Texas STEMI/Heart Attack Hospital Performance Measures

ST-Elevation Myocardial Infarction (STEMI) and Heart Attack System of Care Report

Conducted to advance heart attack reduction efforts, assess policies and practices regarding delivery of care across the state, and identify areas of opportunity for quality improvement

Texas Council on Cardiovascular Disease and Stroke & Texas Department of State Health Services
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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 2014 (Table 1). 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.

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 participate in this data collection initiative. The data were collected by the NCDR Acute Coronary Treatment and Intervention Outcomes Network (ACTION) Registry-Get with the Guidelines (GWTG), a program of the American College of Cardiology in partnership with the American Heart Association and other societies, from the fourth quarter of 2008 through the fourth quarter of 2015. Currently 134 PCI-capable hospitals are participating in the NCDR ACTION Registry-GWTG. In 2015, when the highest number of hospitals were reporting for each measure, at most 47 out of these 134 PCI-capable hospitals were included (35%).

Substantial findings from the 2014 Emergency Medical Services &Trauma Registries data is as follows:

In an effort to include all possible heart attack runs, we defined a possible heart attack run as follows: EMS 911 run in Texas for a patient with chest pain, cardiac rhythm disturbances, or cardiac arrest as either a primary or associated symptom. Standard guidelines were not available to define possible heart attack runs.

- A total of 1,120,047 EMS 911 response runs were reported in 2014, of which 75,950 were considered possible heart attack runs (Table 3).
- 75.5% of possible heart attack runs occurred in urban counties, 20.8% occurred in rural counties (Table 4).
- The median response time among heart attack runs in Texas was 6 minutes (Table 5).
- The median scene time among heart attack runs in Texas was 17 minutes (Table 6).
- The median transport time among heart attack runs in Texas was 12 minutes (Table 7).
- The median total pre-hospital time among heart attack runs in Texas was 38 minutes (Table 8).
- The destination for 71.2% of heart attack patients was a hospital emergency department (Table 9).
- Pre-hospital deaths occurred in 4.2% of heart attack runs (Table 10).

Substantial findings from the 2008-2015 Get With The Guidelines®- NCDR ACTION Registry data is as follows:

- 47 participating hospitals, distributed across 29 cities in Texas, provided data on individual episodes of care for heart attack. Most participating hospitals were located in urban or suburban communities and only 5 hospitals were located in rural communities.
- 38,981 individual episodes of care for heart attack occurred among 37,296 patients at participