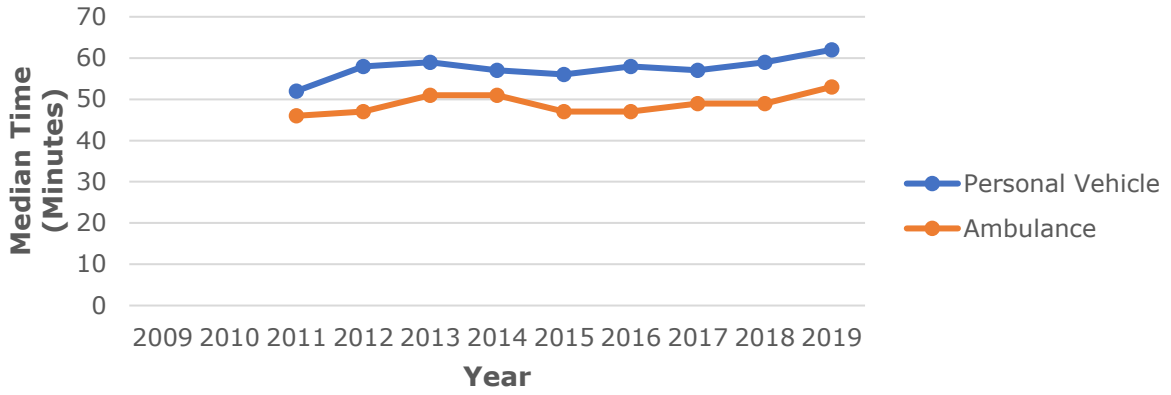

Figure 17. Median time (minutes) from hospital arrival to primary PCI among directly-admitted STEMI patients, by mode of arrival, by year, 2009-2018

Table 18. Median time (minutes) from hospital arrival to primary PCI among directly-admitted STEMI patients, by mode of arrival, by year, 2009-2019

	Mode of Arrival to hospital				
	Personal vehicle		Ambulance		
Year	Cases receiving primary PCI at hospital (n)	Minutes (Median)	Cases receiving primary PCI at hospital (n)	Minutes (Median)	Reporting hospitals (n)
2009	--	--	--	--	--
2010	--	--	--	--	--
2011	477	52	418	46	23
2012	516	58	451	47	30
2013	568	59	560	51	32
2014	655	57	556	51	38
2015	725	56	600	47	41
2016	781	58	699	47	43
2017	788	57	686	49	43
2018	733	59	690	49	43
2019	687	62	603	53	43

-- No data available

Each year, directly-admitted cases who arrived by ambulance had a lower median time to PCI than did those who arrived by personal vehicle. In order to further improve the median time to PCI, hospitals can evaluate their protocol for activation of the catheterization lab and aim to have catheterization lab staff arrive within 30 minutes of the activation call.

DOOR-TO-BALLOON TIME WITHIN 90 MINUTES FOR DIRECTLY-ADMITTED PATIENTS

Figure 18 and Table 19 display the percentage of eligible episodes of care for STEMI cases who received primary PCI within 90 minutes of direct presentation to a STEMI receiving hospital, by mode of arrival, by year. Data on this measure are not available prior to 2011.

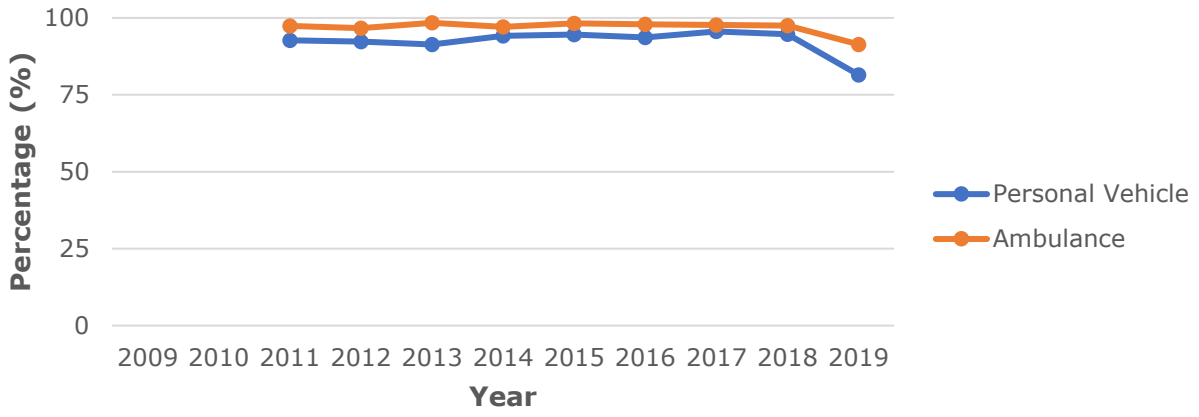

Figure 18. Primary PCI within 90 minutes of hospital arrival among directly-admitted STEMI patients, by mode of arrival, by year, 2009-2018

Table 19. Primary PCI within 90 minutes of hospital arrival among directly-admitted patients, by mode of arrival, by year, 2009-2019

	Mode of Arrival to STEMI receiving hospital						
	Personal vehicle			Ambulance			
Year	Cases receiving primary PCI at STEMI receiving hospital (n)	Cases receiving primary PCI within 90 minutes of first hospital arrival (n)	%	Cases receiving primary PCI at STEMI receiving hospital (n)	Cases receiving primary PCI within 90 minutes of first hospital arrival (n)	%	Reporting hospitals (n)
2009	--		--	--		--	--
2010	--		--	--		--	--
2011	477	442	92.7	418	407	97.4	23
2012	516	476	92.3	451	436	96.7	30
2013	568	519	91.4	560	551	98.4	32
2014	655	617	94.2	556	540	97.1	38
2015	725	686	94.6	600	589	98.2	41
2016	781	732	93.7	699	684	97.9	43
2017	788	753	95.6	686	670	97.7	43
2018	733	694	94.7	690	673	97.5	43
2019	687	560	81.5	603	551	91.4	43

-- No data available

Over all years, a higher percentage of directly-admitted STEMI patients who arrived by ambulance received primary PCI within 90 minutes of hospital arrival than did those who arrived by personal vehicle. In 2019, this difference was 9.9%.

FIRST DOOR-TO-BALLOON TIME FOR TRANSFER PATIENTS

STEMI patients who arrive at a STEMI referral hospital who are eligible for and in need of PCI must be transferred to a STEMI receiving hospital to receive appropriate care and treatment. The standard of care for time from arrival at first hospital to PCI, including transfer time, is 120 minutes. [3] Figure 19 and Table 20, below, display the median time (in minutes) elapsed from arrival at a STEMI referral hospital to time of primary PCI at a STEMI receiving hospital among eligible episodes of care for STEMI, by mode of arrival to the STEMI referral hospital.

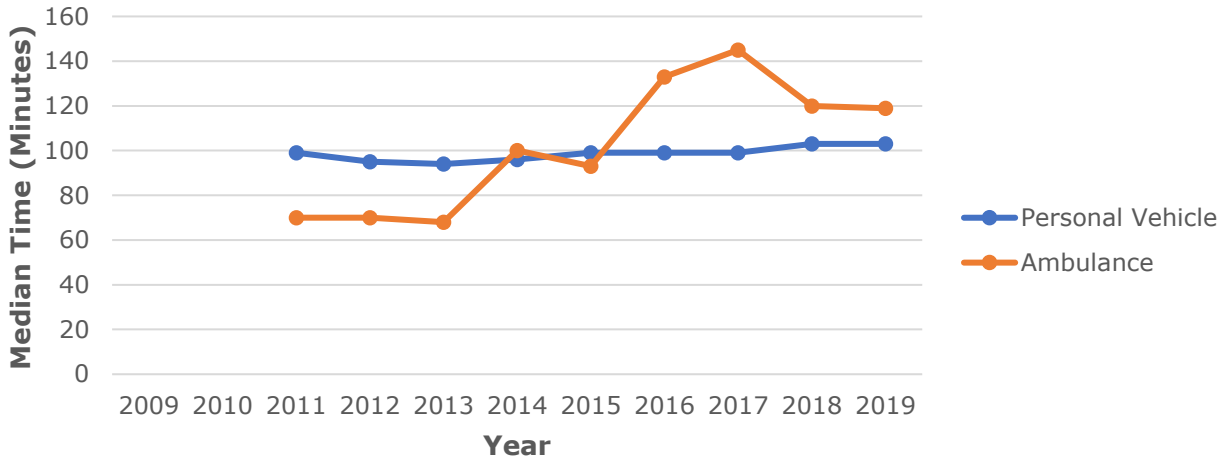

Figure 19. Median time (minutes) from first hospital arrival to primary PCI for STEMI transfer patients, by mode of arrival to first hospital, by year, 2009-2019

Table 20. Median time from first hospital arrival to primary PCI for transfer patients by mode of arrival to first hospital and year, 2009-2019

	Mode of Arrival to first hospital				
	Personal vehicle		Ambulance		
Year	Cases receiving primary PCI at STEMI receiving hospital (n)	Minutes (Median)	Cases receiving primary PCI at STEMI receiving hospital (n)	Minutes (Median)	Reporting hospitals (n)
2009	--	--	--	--	--
2010	--	--	--	--	--
2011	200	99	98	70	17
2012	179	95	86	70	20
2013	193	94	74	68	23
2014	196	96	36	100	27
2015	256	99	39	93	29
2016	239	99	22	133	32
2017	236	99	18	145	30

2018	238	103	28	120	34
2019	203	103	23	119	34

-- No data available

In 2019, transfer cases who arrived at a STEMI referral hospital by ambulance had a higher median time to primary PCI than those who arriving by personal vehicle; this trend has been seen since 2014, whereas prior to 2014, those arriving by ambulance had a lower median time from arrival to PCI. Identifying and addressing the causes of this difference may lead to improved time to primary PCI and potentially better health outcomes.

FIRST DOOR-TO-BALLOON TIME WITHIN 120 MINUTES FOR TRANSFER PATIENTS

Figure 20 and Table 21, below, display the percentage of eligible episodes of care for STEMI cases who received primary PCI at a STEMI receiving hospital within 120 minutes of arriving at a STEMI referral hospital, by mode of arrival to the referral hospital, by year.

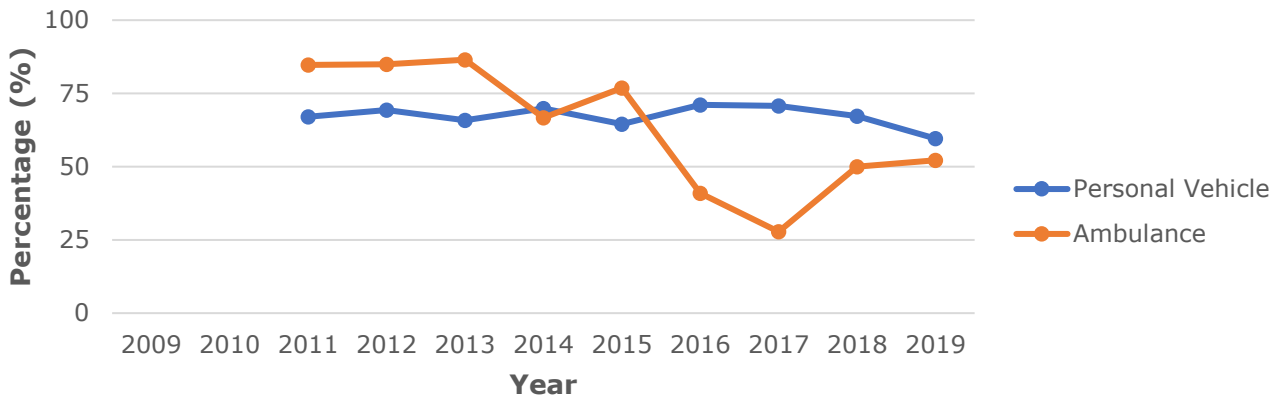

Figure 20. Primary PCI within 120 minutes of first hospital arrival among STEMI transfer patients, by mode of arrival to first hospital, by year, 2009-2019

Table 21. Primary PCI within 120 minutes of first hospital arrival among STEMI transfer patients, by mode of arrival to first hospital, by year, 2009-2019

	Mode of Arrival to first hospital						
	Personal vehicle			Ambulance			
Year	Cases receiving primary PCI at STEMI receiving hospital (n)	Cases receiving primary PCI within 120 minutes of first hospital arrival (n)	%	Cases receiving primary PCI at STEMI receiving hospital (n)	Cases receiving primary PCI within 120 minutes of first hospital arrival (n)	%	Reporting hospitals (n)
2009	--		--	--		--	--
2010	--		--	--		--	--
2011	200	134	67.0	98	83	84.7	17
2012	179	124	69.3	86	73	84.9	20
2013	193	127	65.8	74	64	86.5	23
2014	196	137	69.9	36	24	66.7	27
2015	256	165	64.5	39	30	76.9	29
2016	239	170	71.1	22	9	40.9	32
2017	236	167	70.8	18	5	27.8	30
2018	238	160	67.2	28	14	50.0	34
2019	203	121	59.6	28	12	52.2	34

-- No data available

In 2018, 68 out of 100 STEMI transfer cases who arrived at a STEMI referral hospital by private vehicle received primary PCI within 120 minutes of arrival at the STEMI referral hospital, compared to only 56 out of 100 who arrived at the referral hospital by ambulance.

FIRST DOOR-TO-BALLOON TIME WITHIN 90 MINUTES FOR TRANSFER PATIENTS

According to American Heart Association's (AHA) STEMI systems of care recommendations, the door to balloon time for transfer patients, including transport time, should be within 90 minutes. [5] Figure 21 and Table 22 display the percentage of eligible episodes of care for STEMI cases who received primary PCI at a STEMI receiving hospital within 90 minutes of arriving at a STEMI referral hospital, by mode of arrival to STEMI referral hospital, by year.

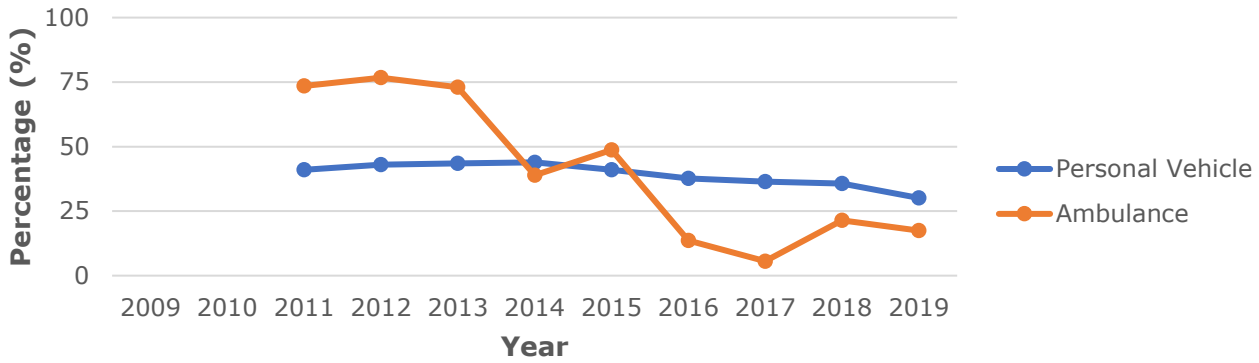

Figure 21. Primary PCI within 90 minutes of first hospital arrival among STEMI transfer patients, by mode of arrival to first hospital, by year, 2009-2019

Table 22. Primary PCI within 90 minutes of first hospital arrival among STEMI transfer patients, by mode of arrival to first hospital, by year, 2009-2019

	Mode of Arrival to first hospital						
	Personal vehicle			Ambulance			
Year	Cases receiving primary PCI at STEMI receiving hospital (n)	Cases receiving primary PCI within 90 minutes of first hospital arrival (n)	%	Cases receiving primary PCI at STEMI receiving hospital (n)	Cases receiving primary PCI within 90 minutes of first hospital arrival (n)	%	Reporting hospitals (n)
2009	--		--	--		--	--
2010	--		--	--		--	--
2011	200	82	41.0	98	72	73.5	17
2012	179	77	43.0	86	66	76.7	20
2013	193	84	43.5	74	54	73.0	23
2014	196	86	43.9	36	14	38.9	27
2015	256	105	41.0	39	19	48.7	29
2016	239	90	37.7	22	3	13.6	32
2017	236	86	36.4	18	1	5.6	30
2018	238	85	35.7	28	6	21.4	34
2019	203	61	30.1	23	4	17.4	34

-- No data available

In 2019, more patients arriving at a STEMI referral hospital by personal vehicle received primary PCI within 90 minutes than did those who arrived by ambulance (30.1% vs. 17.4%, respectively).

The number of cases arriving via ambulance to STEMI referral hospitals has been decreasing since 2013. One reason for this may be that ambulances are bypassing STEMI referral hospitals and transporting cases directly to STEMI receiving hospitals in efforts to decrease ischemic times and improve outcomes. [6]

FIRST MEDICAL CONTACT (FMC) TO BALLOON TIME

According to both the 2013 American College of Cardiology Foundation and the AHA STEMI guidelines, in order to improve STEMI outcomes, the focus and emphasis has shifted to targeting first medical contact (FMC) to balloon time rather than door-to-balloon time. [7] Figure 22 and Table 23**,** below, display the median time from FMC to balloon time, by year, for STEMI patients who arrived by an ambulance to the first hospital. Both transfers and directly-admitted patients were included.

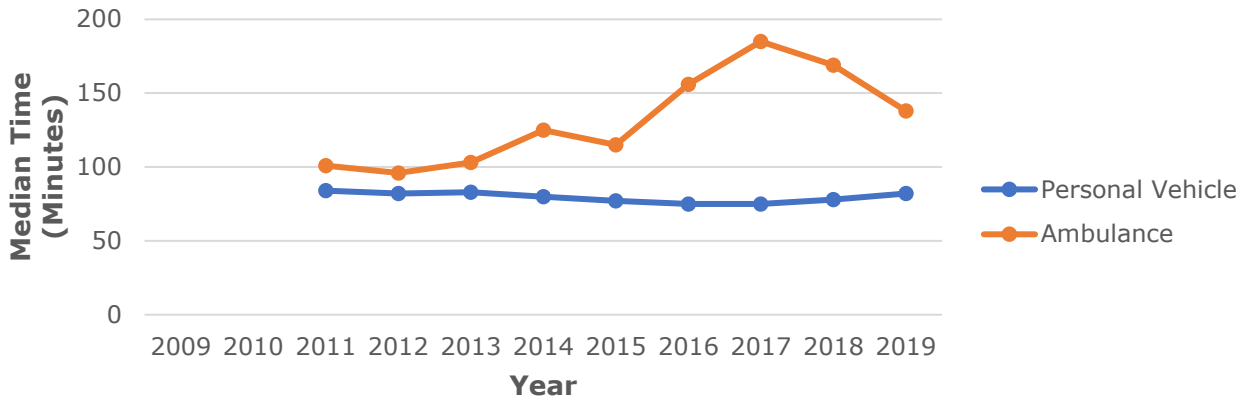

Figure 22. Median time from first medical contact to balloon time among STEMI patients who arrived at the first hospital by ambulance, by patient type, by year, 2009-2019

Table 23. Median time from first medical contact to balloon time among STEMI cases who arrived at the first hospital by ambulance, by patient type, by year, 2009-2019

	Patient Type					
	Directly-admitted			Transfer		
Year	Cases receiving primary PCI at STEMI receiving hospital (n)	Minutes (Median)	Reporting Hospitals (n)	Cases receiving primary PCI at STEMI receiving hospital (n)	Minutes (Median)	Reporting hospitals (n)
2009	--	--	--	--	--	--
2010	--	--	--	--	--	--
2011	321	84	22	98	101	10
2012	370	82	27	86	96	12
2013	496	83	31	74	103	11
2014	518	80	36	33	125	13
2015	562	77	39	32	115	10
2016	681	75	42	17	156	8
2017	668	75	43	10	185	6
2018	656	78	43	17	169	6
2019	550	82	43	17	138	6

-- No data available

Among those arriving to the hospital via ambulance, the median time from FMC to primary PCI was higher for transfer patients compared to directly-admitted patients.

Figure 23 shows the median time from FMC to balloon time for directly-admitted patients arriving by ambulance to a STEMI receiving hospital, by setting (urban/rural). Rural areas had a higher median time from FMC to primary PCI as compared to urban areas.

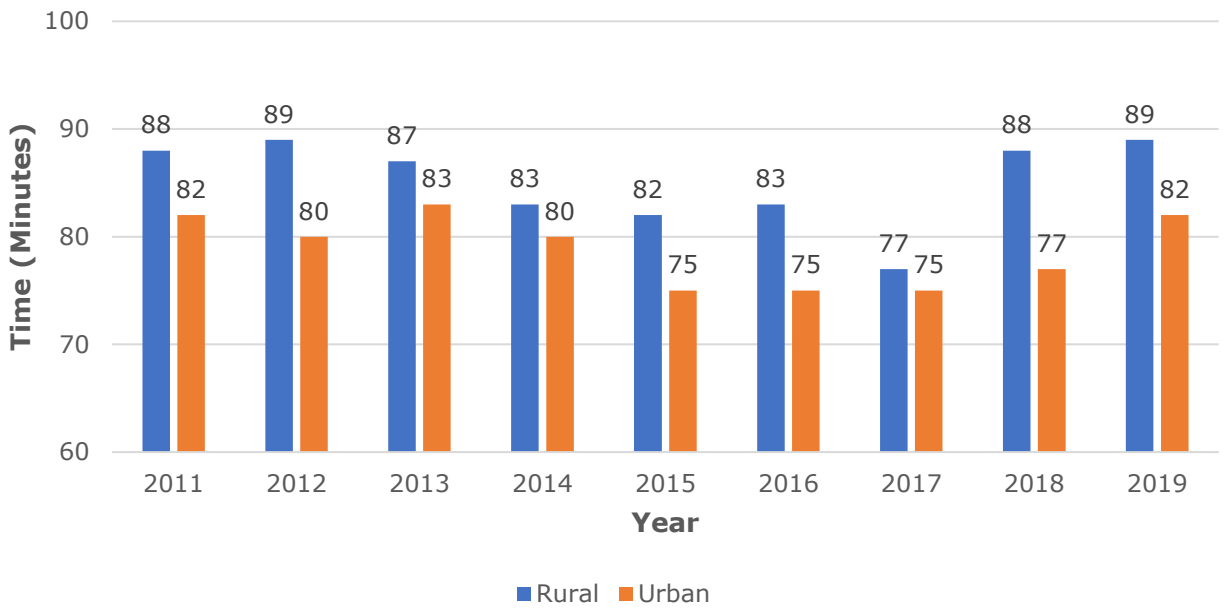

Figure 23: Median times from first medical contact to balloon times in directly-admitted STEMI patients arriving by ambulance to receiving hospital, by setting (urban vs. rural), 2011-2019

TOTAL ISCHEMIC TIME AMONG STEMI TRANSFER PATIENTS

According to a 2015 study, "ischemic time is a better predictor than door-to-balloon time for mortality and infarct size in (STEMI)" patients. [8] The study suggests that the focus of STEMI care should be directed to reducing the ischemic time rather than door-to-balloon time. This can be achieved by early initiation of therapy. Figure 24 and Table 24, below, display the total ischemic time among STEMI transfer patients from 2011 to 2018, by three categories of ischemic time: less than 120 minutes, 120–239 minutes, and 240 minutes or more.

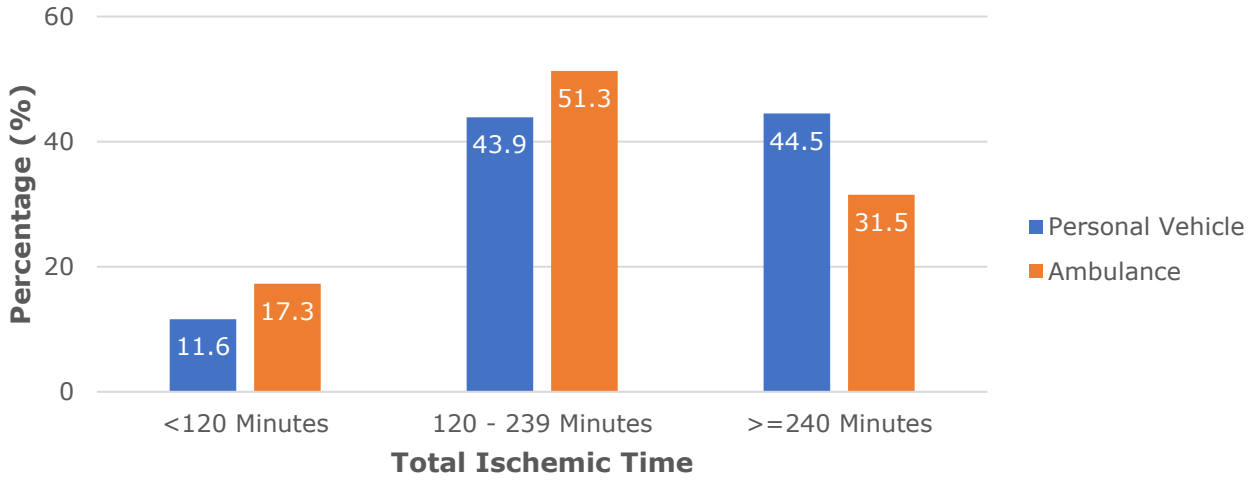

Figure 24: Total ischemic time (minutes) among transfer patients, by mode of arrival to first hospital, 2011-2019

Table 24: Total ischemic time among STEMI transfer patients, by mode of arrival to first hospital, 2011-2019

	Mode of arrival to first hospital						
	Personal vehicle			Ambulance			
	Total Ischemic Time (Minutes)			Total Ischemic Time (Minutes)			Reporting hospitals (n)
	< 120	120-239	≥ 240	< 120	120-239	≥ 240	
N (%)	213 (11.6)	805 (43.9)	817 (44.5)	83 (17.3)	246 (51.3)	151 (31.5)	42

The best clinical outcomes were observed in patients who had a total ischemic time <120 minutes. Total ischemic time <120 minutes was more common among patients who arrived at the STEMI referral hospital by ambulance (17.3%) than by personal vehicle (11.6%). Nearly half (44.5%) of transfer patients arriving at the STEMI referral hospital by personal vehicle had a total ischemic time of 240 minutes or more, as compared with nearly one-third (31.5%) arriving by ambulance.

TOTAL ISCHEMIC TIME AMONG STEMI DIRECTLY-ADMITTED PATIENTS

Figures 25-27 and Table 25 display the total ischemic time among STEMI patients from 2011 to 2018, by three categories of ischemic time: <120 minutes, 120 – 239 minutes, and >=240 minutes. The best clinical outcomes are observed in patients who have total ischemic time <120 minutes. [8]

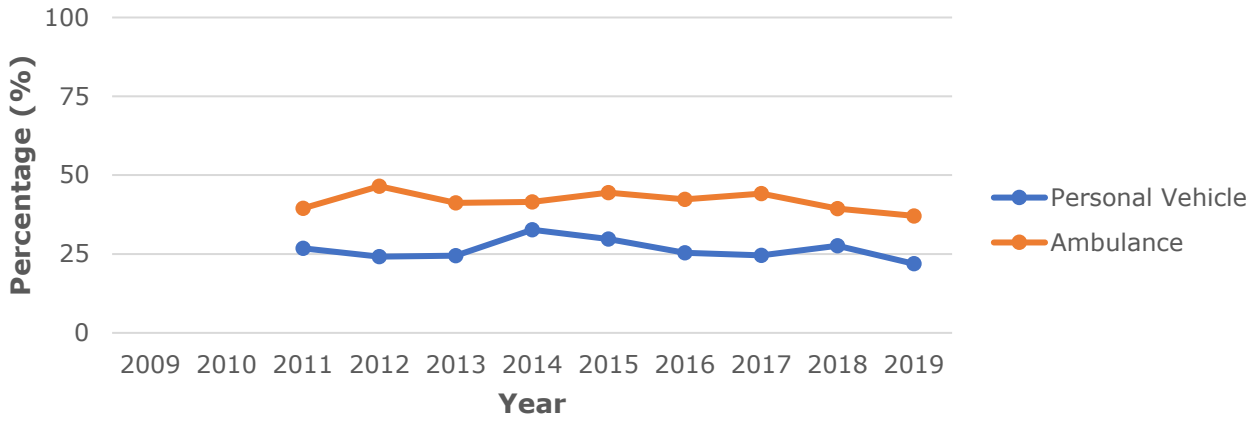

Figure 25: Total ischemic time <120 minutes among directly-admitted STEMI patients, by mode of arrival, by year, 2009-2019

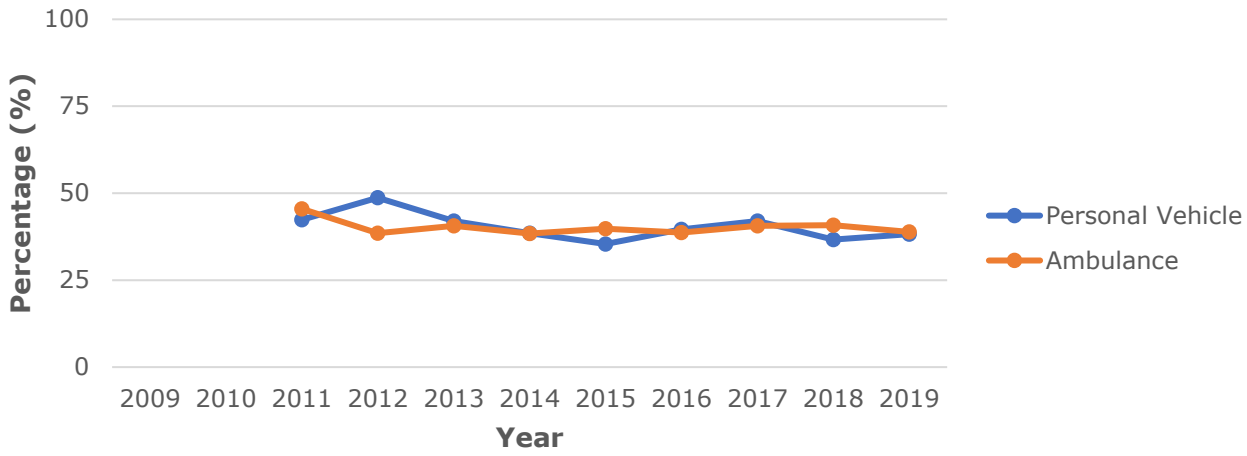

Figure 26: Total ischemic time 120 - 239 minutes among directly-admitted STEMI patients, by mode of arrival, by year, 2009-2019

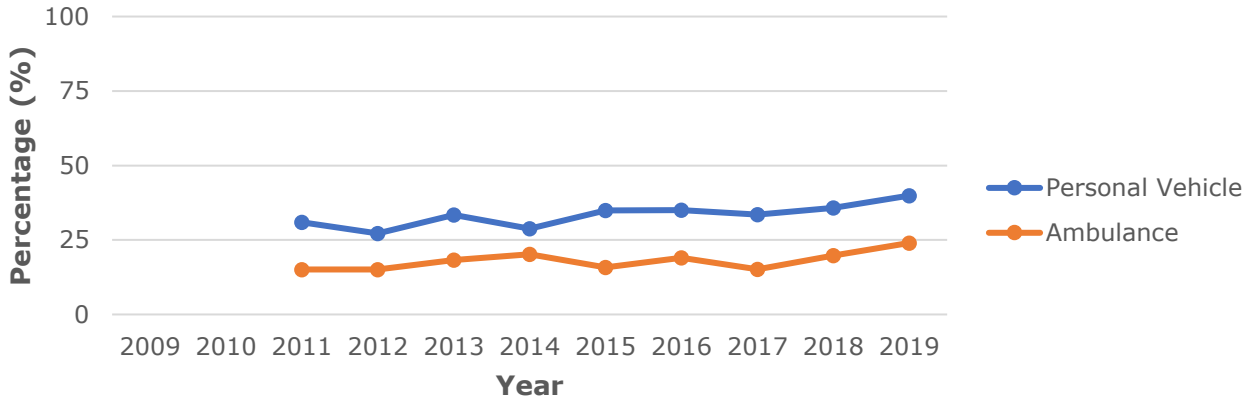

Figure 27: Total ischemic time ≥ 240 minutes among directly-admitted STEMI patients, by mode of arrival, by year, 2009-2019

Figure 25 shows that, from 2011 to 2019, total ischemic time <120 minutes was more common among directly-admitted STEMI patients who arrived at the receiving hospital by ambulance than by personal vehicle. Figure 26 shows that there is very little difference in the number of directly-admitted STEMI patients with an ischemic time of 120-239 minutes by mode of hospital arrival. Figure 27 shows that, from 2011 to 2019, total ischemic time >=240 minutes was more common among directly-admitted STEMI patients arriving by personal vehicle than by ambulance.

Table 25: Total ischemic time among directly-admitted STEMI patients, by mode of arrival, by year, 2009-2019

	Mode of arrival to first hospital						
	Personal vehicle			Ambulance			
	Total Ischemic Time			Total Ischemic Time			
Year	< 120 Minutes, n (%)	120-239 Minutes, n (%)	≥ 240 Minutes, n (%)	< 120 Minutes, n (%)	120-239 Minutes, n (%)	≥ 240 Minutes, n (%)	Reporting Hospitals (n)
2009	--	--	--	--	--	--	--
2010	--	--	--	--	--	--	--
2011	65 (26.8)	103 (42.4)	75 (30.9)	118 (39.5)	136 (45.5)	45 (15.1)	23
2012	72 (24.2)	145 (48.7)	81 (27.2)	157 (46.5)	130 (38.5)	51 (15.1)	27
2013	77 (24.5)	132 (42.0)	105 (33.4)	194 (41.2)	191 (40.6)	86 (18.3)	31
2014	128 (32.7)	151 (38.5)	113 (28.8)	187 (41.5)	173 (38.4)	91 (20.2)	36
2015	123 (29.8)	146 (35.4)	144 (34.9)	226 (44.5)	202 (39.8)	80 (15.8)	40
2016	126 (25.4)	197 (39.6)	174 (35.0)	270 (42.3)	247 (38.7)	121 (19.0)	43
2017	124 (24.6)	212 (42.0)	169 (33.5)	265 (44.2)	243 (40.6)	91 (15.2)	43
2018	124 (27.6)	165 (36.7)	161 (35.8)	246 (39.4)	255 (40.8)	124 (19.8)	43
2019	92 (21.9)	161 (38.2)	168 (39.9)	204 (37.1)	214 (38.9)	132 (24.0)	43

-- No data available

In 2019, 21.9% of directly-admitted STEMI patients who arrived at the hospital by personal vehicle and 37.1% of those arriving by ambulance had total ischemic time of <120 minutes (Table 25). Conversely, for 2019, more patients who arrived at the hospital by personal vehicle had a total ischemic time >=240 minutes as compared with those arriving by ambulance (39.9% vs 24.0%, respectively).

MEDIAN TIME FROM SYMPTOM ONSET TO PRIMARY PCI IN DIRECTLY-ADMITTED AND TRANSFER STEMI PATIENTS, 2018

The shorter the time from symptom onset to treatment, the better the patient outcome. Figure 28 shows the median time STEMI cases spent in each stage of the treatment process, from onset of symptoms to time of PCI, comparing directly-admitted and transfer patients in 2018.

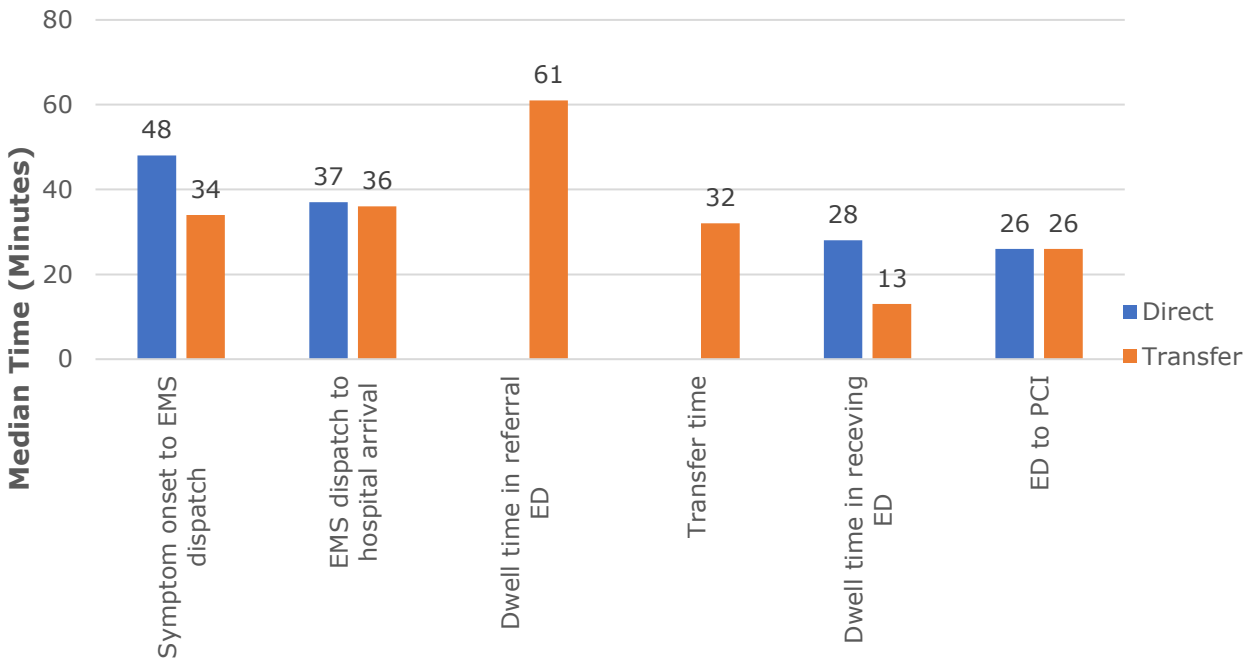

Figure 28: Median time (in minutes) from symptom onset to primary PCI, directly-admitted vs. transfer STEMI cases, 2018

Time from symptom onset to PCI was dramatically shorter for directly-admitted vs transfer cases (median minutes of 162 vs 199, respectively). This is primarily due to dwell time in the referral hospitals' ED, and transfer time to the STEMI-receiving hospital required for transfer, but not directly-admitted patients. It should be noted that the number of STEMI cases vary for each measure in the above chart. This is due to different missing values for each variable used in calculating the measures. There were fewer than 20 cases among STEMI transfer patients for the measures "Symptom onset to EMS dispatch time" and "EMS dispatch to hospital arrival." There were more than 20 STEMI cases for all the other measures.

ACTIVATION OF CATHETERIZATION LAB PRIOR TO ARRIVAL AMONG TRANSFER PATIENTS

Figure 29 and Table 26 show data on activation of the cardiac catheterization lab prior to patients' hospital arrival, known as "pre-cath lab activation", among STEMI transfer patients who arrived at the first hospital by personal vehicle or ambulance.

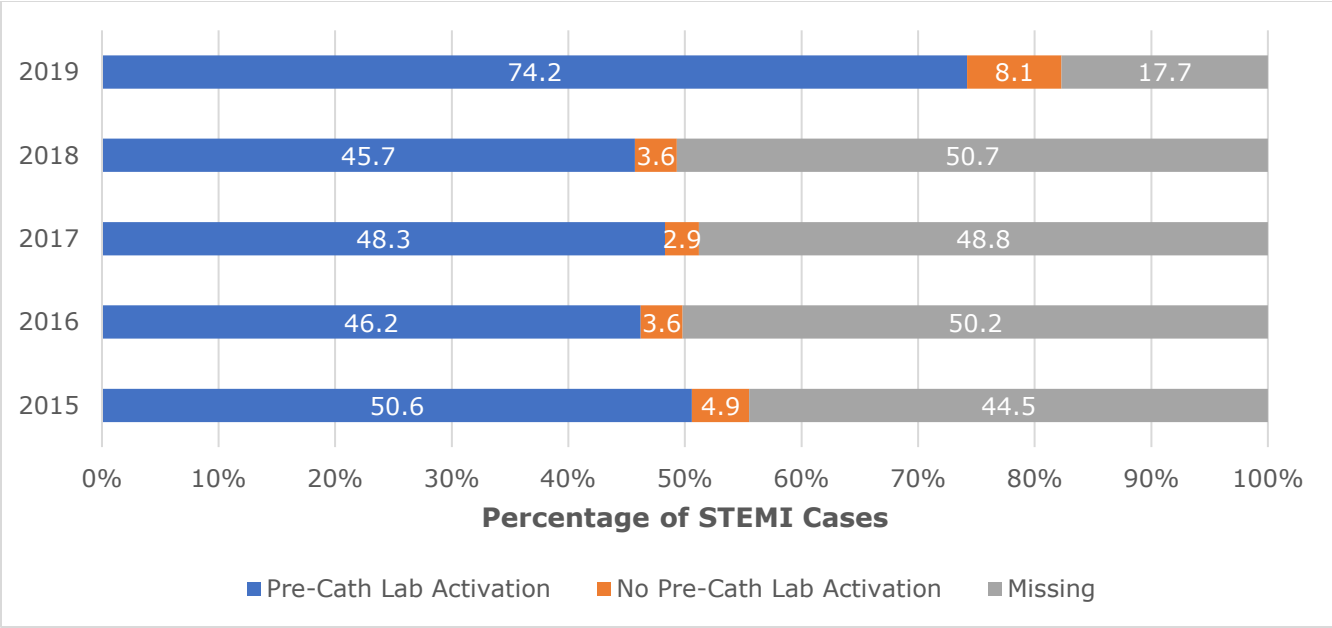

Figure 29: Percentage of pre-catheterization lab activation among STEMI transfer patients arriving to the first hospital by personal vehicle or ambulance, 2015- 2019

Table 26: Pre-catheterization lab activation among STEMI transfer patients arriving to the first hospital by personal vehicle or ambulance, 2015-2019

Year	Total STEMI cases	Pre-Cath lab activation	No Pre-Cath lab activation	Missing	Reporting Hospitals
	n	n (%)	n (%)	n (%)	n
2015	247	125 (50.6)	12 (4.9)	110 (44.5)	26
2016	225	104 (46.2)	8 (3.6)	113 (50.2)	31
2017	205	99 (48.3)	6 (2.9)	100 (48.8)	27
2018	223	102 (45.7)	8 (3.6)	113 (50.7)	31
2019	209	155 (74.2)	17 (8.1)	37 (17.7)	31

For the past four years, pre-cath lab activation has occurred for approximately half to three-quarters of STEMI transfer patients. In 2019, the catheterization lab was activated prior to arrival at the STEMI receiving hospital for nearly 3 in 4 (74.2%) cases, and not activated for 8 in 100 cases (8.1%) of cases (data was missing for 17.7% of cases). Implementing appropriate protocols for "pre-cath lab activation" at STEMI receiving hospitals for transfer patients could reduce total ischemic time among these patients and improve outcomes.

ACTIVATION OF CATHETERIZATION LAB PRIOR TO ARRIVAL AMONG DIRECTLY-ADMITTED PATIENTS

Figure 30 and Table 27 show data on pre-cath lab activation among directly-admitted STEMI patients who arrived at the hospital by an ambulance; only cases arriving by ambulance were included because pre-cath lab activation requires notification by the EMS team.

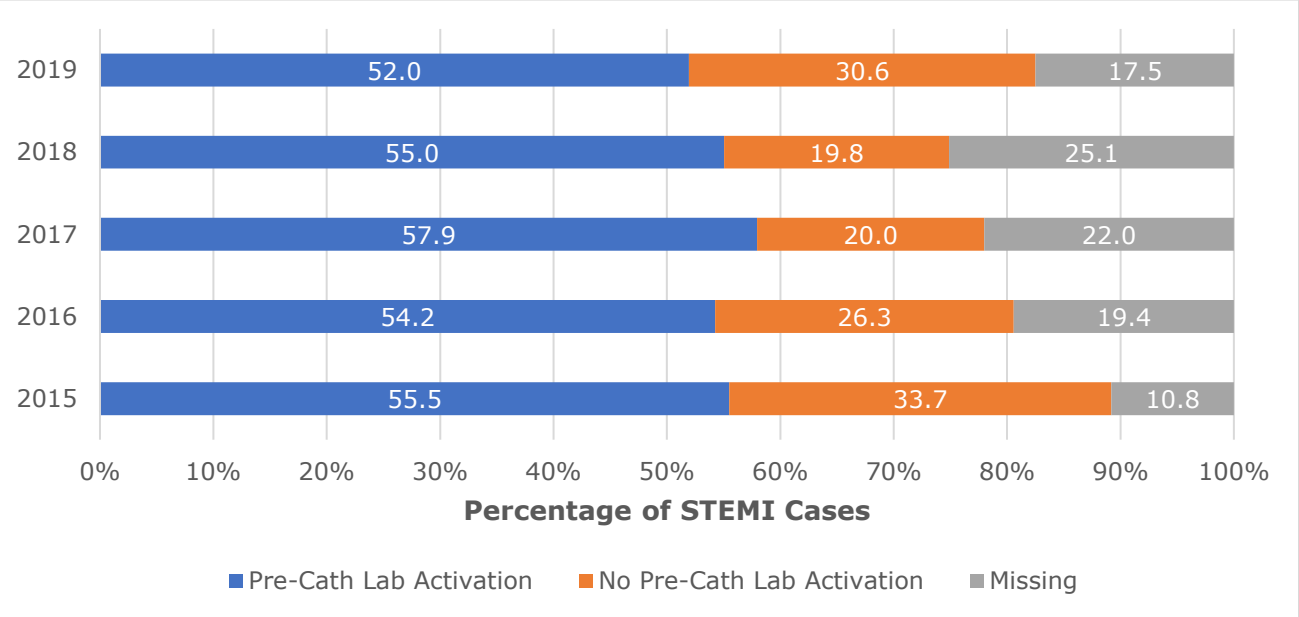

Figure 30: Pre-catheterization lab activation arrival among directly-admitted STEMI patients arriving by ambulance, 2015-2019

Table 27: Pre-catheterization lab activation among directly-admitted STEMI patients arriving by ambulance, 2015-2019

Year	Total STEMI cases	Pre-Cath lab activation	No Pre-Cath lab activation	Missing	Reporting Hospitals
	n	n (%)	n (%)	n (%)	n
2015	508	282 (55.5)	171 (33.7)	55 (10.8)	37
2016	638	346 (54.2)	168 (26.3)	124 (19.4)	42
2017	599	347 (57.9)	120 (20.0)	132 (22.0)	41
2018	625	344 (55.0)	124 (19.8)	157 (25.1)	41
2019	550	286 (52.0)	752 (30.6)	96 (17.5)	41

Over the past four years, pre-cath lab activation has occurred for slightly more than half of directly-admitted STEMI patients arriving by ambulance. In 2019, pre-cath lab activation occurred for just over half (52.0%), but not for 30.6%, of directly-admitted STEMI patients arriving by ambulance. Pre-hospital ECG within 10 minutes of FMC and accurate diagnoses of STEMI cases, when communicated to the STEMI receiving hospital, lead to greater pre-cath lab activation. Implementing standard protocols for pre-cath lab activation at STEMI receiving hospitals for patients arriving by ambulance can reduce total ischemic time and improve outcomes for these patients. Collaborative efforts between EMS providers, nursing staff, and physicians can increase pre-cath lab activation in Texas.

CARDIAC REHABILITATION REFERRAL AMONG STEMI PATIENTS

A cardiac rehabilitation referral is defined as an official communication between the healthcare provider and the patient to recommend and carry out a referral order to an outpatient cardiac-rehabilitation program. As stated in the CDC Cardiac Rehabilitation Facts, "Comprehensive cardiac rehabilitation has been shown to reduce re-hospitalization rates, reduce recurrent sudden cardiac death, lessen the need for cardiac medications, and increase the rate of persons returning to work". [9] Figure 31 and Table 28 display 2008-2019 cardiac rehabilitation referrals among STEMI cases at time of discharge; analyses exclude deceased MI cases (N=2,817).

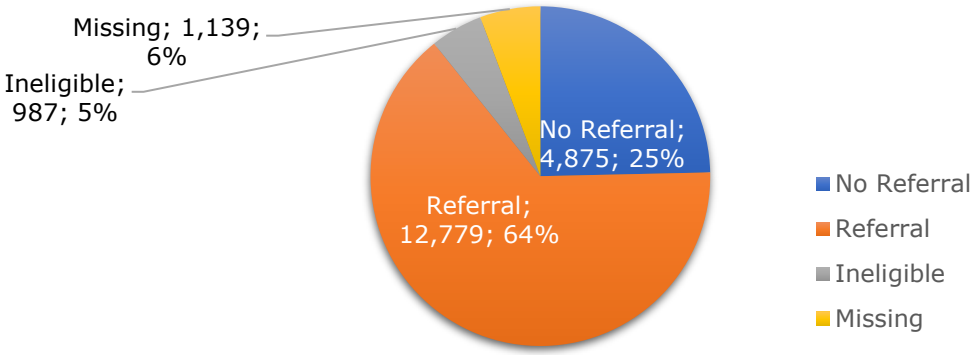

Figure 31: Cardiac rehabilitation referral among STEMI cases, 2008-2019

Table 28: Cardiac rehabilitation referral among STEMI cases, 2008-2019

	Cardiac Rehabilitation Referral				
	Yes	**No**	**Ineligible**	**Missing**	**Reporting Hospitals**
N	12,779	4,875	987	1,139	43
%	64.6	24.7	5.0	5.8	

Almost two-thirds of STEMI cases (64.6%) were referred to a cardiac rehabilitation program upon hospital discharge, with two in 10 (24.7%) not getting referred, and five in 100 (5.0%) being ineligible for referral. The ineligible factors include medical reason, patient factors, and health care system factors. For example, a patient with a medically unstable, life-threatening condition is ineligible due to a medical reason. A patient needing to be discharged to a nursing care facility for long-term care is ineligible due to a patient factor. An example of a health care system factors is no cardiac rehabilitation program within 60 minutes from the patient's home. Recent research suggests that physician referral is the most powerful predictor for cardiac rehabilitation enrollment. [9] Appropriate measures should be taken to increase cardiac rehabilitation referral by physicians.

Out of 61,669 MI cases with information on cardiac referral **59.8%** of male and **51.8%** of female cases were referred for cardiac rehabilitation. More male than female STEMI patients were referred for cardiac rehabilitation (69.4% vs. 66.2%, respectively) among 18,642 STEMI patients.

Among 69,502 MI cases, 46 out of 100 (n=31,704; 45.6%) had Medicare insurance and of these, nearly half (n=14,879; 46.9%) were referred to cardiac rehabilitation.

VI. COMORBIDITIES AMONG MI PATIENTS

Figures 32-34 and Table 29 show the percentages (2008-2019) of comorbidities among all MI patients.

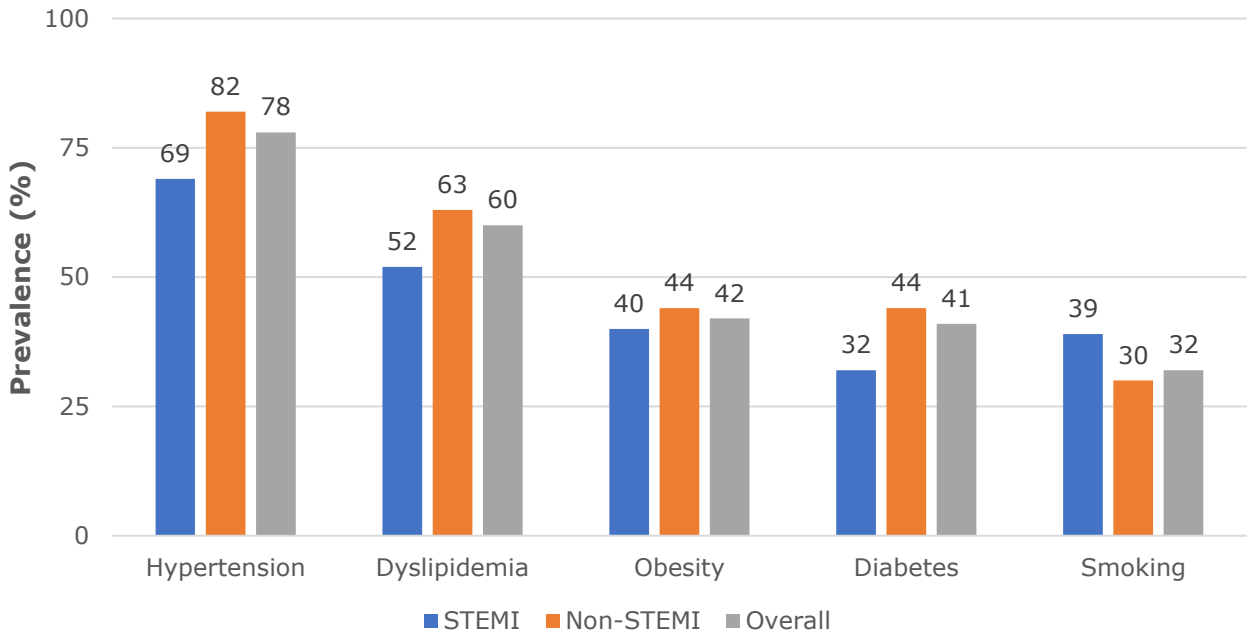

Figure 32. Prevalence of select comorbidities, overall and by MI sub-type, 2008-2019

Table 29. Prevalence of select comorbidities among MI patients, 2008-2019

	N (%)		
	Yes	**No**	**Missing**
Hypertension	54,198 (78.0)	15,280 (21.9)	24 (<0.1)
Dyslipidemia	41,173 (59.2)	27,445 (39.5)	884 (1.3)
Obese	29,176 (42.0)	38,822 (55.9)	1,506 (2.2)
Diabetes	28,187 (40.6)	41,273 (59.4)	44 (<0.1)
Smoker	22,532 (32.4)	46,783 (67.3)	187 (0.3)

Out of 69,502 MI patients, eight in 10 (78.0%) were hypertensive, six in 10 (59.2%) had dyslipidemia (defined as total cholesterol > 200 mg/dL, low density lipoprotein [LDL] >= 130 mg/dL, or high density lipoprotein [HDL] < 40 mg/dL), four in 10 (42.0%) were obese or had diabetes (40.6%), three in 10 (32.4%) were current or recent smokers (within the past year), and almost three in 10 (26.9%) were anemic. Missing values for each comorbidity were excluded from further analysis. Hypertension is a very common and important risk factor for MI, and efforts should be taken to reduce the prevalence of hypertension.

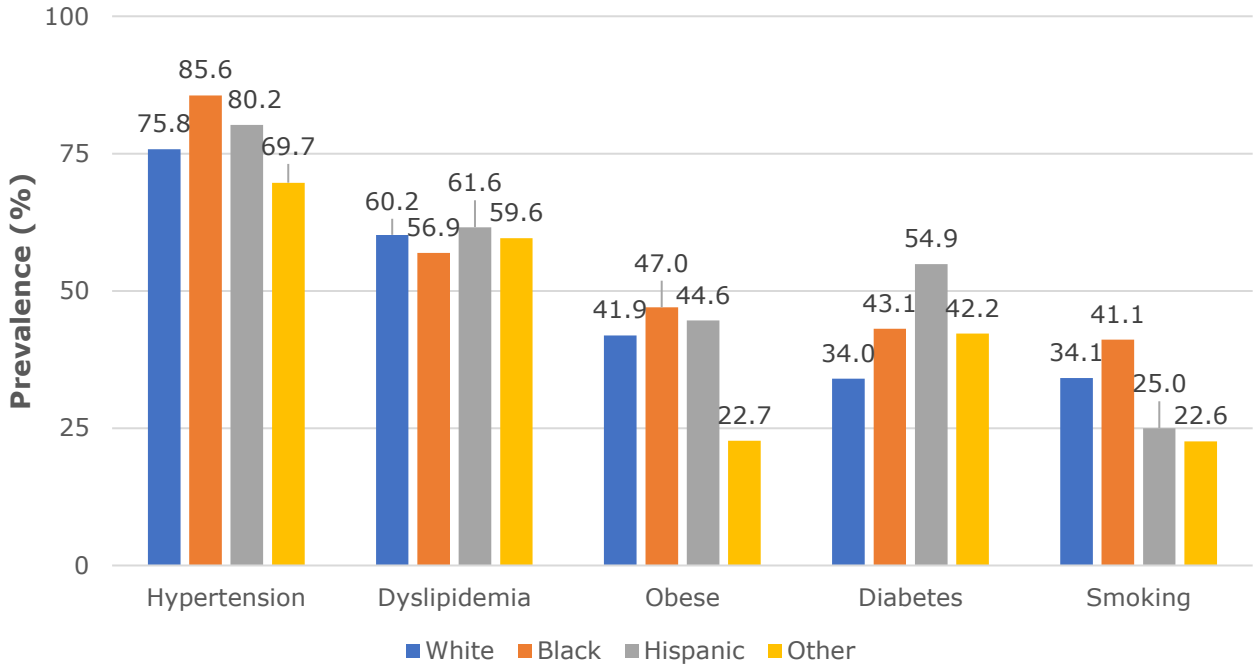

Figure 33. Prevalence of select comorbidities among MI patients, by race and ethnicity groups, 2008-2019

Comorbidities were examined by race and ethnicity. Of White MI patients, almost eight in 10 (76%) were hypertensive, six in ten (60%) had dyslipidemia, four in 10 (42%) were obese, one-third (34%) had diabetes or were current / recent smokers (34%), and two in 10 (23%) were anemic. Of Black MI patients, almost nine in 10 (86%) were hypertensive,

six in 10 (57%) had dyslipidemia, 47% were obese, 43% had diabetes, 41% were current or recent smokers, and 37% were anemic. Of Hispanic MI patients, three in four (80%) were hypertensive, six in 10 (62%) had dyslipidemia, five in 10 had diabetes (55%), or were obese (45%), one in four (25%) were current or recent smokers, and almost three in 10 (32%) were anemic. Hypertension, obesity, smoking, and anemia were more prevalent among Black than White or Hispanic cases, while diabetes was more prevalent among Hispanic than among Black or White cases.

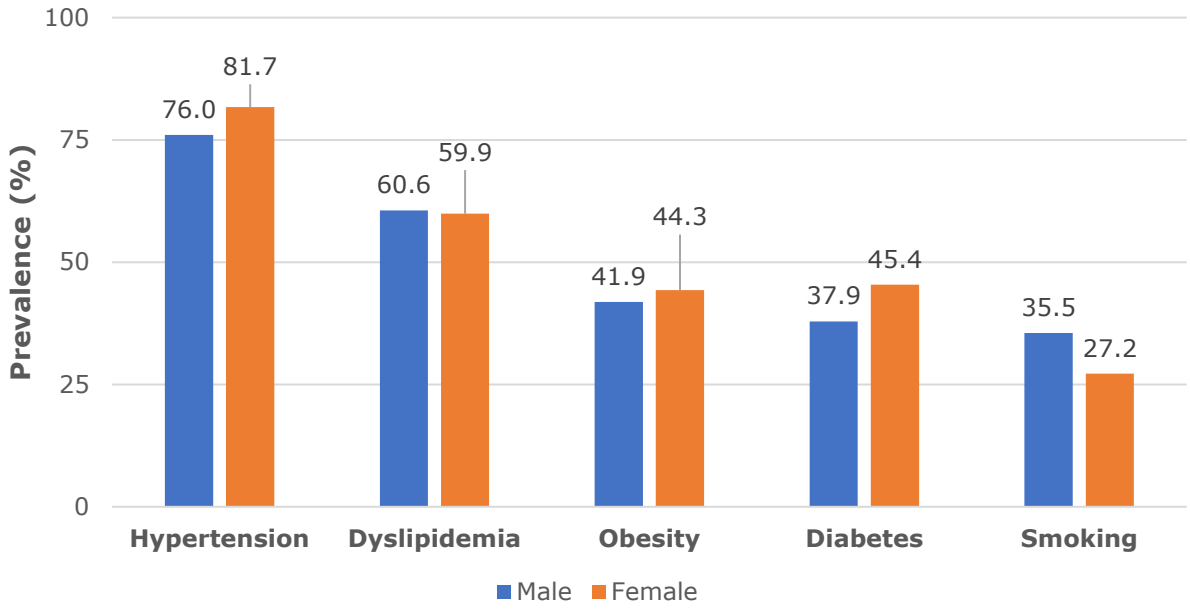

Figure 34. Prevalence of comorbidities among MI patients, by sex, 2008-2019

Comorbidities are more prevalent among female than male MI cases with the exception of smoking (more common among males), and dyslipidemia (same for either sex).

SMOKING CESSATION ADVICE UPON DISCHARGE AMONG MI PATIENTS

Smoking is a major modifiable risk factor for heart attack. Smoking increases the risk of atherosclerosis, increases the levels of triglycerides, and decreases the levels of beneficial high–density lipoprotein cholesterol (HDLc). All of these negatively impact the heart's blood flow and can thereby increase the risk of MI. [10] Smoking causes one of every three deaths from cardiovascular disease. [10] According to the World Health Organization's Tobacco Free Initiative, MI patients who quit smoking after an episode of heart attack reduce their chance of having another heart attack by 50%. [11]

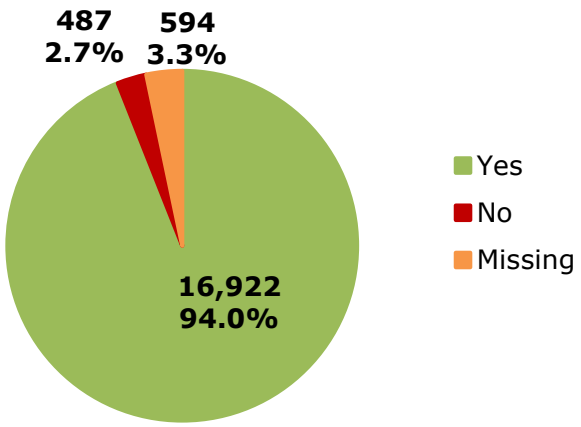

Figure 35. Smoking cessation advice given upon discharge among MI patients who were current or recent smokers, 2008-2018

From 2008-2018, of the total MI cases reported, almost a third (32.4%) were smokers. At time of hospital discharge, more than nine in 10 (94.0%) MI patients who reported being smokers were advised for smoking cessation. Three in 100 (2.7%) were not advised, and data were missing for 3.3%. Note that this data element was no longer collected in 2019 as most hospitals were performing near 100%.

PRIOR DIABETES TREATMENT UPON ADMISSION AMONG MI PATIENTS

Diabetes mellitus is a major public health problem, affecting an estimated 10.5% of the US population in 2017, [12] and is related to an increased risk of MI. [13] Studies show that people with diabetes are not only more likely to have an MI than someone without diabetes, but are also twice as likely to die from their MI than someone without diabetes. [14] According to some studies, the renin-angiotensin system is activated in those with diabetes, and angiotensin II inhibition has proved to be more beneficial at improving mortality rates after MI in people with vs without diabetes. [14] Along with angiotensin II antagonists, anti-hyperglycemic therapy may also improve mortality after MI in people with diabetes. [14]

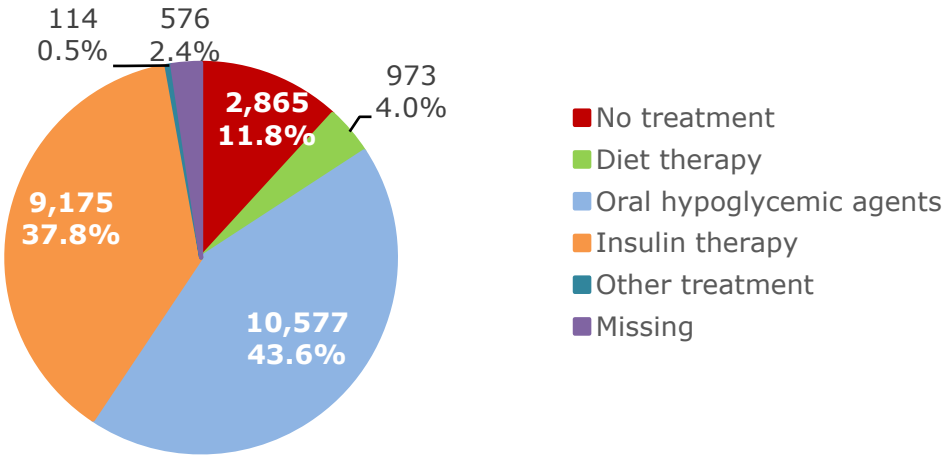

Figure 36. Diabetes treatment methods upon admission among MI patients, 2008-2018

Between 2008 and 2018, four in ten MI cases (n=28,187, 40.6%) had a diabetes diagnosis prior to their MI. Of these, just over one in ten (11.8%) were not on a plan to control their diabetes; four in 100 (4.0%) were on diet only treatment; four in 10 (43.6%) were on oral anti-hyperglycemic agents; and almost four in 10 (37.8%) were on insulin therapy. Data on this measure were missing for 2.4% of cases. In 2019, data collection procedures changed, and diet therapy and other treatment were no longer collected as measures for diabetes control. However, in 2019, among patients with diabetes, one-third (33.4%) were on insulin therapy and half (50.0%) were on oral anti-hyperglycemic agents.

EVALUATION OF TRIGLYCERIDE LEVELS AMONG MI PATIENTS

Hypertriglyceridemia may substantially increase cardiovascular disease risk. [15] It is recommended that patients with primary hypertriglyceridemia be evaluated for other cardiovascular risk factors such as central obesity, hypertension, liver dysfunction, and glucose metabolism abnormalities such as diabetes. [15] Normal triglyceride levels are below 150 mg/dl; levels between 150 - 199 mg/dl are considered as borderline high; levels between 200 - 499 mg/dl are considered high; and levels of 500 mg/dl or more are considered very high.

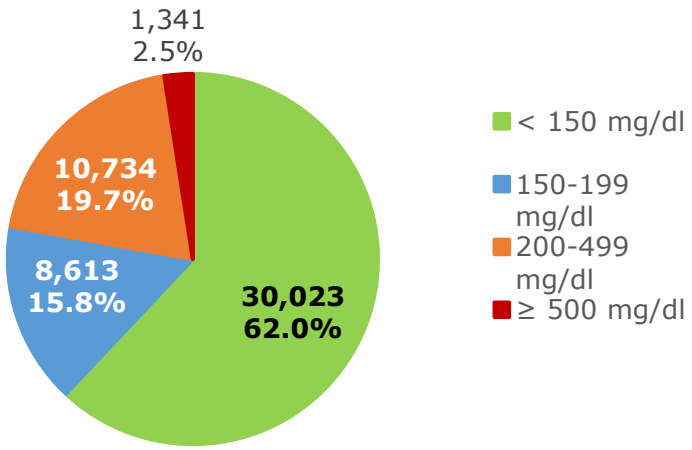

Figure 37: Triglyceride levels among MI patients, 2008-2019

Between 2008 and 2019, out of 54,481 MI cases with information on triglycerides at episode of care, six in 10 (62.0%) had triglyceride levels within normal limits (i.e., below 150 mg/dL). Of the remaining cases, sixteen in 100 (15.8%) had triglyceride levels between 150 - 199 mg/dL, twenty in 100 (19.7%) had triglycerides between 200 - 500 mg/dL, and three in 100 (2.5%) had triglyceride levels of 500 or more.

ASPIRIN ADMINISTERED WITHIN FIRST 24 HOURS OF EITHER FMC OR HOSPITAL ARRIVAL

Aspirin inhibits the enzyme cyclooxygenase I in the platelets and thereby reduces platelet aggregation. Daily aspirin therapy for the first five weeks after MI has been well established to reduce early mortality. [16]

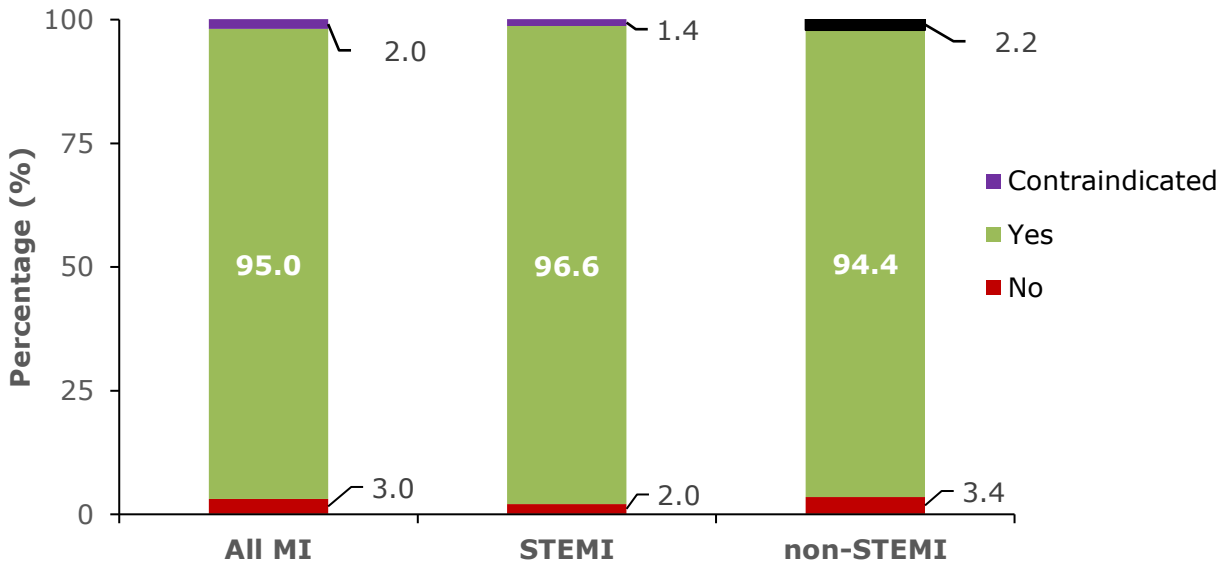

Figure 38: Aspirin administered within 24 hours of either FMC or hospital arrival, by MI type, 2008–2019

Table 30. Aspirin administered within 24 hours of either FMC or hospital arrival, by MI type, 2008-2019

		Aspirin administered with 24 hours of hospital arrival or First Medical Contact N (%)			
Cases	n	Yes	No	Contraindicated	Missing
All MI	69,502	66,000 (95.0)	2,103 (3.0)	1,360 (2.0)	39 (0.1)
STEMI	19,885	19,204 (96.6)	390 (2.0)	279 (1.4)	12 (0.1)
Non-STEMI	49,477	46,690 (94.4)	1,682 (3.4)	1,078 (2.2)	27 (0.1)

Out of 69,502 MI cases reported between 2008 and 2019, almost all (95.0%) were prescribed aspirin within 24 hours of either FMC or hospital arrival. Only 3.0% did not receive this therapy, and 2.0% had contraindications to aspirin use. The administration of aspirin within 24 hours of either FMC or hospital arrival among MI cases did not differ by sub-type (STEMI or non-STEMI). Out of 19,885 STEMI cases reported from 2008-2019, aspirin was prescribed within the first 24 hours of either FMC or hospital arrival for 96.6%, not prescribed for 2.0%, and contraindicated in 1.4%.

PRESCRIBING ASPIRIN AT DISCHARGE

As stated above, daily aspirin therapy for the first five weeks after MI has been well established to reduce mortality. [16] The following table and figure present data on the number and percentage of all MI cases, and by MI sub-type, who were prescribed aspirin upon hospital discharge, 2008-2019.

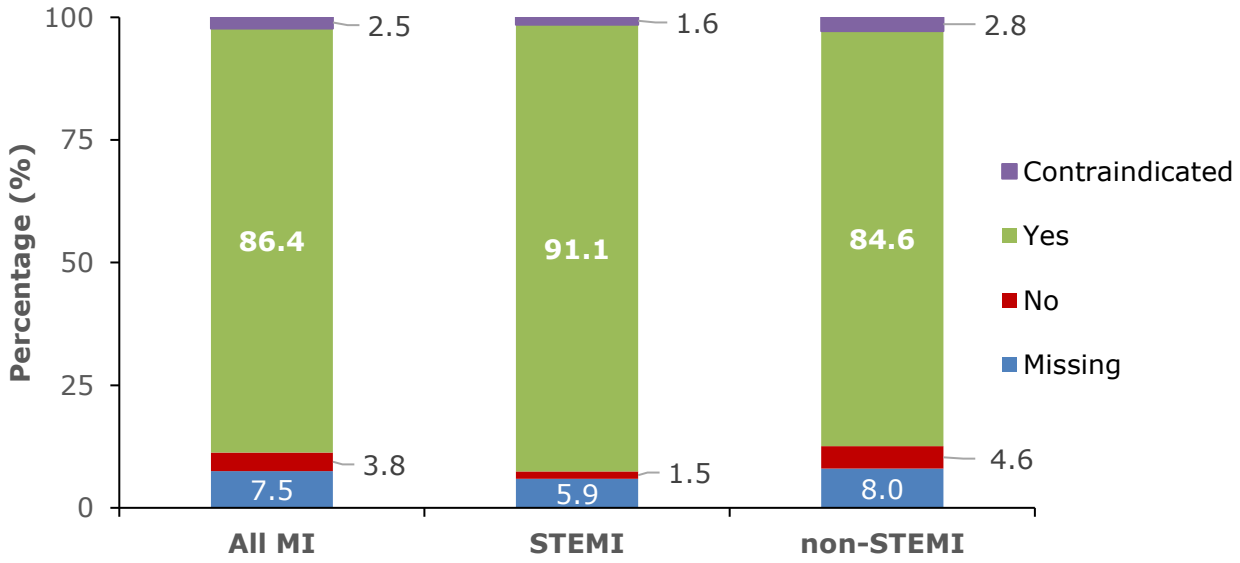

Figure 39. Aspirin prescribed at discharge, all MI and MI sub-types, 2008 -2019

Table 31. Aspirin prescribed at discharge, all MI and MI sub-type, 2008 -2019

		Aspirin prescribed at hospital discharge N (%)			
Cases	n	Yes	No	Contraindicated	Missing
All MI	66,685	57,581 (86.4)	2,498 (3.8)	1,640 (2.5)	4,966 (7.5)
STEMI	18,565	16,906 (91.1)	269 (1.5)	299 (1.6)	1,091 (5.9)
Non-STEMI	47,984	40,584 (84.6)	2,202 (4.6)	1,339 (2.8)	3,859 (8.0)

Out of 66,685 MI cases reported alive upon hospital discharge, between 2008 and 2019, 86 in 100 (86.0%) were prescribed aspirin at discharge; four in 100 (3.8%) were not prescribed aspirin and three in 100 had contraindication for aspirin (2.5%). Data were missing on 7.5% of overall MI cases. The administration of aspirin at discharge among MI patients was slightly higher among STEMI patients (91.1%) compared to non-STEMI patients (84.6%). Out of 18,565 STEMI cases alive upon hospital discharge (2008-2019),

nine in 10 (91.1%) were prescribed aspirin at discharge, nearly two in 100 (1.5%) were not, and two in 100 (1.6%) had contraindications. Data are missing for 5.9% of STEMI cases.

PRESCRIBING BETA-BLOCKERS AT DISCHARGE

Beta-blockers may reduce mortality in MI patients. [17] These medications effectively reduce resting and exercise-induced heart rate, blood pressure, and myocardial contractility, and hence myocardial oxygen demand. They are also associated with fewer dysrhythmias, limitation of infarct size, and lower incidence of ventricular septal rupture when given to MI patients. [17]

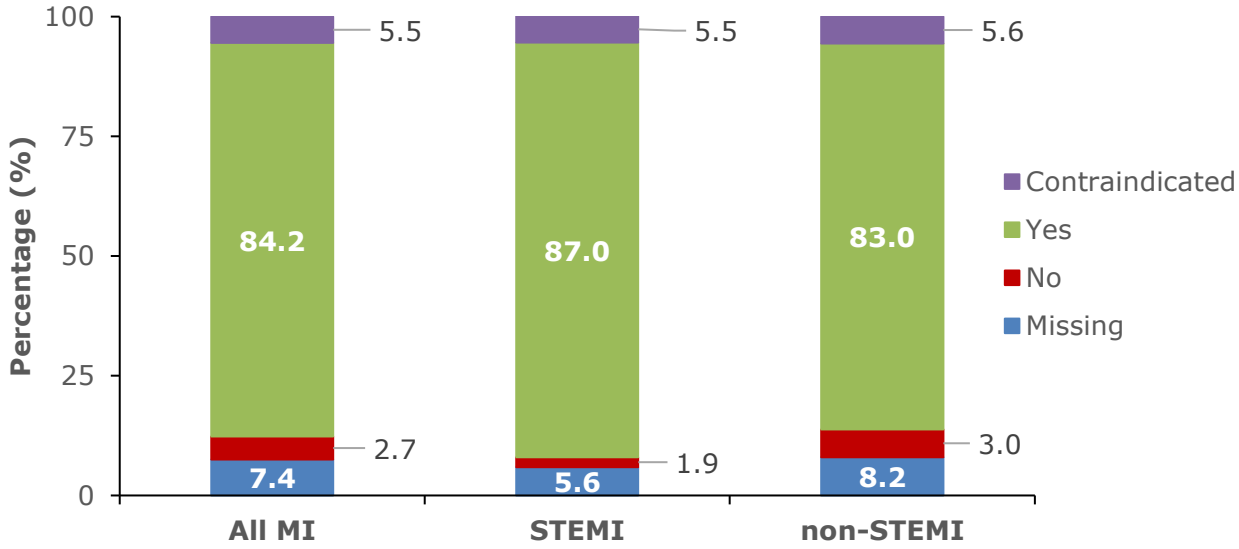

Figure 40. Beta-blockers prescribed at discharge, all MI and sub-types, 2008 -2019

Table 32. Beta-blockers prescribed at discharge, all MI and sub-types, 2008 -2019

		Beta-Blocker prescribed at hospital discharge N (%)			
Cases	n	Yes	No	Contraindicated	Missing
All MI	66,685	54,835 (82.2)	3,196 (4.8)	3,686 (5.5)	4,968 (7.5)
STEMI	18,565	16,078 (86.6)	383 (2.1)	1,012 (5.5)	1,092 (5.9)
Non-STEMI	47,984	38,677 (80.6)	2,778 (5.8)	2,669 (5.6)	3,860 (8.0)

Out of 66,685 cases of MI alive upon hospital discharge, 82 in 100 (82.2%) were prescribed beta-blockers upon hospital discharge, five in 100 (4.8%) were not prescribed beta-blockers, and six in 100 (5.5%) had contraindications for beta-blockers. Data on this measure were missing for 7.5% of cases. Prescribing beta-blockers at discharge among MI patients was slightly higher for STEMI (86.6%) vs. non-STEMI (80.6%) patients. Out

of 18,565 STEMI cases alive at hospital discharge, 86.6% were prescribed beta-blockers upon hospital discharge, 2.1% were not prescribed beta-blockers, and 5.5% had contraindications for beta-blockers. Data on this measure were missing values for 5.9% of cases.

PRESCRIBING STATINS AT DISCHARGE FOR LOW DENSITY LIPOPROTEIN CHOLESTEROL (LDLc) >= 100 MG/DL

There is strong evidence that statin therapy confers survival benefits for post MI patients. The literature shows that from 2007 to 2016, there have been improvements in statin use, adherence and adverse outcomes in patients with cardiovascular disease. During the same time period, out-of-pocket costs associated with statin use decreased, likely due to the availability of generic versions. [16].

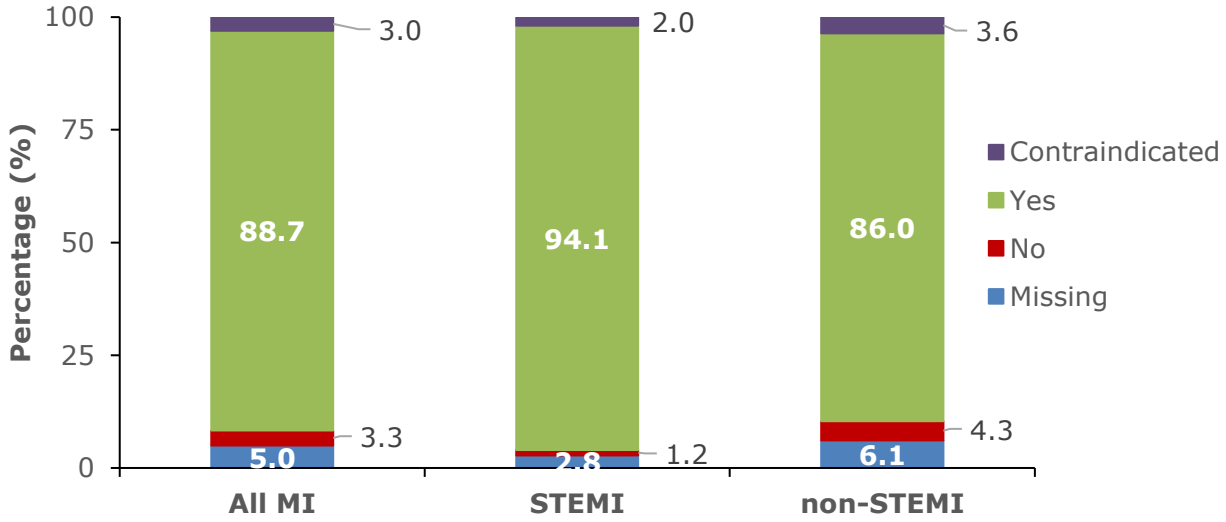

Figure 41. Statin prescribed at hospital discharge for MI cases with LDLc ≥100 mg/dl, 2008-2019

Table 33. Statin prescribed at hospital discharge for MI cases with LDLc ≥100 mg/dl, 2008-2019

		Statin prescribed at hospital discharge N (%)			
Cases	n	Yes	No	Contraindicated	Missing
All MI	23,911	21,202 (88.7)	786 (3.3)	724 (3.0)	1,199 (5.0)
STEMI	7,904	7,434 (94.1)	94 (1.2)	155 (2.0)	221 (2.8)
Non-STEMI	15,907	13,739 (86.0)	687 (4.3)	568 (3.6)	976 (6.1)

Out of 23,911 reported cases of MI with LDLc ≥ 100 mg/dl alive upon hospital discharge, 89 in 100 (88.7%) were prescribed a statin upon hospital discharge, one in 100 were not

(1.2%), and three in 100 (2.8%) had a contraindication for statins. Slightly more STEMI vs. non-STEMI cases were prescribed statins upon hospital discharge. Out of 7,904 reported STEMI cases with LDLc ≥ 100mg/dl, 94.1% were prescribed a statin upon hospital discharge, 1.2% were not prescribed a statin, and 2.0% had contraindications for statins.

ACE INHIBITORS OR ARB AT DISCHARGE (EJECTION FRACTION, EF, < 40%)

Many studies have examined the role of Angiotensin converting enzyme (ACE) inhibitors or Angiotensin II receptor blockers (ARB) in post MI patients with reduced left ventricular function (decreased left ventricular ejection fraction, LVEF) and have found modest treatment benefits with these drugs. [15] ACE inhibitors competitively antagonize the conversion of the enzyme angiotensin I to angiotensin II and hence reduce systemic vascular resistance and cardiac afterload. [15] These drugs also reduce cardiac preload by decreasing aldosterone release and hence a reduction of circulating fluid overload. [15] They have been shown to decrease mortality rates in MI patients, and recent MI patients with left ventricular (LV) systolic dysfunction, patients with diabetes mellitus and with LV dysfunction, and also patients with normal LV function. [7] ARBs are prescribed for patients who have adverse effects with ACE inhibitors.

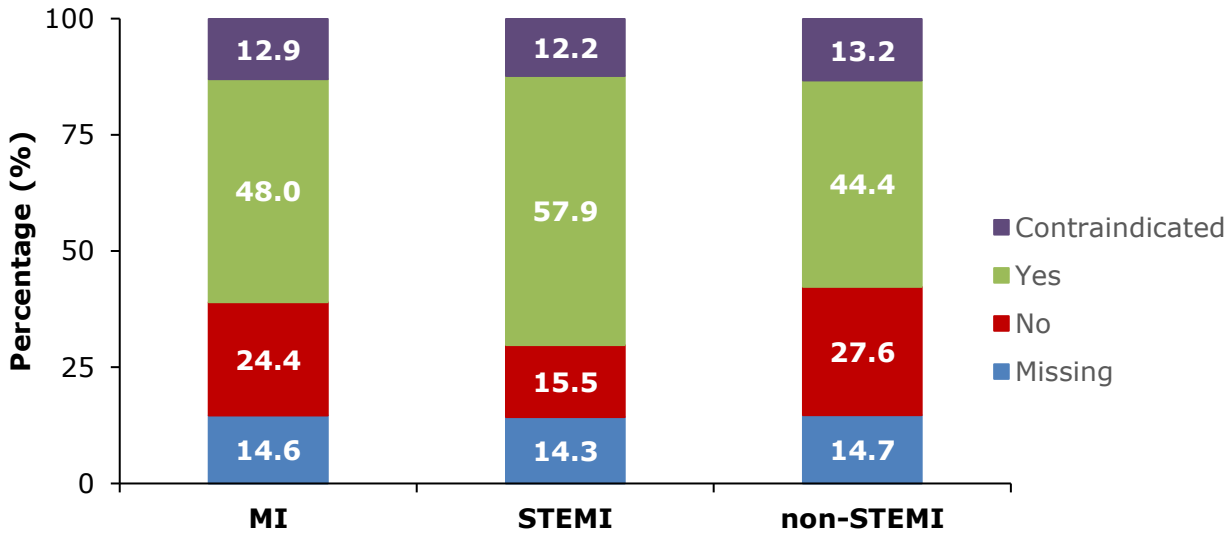

Figure 42. ACE Inhibitors prescribed at hospital discharge for MI cases with LVEF <40%, 2008-2019

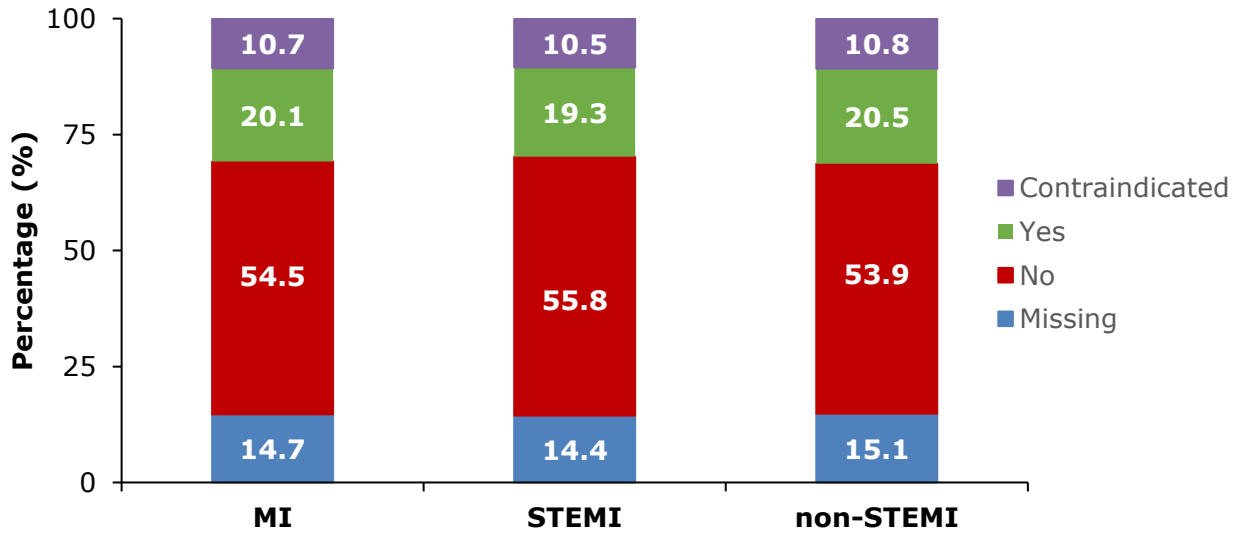

Figure 43. ARB prescribed at hospital discharge for MI cases with LVEF <40%, 2008-2019

Table 34. ACE inhibitor or ARB prescribed at hospital discharge for MI cases with LVEF <40%, 2008-2019

		ACE Inhibitor (ACEI) or ARB prescribed at hospital discharge							
	Cases n	Yes n (%)		No n (%)		Contraindicated n (%)		Missing n (%)	
		ACEI	**ARB**	**ACEI**	**ARB**	**ACEI**	**ARB**	**ACEI**	**ARB**
ALL MI	17,801	8,549 (48.0)	3,582 (20.1)	4,344 (24.4)	9,693 (54.5)	2,302 (12.9)	1,906 (10.7)	2,606 (14.6)	2,620 (14.7)
STEMI	4,860	2,813 (57.9)	939 (19.3)	755 (15.5)	2,710 (55.8)	595 (12.2)	509 (10.5)	697 (14.3)	702 (14.4)
Non-STEMI	12,890	5,726 (44.4)	2,637 (20.5)	3,563 (27.6)	6,952 (53.9)	1,704 (13.2)	1,395 (10.8)	1,897 (14.7)	1,906 (14.8)

Out of 17,801 reported MI cases with LVEF <40 % who were alive at hospital discharge, nearly half (48.0%) were prescribed ACE inhibitors upon hospital discharge, 24 in 100 (24.4%) were not prescribed ACE inhibitors, and 13 in 100 (12.9%) had a contraindication. Data on this measure were missing for 14.6% of cases. The prescription of ACE inhibitors at discharge among MI cases varied slightly by STEMI or non-STEMI type, with more STEMI cases being prescribed ACE inhibitors than non-STEMI cases. Out of 4,860 reported STEMI cases with LVEF <40 %, more than half (57.9%) were prescribed an ACE inhibitor upon hospital discharge, 16 in 100 (15.5%) were not prescribed an ACE inhibitor, and 12 in 100 (12.2%) had a contraindication for ACE inhibitors. Data on this measure were missing for 14.3% of cases.

At time of hospital discharge, ARBs were prescribed to 20 in 100 (20.1%) of the 17,801 MI cases with LVEF <40%, and to nine in 100 (8.5%) of the STEMI cases. The prescription of ARBs at discharge among MI cases was similar by STEMI or non-STEMI type, with ARBs prescribed with similar frequency to non-STEMI than to STEMI cases

(20.5% and 19.3%, respectively). Combined together, 68 in 100 (68.1%) of all MI cases, including 77 in 100 (77.2%) STEMI cases and 65 in 100 (64.9%) non-STEMI cases, were prescribed any treatment for reduced left ventricular function at discharge.

TOTAL LIPID ASSESSMENT

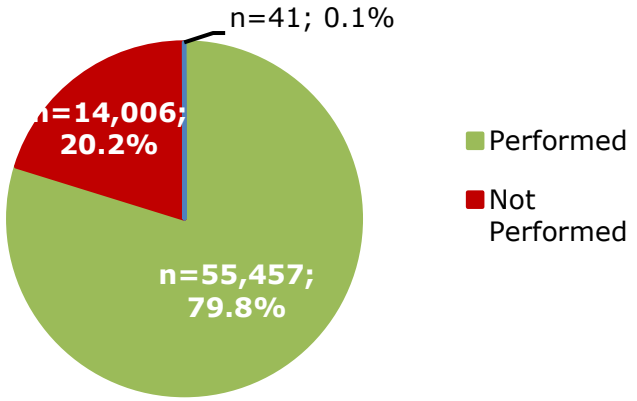

Figure 44: Total lipid assessment among MI patients, 2008-2019

Of the 69,502 reported MI cases between 2008 and 2019, eight in ten (79.8%) had a lipid (total lipids and LDLc) panel assessment, but this was not performed in the remaining 20.2%. Among STEMI cases reported over the same period, lipid assessment was done in a similar number of patients (82.9%).

VII. UNADJUSTED IN-HOSPITAL MORTALITY RATES

The table and figure shown below display the unadjusted in-hospital mortality rates for MI cases (overall and by sub-type), between 2008 and 2019. Out of the 69,502 MIs reported, more than nine in 10 (96.0%) were alive upon hospital discharge.

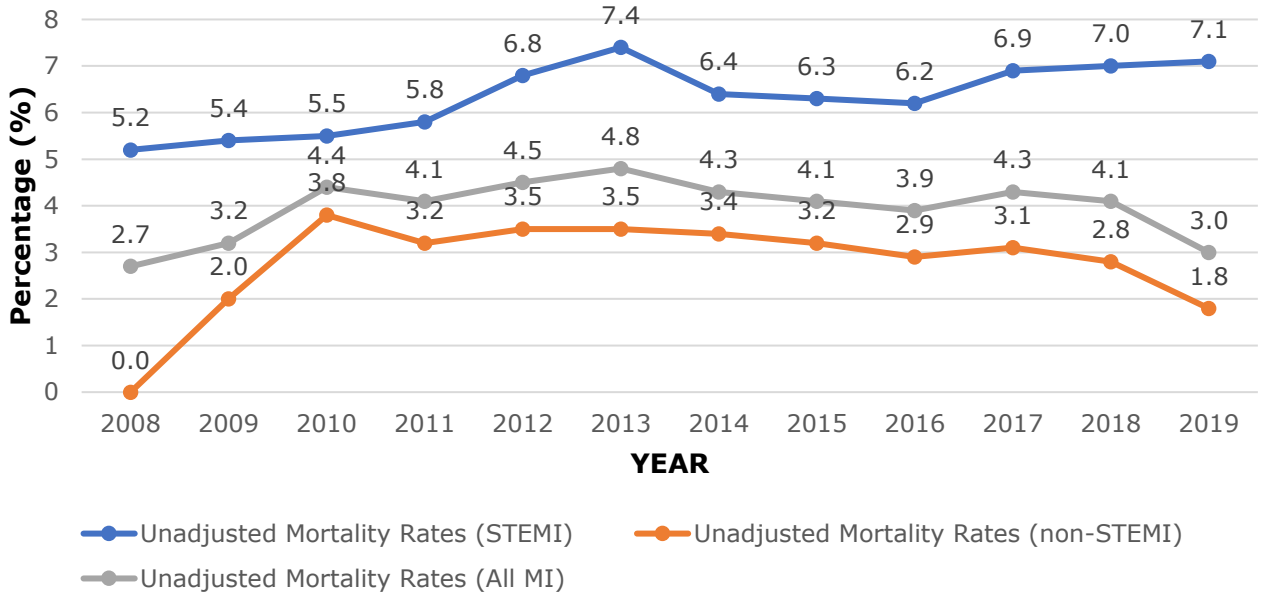

Figure 45. Unadjusted in-hospital mortality rates among STEMI, non-STEMI and all MI cases, 2008-2019

Table 35. Unadjusted in-hospital mortality rates among STEMI, non-STEMI and all MI cases, 2008 – 2019

Year	STEMI	In-hospital deaths	Non-STEMI	In-hospital deaths	All MI	In-hospital deaths
	n	n (%)	n	n (%)	n	n (%)
2008	58	3 (5.2)	54	0 (0.0)	112	3 (2.7)
2009	294	16 (5.4)	513	10 (2.0)	807	26 (3.2)
2010	1,007	55 (5.5)	1,880	71 (3.8)	2,887	126 (4.4)
2011	1,566	91 (5.8)	2,916	93 (3.2)	4,482	184 (4.1)
2012	1,776	120 (6.8)	3,880	134 (3.5)	5,656	254 (4.5)
2013	2,019	149 (7.4)	4,212	148 (3.5)	6,231	297 (4.8)
2014	2,171	139 (6.4)	4,862	164 (3.4)	7,033	303 (4.3)
2015	2,368	148 (6.3)	5,241	165 (3.2)	7,609	313 (4.1)
2016	2,651	164 (6.2)	5,874	169 (2.9)	8,525	333 (3.9)
2017	2,579	179 (6.9)	5,692	176 (3.1)	8,271	355 (4.3)
2018	2,584	180 (7.0)	5,876	164 (2.8)	8,460	344 (4.1)
2019	2,110	150 (7.1)	7,319	129 (1.8)	9,429	279 (3.0)

The in-hospital mortality rates range from a low of 5.2% in 2008 to a high of 7.4% in 2013 among STEMI patients. Rates then declined slowly each year until 2016, and have increased annually since then. Among non-STEMI patients, the mortality rates range from a low of 0% in 2008 to a high of 3.8% in 2010, with a general downward trend since then. Across all years, twice as many STEMI than non-STEMI cases died during their episode of care: nearly seven in 100 STEMI cases (6.6%) as compared with three in 100 non-STEMI cases (3.0%). Note: Care should be taken when interpreting rates from 2008, which are reported only from the fourth quarter.

VIII. APPENDIX – DATA SOURCES AND DEFINITIONS

Glossary

- ***First hospital*** refers to the facility where a patient is initially seen.
- ***STEMI referral hospital*** refers to a facility where a patient is initially seen and from which the patient is transferred to a STEMI receiving facility. All STEMI referral hospitals are considered **first hospitals**.
- ***STEMI receiving hospital*** refers to a facility to which a patient is transferred after being initially seen at a non-PCI-capable hospital or STEMI referral hospital.
- ***Directly-admitted patient*** refers to a STEMI patient first presents to a STEMI receiving hospital or PCI-capable hospital, bypassing a STEMI referral hospital.
- ***Transfer patient*** refers to a STEMI patient who first presents at a STEMI referral hospital and requires transfer to a STEMI receiving hospital.

Table 1

Data Source: Texas Behavioral Risk Factor Surveillance System Public Use Data File, 2011-18. Texas Department of State Health Services, Center for Health Statistics, Austin, Texas.

Table 2

Data Sources: Texas Hospital Inpatient Discharge Public Use Data File, 2008-18. Texas Department of State Health Services, Center for Health Statistics, Austin, Texas; and County-Level Population Data, 2008-18. Texas Department of State Health Services, Center for Health Statistics, Austin, Texas.

Prior to September 2015, hospitalization rates were based on hospital records for which acute myocardial infarction was coded as the principal diagnosis, using International Classification of Diseases, Ninth Revision, Clinical Modification **(ICD-9-CM)** codes 410.00-410.01, 410.10-410.11, 410.20-410.21, 410.30-410.31, 410.40-410.41, 410-.50-410.51, 410.60-410.61, 410.70-410.71, 410.80-410.81, 410.90-410.91, a classification defined in the Specifications Manual for National Hospital Inpatient Quality Measures. Records from September 2015 forward are based on **ICD-10** codes I21-22. Excludes records for HIV and drug/alcohol use patients and non-residents hospitalized in-state. Population estimates were generated using the 2000 Projected U.S. Standard Population for age-adjustment and the following age-adjustment groups: 0-4, 5-9, 10-14, 15-34, 35-64, 65+.

Figure 1

Data Sources: County-Level Mortality Data, 2010-17. Texas Department of State Health Services, Center for Health Statistics, Austin, Texas; and County-Level Population Data, 2009-17. Texas Department of State Health Services, Center for Health Statistics, Austin, Texas.

Mortality rates were based on death records for which heart attack was coded as the underlying cause of death, using International Classification of Diseases, Tenth Revision (ICD-10) codes I21-I22; and generated using the 2000 U.S. Standard Population for age-adjustment and the following age-adjustment groups: 0, 1-4, 5-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74,75+

Figure 2

Source: Bates, E.R. and Jacobs, A.K. (2013). Time to treatment in patients with STEMI. *The New England Journal of Medicine, 369* (10), 889-892.

PRE-HOSPITAL ECG WITHIN 10 MINUTES OF FIRST MEDICAL CONTACT

Definition

Time to pre-hospital ECG was estimated by measuring the time elapsed from first medical contact (when the patient was first evaluated by either emergency medical services or another healthcare provider prior to arrival at the hospital) to receipt of first ECG among patients arriving at the hospital by ambulance and receiving their first ECG prior to arrival at the hospital.

Population excludes patients:

- <18 years old
- Arriving at STEMI receiving hospital via personal vehicle, mobile ICU, or air
- Received as transfer from STEMI referral hospital to STEMI receiving hospital
- Receiving first ECG after arrival at STEMI receiving hospital
- Receiving first ECG>24 hours after first medical contact
- With incomplete records—i.e., records with missing data for any variable used to define the population

TIME FROM HOSPITAL ARRIVAL TO FIRST ECG AMONG TRANSFER CASES

Definition

Time to ECG was estimated by measuring the time elapsed from arrival at a STEMI referral hospital to receipt of first ECG. Thus, for episodes of care involving patients received as transfers at the STEMI receiving hospital, the date and time of arrival at the STEMI referral hospital, as documented by the STEMI receiving hospital, was used to clock time to ECG.

Population excludes patients:

- <18 years old
- Arriving at STEMI referral hospital via mobile ICU or air
- Directly admitted to STEMI receiving hospital
- Receiving first ECG before arrival at STEMI referral hospital, e.g., while in transit in an ambulance
- Receiving first ECG>24 hours after arrival at STEMI referral hospital
- With incomplete records—i.e., records with missing data for any variable used to define the population

TIME FROM HOSPITAL ARRIVAL TO FIRST ECG AMONG DIRECTLY-ADMITTED CASES

Definition

Time to ECG was estimated by measuring the time elapsed from arrival at the STEMI receiving hospital to receipt of first ECG.

Population excludes patients:

- <18 years old

- Arriving at STEMI receiving hospital via mobile ICU or air
- Received as transfer from STEMI referral hospital to STEMI receiving hospital
- Receiving first ECG before arrival at STEMI receiving hospital, e.g., while in transit in an ambulance
- Receiving first ECG>24 hours after arrival at STEMI receiving hospital
- With incomplete records—i.e., records with missing data for any variable used to define the population

HOSPITAL ECG WITHIN 10 MINUTES OF ARRIVAL AMONG TRANSFER CASES

Definition

Time to ECG was estimated by measuring the time elapsed from arrival at the STEMI referral hospital to receipt of first ECG. Thus, for episodes of care involving patients received as transfers at a STEMI receiving hospital, the date and time of arrival at the transferring hospital, as documented by the STEMI receiving hospital, was used to clock time to ECG.

Population excludes patients:

- <18 years old
- Arriving at STEMI referral hospital via mobile ICU or air
- Directly admitted to STEMI receiving hospital
- Receiving first ECG before arrival at STEMI referral hospital, e.g., while in transit in an ambulance
- Receiving first ECG>24 hours after arrival at STEMI referral hospital
- With incomplete records—i.e., records with missing data for any variable used to define the population

HOSPITAL ECG WITHIN 10 MINUTES OF ARRIVAL AMONG DIRECTLY-ADMITTED CASES

Definition

Time to ECG was estimated by measuring the time elapsed from arrival at the STEMI receiving hospital to receipt of first ECG.

Population excludes patients:

- <18 years old
- Arriving at STEMI receiving hospital via mobile ICU or air
- Received as transfer from STEMI referral hospital to STEMI receiving hospital
- Receiving first ECG before arrival at STEMI receiving hospital, e.g., while in transit in an ambulance
- Receiving first ECG>24 hours after arrival at STEMI receiving hospital
- With incomplete records—i.e., records with missing data for any variable used to define the population

DWELL TIME IN THE EMERGENCY DEPARTMENT OF REFERRAL HOSPITAL

Definition

Dwell time in the emergency department was estimated by measuring the time elapsed from arrival at the STEMI referral hospital to discharge at the STEMI referral hospital.

Population excludes patients:

- <18 years old

- Diagnosed with non-STEMI heart attack
- Arriving at STEMI referral hospital via mobile ICU or air
- Directly admitted to STEMI receiving hospital
- Not first evaluated in the emergency department of STEMI referral hospital
- Not discharged and transferred to another hospital for PCI
- Transferred >24 hours after arrival at STEMI referral hospital
- With incomplete records—i.e., records with missing data for any variable used to define the population

DWELL TIME IN THE EMERGENCY DEPARTMENT OF RECEIVING HOSPITAL AMONG TRANSFER CASES

Definition

Time spent in the emergency department was estimated by measuring the time elapsed from arrival at the STEMI receiving hospital to transfer out of the emergency department of the STEMI receiving hospital. Thus, for episodes of care involving patients received as transfers at the STEMI receiving hospital, the time elapsed reflects wait time at the subsequent hospital and not at the STEMI referral hospital.

Population excludes patients:

- <18 years old
- Diagnosed with non-STEMI heart attack
- Diagnosed with STEMI heart attack on subsequent ECG
- Arriving at STEMI referral hospital via mobile ICU or air
- Directly admitted to STEMI receiving hospital
- Not first evaluated in the emergency department of STEMI receiving hospital
- Spending >24 hours in the emergency department of STEMI receiving hospital
- With incomplete records—i.e., records with missing data for any variable used to define the population

DWELL TIME IN THE EMERGENCY DEPARTMENT OF RECEIVING HOSPITAL AMONG DIRECTLY-ADMITTED CASES

Definition

Time spent in the emergency department was estimated by measuring the time elapsed from arrival at the STEMI receiving hospital to transfer out of the emergency department of the STEMI receiving hospital.

Population excludes patients:

- <18 years old
- Diagnosed with non-STEMI heart attack
- Diagnosed with STEMI heart attack on subsequent ECG
- Arriving at STEMI receiving hospital via mobile ICU or air
- Received as transfer from STEMI referral hospital to STEMI receiving hospital
- Not first evaluated in the emergency department of STEMI receiving hospital
- Spending >24 hours in the emergency department of STEMI receiving hospital
- With incomplete records—i.e., records with missing data for any variable used to define the population

FIRST DOOR-TO-NEEDLE TIME

Definition

Door to needle time was estimated by measuring the time elapsed from arrival at the STEMI referral hospital to receipt of fibrinolytic therapy at the STEMI referral hospital. For episodes of care involving patients received as transfers at the STEMI receiving hospital, the date and time of arrival at the STEMI referral hospital, as documented by the STEMI receiving hospital, was used to clock door to needle time.

Population excludes patients:

- <18 years old
- Diagnosed with non-STEMI heart attack
- Diagnosed with STEMI heart attack on subsequent ECG
- Arriving at STEMI referral hospital via mobile ICU or air
- Directly admitted to STEMI receiving hospital
- Receiving percutaneous coronary intervention for reperfusion therapy
- With a non-system reason for delay of fibrinolysis
- Receiving fibrinolysis >6 hours after arrival at STEMI referral hospital
- With incomplete records—i.e., records with missing data for any variable used to define the population

DOOR-TO-NEEDLE TIME WITHIN 30 MINUTES AMONG TRANSFER CASES

Definition

Door to needle time was estimated by measuring the time elapsed from arrival at the STEMI referral hospital to receipt of fibrinolytic therapy at the STEMI referral hospital. For episodes of care involving patients received as transfers at the STEMI receiving hospital, the date and time of arrival at the STEMI referral hospital, as documented by the STEMI receiving hospital, was used to clock door to needle time.

Population excludes patients:

- <18 years old
- Diagnosed with non-STEMI heart attack
- Diagnosed with STEMI heart attack on subsequent ECG
- Arriving at STEMI referral hospital via mobile ICU or air
- Directly admitted to STEMI receiving hospital
- Receiving percutaneous coronary intervention for reperfusion therapy
- With a non-system reason for delay of fibrinolysis
- Receiving fibrinolysis >6 hours after arrival at STEMI referral hospital
- With incomplete records—i.e., records with missing data for any variable used to define the population

DOOR-TO-BALLOON TIME FOR DIRECTLY-ADMITTED CASES

Definition

Door to balloon time was estimated by measuring the time elapsed from arrival at the hospital to receipt of primary percutaneous coronary intervention.

Population excludes patients:

- <18 years old
- Diagnosed with non-STEMI heart attack
- Diagnosed with STEMI heart attack on subsequent ECG
- Arriving at STEMI receiving hospital via mobile ICU or air
- Received as transfer from STEMI referral hospital to STEMI receiving hospital
- Not receiving percutaneous coronary intervention as primary reperfusion therapy
- With a non-system reason for delay of percutaneous coronary intervention
- Receiving percutaneous coronary intervention >24 hours after arrival at STEMI receiving hospital
- With incomplete records—i.e., records with missing data for any variable used to define the population

DOOR-TO-BALLOON TIME WITHIN 90 MINUTES FOR DIRECTLY-ADMITTED CASES

Definition

Door to balloon time was estimated by measuring the time elapsed from arrival at the STEMI receiving hospital to receipt of primary percutaneous coronary intervention.

Population excludes patients:

- <18 years old
- Diagnosed with non-STEMI heart attack
- Diagnosed with STEMI heart attack on subsequent ECG
- Arriving at STEMI receiving hospital via mobile ICU or air
- Received as transfer from STEMI referral hospital to STEMI receiving hospital
- Not receiving percutaneous coronary intervention as primary reperfusion therapy
- With a non-system reason for delay of percutaneous coronary intervention
- Receiving percutaneous coronary intervention >24 hours after hospital arrival at STEMI receiving hospital
- With incomplete records—i.e., records with missing data for any variable used to define the population

FIRST DOOR-TO-BALLOON TIME FOR TRANSFER CASES

Definition

Time from first door to balloon was estimated by measuring the time elapsed from arrival at the STEMI referral hospital to receipt of primary percutaneous coronary intervention at the STEMI receiving hospital. For episodes of care involving patients received as transfers at the STEMI receiving hospital, the date and time of arrival at the STEMI referral hospital, as documented by the STEMI receiving hospital, was used to clock first door to balloon time.

Population excludes patients:

- <18 years old
- Diagnosed with non-STEMI heart attack
- Diagnosed with STEMI heart attack on subsequent ECG
- Arriving at STEMI referral hospital via mobile ICU or air
- Directly admitted to STEMI receiving hospital
- Not receiving percutaneous coronary intervention as primary reperfusion therapy
- With a non-system reason for delay of percutaneous coronary intervention
- Receiving percutaneous coronary intervention >24 hours after arrival at STEMI referral hospital

- With incomplete records—i.e., records with missing data for any variable used to define the population

FIRST DOOR-TO-BALLOON TIME WITHIN 120 MINUTES FOR TRANSFER CASES

Definition

Time from first door to balloon was estimated by measuring the time elapsed from arrival at the STEMI referral hospital to receipt of primary percutaneous coronary intervention at the STEMI receiving hospital. For episodes of care involving patients received as transfers at the STEMI receiving hospital, the date and time of arrival at the STEMI referral hospital, as documented by the STEMI receiving hospital, was used to clock first door to balloon time.

Population excludes patients:

- <18 years old
- Diagnosed with non-STEMI heart attack
- Diagnosed with STEMI heart attack on subsequent ECG
- Arriving at STEMI referral hospital via mobile ICU or air
- Directly admitted to STEMI receiving hospital
- Not receiving percutaneous coronary intervention as primary reperfusion therapy
- With a non-system reason for delay of percutaneous coronary intervention
- Receiving percutaneous coronary intervention >24 hours after arrival at STEMI referral hospital
- With incomplete records – i.e., records with missing data for any variable used to define the population.

FIRST DOOR-TO-BALLOON TIME WITHIN 90 MINUTES FOR TRANSFER CASES

Definition

Time from first door to balloon was estimated by measuring the time elapsed from arrival at the STEMI referral hospital to receipt of primary percutaneous coronary intervention at the STEMI receiving hospital.

Population excludes patients:

- <18 years old
- Diagnosed with non-STEMI heart attack
- Diagnosed with STEMI heart attack on subsequent ECG
- Arriving at STEMI referral hospital via mobile ICU or air
- Directly admitted to STEMI receiving hospital
- Not receiving percutaneous coronary intervention as primary reperfusion therapy
- With a non-system reason for delay of percutaneous coronary intervention
- Receiving percutaneous coronary intervention >24 hours after arrival at STEMI referral hospital
- With incomplete records – i.e., records with missing data for any variable used to define the population.

FIRST MEDICAL CONTACT TO BALLOON TIME

Definition

Time from the first medical contact by EMS to the primary percutaneous coronary intervention in both transfer and directly admitted patients is referred as first medical contact to balloon time.

Population excludes patients:

- <18 years old
- Diagnosed with non-STEMI heart attack
- Diagnosed with STEMI heart attack on subsequent ECG
- Arriving at STEMI referral hospital via mobile ICU or air
- Not receiving percutaneous coronary intervention as primary reperfusion therapy
- With a non-system reason for delay of percutaneous coronary intervention
- Receiving percutaneous coronary intervention >24 hours after arrival at STEMI referral hospital
- With incomplete records – i.e., records with missing data for any variable used to define the population.

TOTAL ISCHEMIC TIME AMONG STEMI TRANSFER CASES

Definition

Ischemic Time was estimated by measuring the time from symptom onset to receipt of primary percutaneous coronary intervention at the STEMI receiving hospital.

Population excludes patients:

- <18 years old
- Diagnosed with non-STEMI heart attack
- Diagnosed with STEMI heart attack on subsequent ECG
- Arriving at STEMI receiving hospital via mobile ICU or air
- Directly admitted to STEMI receiving hospital
- Not receiving percutaneous coronary intervention as primary reperfusion therapy
- With a non-system reason for delay of percutaneous coronary intervention
- Receiving percutaneous coronary intervention >24 hours after hospital arrival at STEMI receiving hospital
- With incomplete records—i.e., records with missing data for any variable used to define the population

TOTAL ISCHEMIC TIME AMONG STEMI DIRECTLY-ADMITTED CASES

Definition

Ischemic Time was estimated by measuring the time from symptom onset to receipt of primary percutaneous coronary intervention at the STEMI receiving hospital.

Population excludes patients:

- <18 years old
- Diagnosed with non-STEMI heart attack
- Diagnosed with STEMI heart attack on subsequent ECG
- Arriving at STEMI receiving hospital via mobile ICU or air
- Not receiving percutaneous coronary intervention as primary reperfusion therapy
- With a non-system reason for delay of percutaneous coronary intervention
- Received as transfer from STEMI referral hospital to STEMI receiving hospital
- Receiving percutaneous coronary intervention >24 hours after hospital arrival at STEMI receiving hospital

- With incomplete records—i.e., records with missing data for any variable used to define the population

MEDIAN TIMES FROM SYMPTOM ONSET TO PRIMARY PCI IN DIRECTLY-ADMITTED AND TRANSFER STEMI CASES

Definition

The median times from the symptom onset to the primary percutaneous coronary intervention in both transfer and directly admitted patients are calculated.

Population excludes patients:

- <18 years old
- Diagnosed with non-STEMI heart attack
- Diagnosed with STEMI heart attack on subsequent ECG
- Arriving at STEMI referral hospital via mobile ICU or air
- Not receiving percutaneous coronary intervention as primary reperfusion therapy
- With a non-system reason for delay of percutaneous coronary intervention
- Receiving percutaneous coronary intervention >24 hours after arrival at STEMI referral hospital
- With incomplete records – i.e., records with missing data for any variable used to define the population.

ACTIVATION OF CATHETERIZATION LAB PRIOR TO ARRIVAL AMONG TRANSFER CASES

Definition

Prehospital activation of the cardiac catheterization lab prior to arrival of transfer patients.

Population excludes patients:

- <18 years old
- Diagnosed with non-STEMI heart attack
- Directly-admitted to STEMI receiving hospital
- Diagnosed with STEMI heart attack on subsequent ECG
- Arriving at STEMI receiving hospital via mobile ICU or air
- Not receiving percutaneous coronary intervention as primary reperfusion therapy
- With a non-system reason for delay of percutaneous coronary intervention

ACTIVATION OF CATHETERIZATION LAB PRIOR TO ARRIVAL AMONG DIRECTLY-ADMITTED CASES

Definition

Prehospital activation of the cardiac catheterization lab prior to arrival of directly-admitted patients. Prehospital EKG identifies STEMI patients and assists in cardiac lab activation prior to arrival of the patients at the hospital.

Population excludes patients:

- <18 years old
- Diagnosed with non-STEMI heart attack
- Directly-admitted to STEMI receiving hospital
- Diagnosed with STEMI heart attack on subsequent ECG
- Arriving at STEMI receiving hospital via mobile ICU or air

- Received as transfer from STEMI referral hospital to STEMI receiving hospital
- Not receiving percutaneous coronary intervention as primary reperfusion therapy
- With a non-system reason for delay of percutaneous coronary intervention

CARDIAC REHABILITATION REFERRAL

Definition

A referral is defined as an official communication between the healthcare provider and the patient to recommend and carry out a referral order to an outpatient cardiac rehabilitation program. Many people with heart disease can benefit from cardiac rehabilitation. The purpose of cardiac rehabilitation is to reduce morbidity and mortality associated with cardiovascular illness by modifying the patient's coronary risk factors.

Population excludes patients:

- <18 years old
- With incomplete records—i.e., records with missing data for any variable used to define the population
- Deceased at discharge
- Diagnosed with non-STEMI heart attack

COMORBIDITIES AMONG MI CASES

Definition

The simultaneous presence of two chronic diseases or conditions in a patient. For example, the simultaneous presence of hypertension or diabetes or obesity or dyslipidemia or smoking history in a heart attack patient. According to the World Health Organization (WHO) definition, anemia is defined as a hemoglobin value <12g/dl in women and <13g/dl in men.

Population excludes patients:

- <18 years old
- With incomplete records – i.e., records with missing data for comorbidities.

SMOKING CESSATION ADVICE UPON DISCHARGE

Definition

Smoking cessation advice or counseling given during discharge among patients who smoked cigarettes any time in the year prior to hospital arrival.

Population excludes patients:

- <18 years old
- Not reporting cigarette smoking at any time in the year prior to hospital arrival
- Deceased at discharge

PRIOR DIABETES TREATMENT UPON ADMISSION

Definition

Prior anti-diabetic treatment for admitted diabetes patients of Acute Myocardial Infarction. The treatment includes diet therapy, insulin therapy or any other oral hypoglycemic drugs.

Population excludes patients:

- <18 years old

EVALUATION OF TRIGLYCERIDE LEVELS AMONG MI CASES

Population excludes patients:

- <18 years old

ASPIRIN ADMINISTERED WITHIN FIRST 24 HOURS

Population excludes patients:

- <18 years old

ASPIRIN AT DISCHARGE

Population excludes patients:

- <18 years old

BETA-BLOCKERS AT DISCHARGE

Population excludes patients:

- <18 years old

STATIN AT DISCHARGE FOR LDL >= 100 MG/DL

Population excludes patients:

- <18 years old
- With LDL < 100 mg/dl

ACE INHIBITORS OR ARB AT DISCHARGE (LVEF <40%)

Population excludes patients:

- <18 years old
- With LVEF ≥ 40%

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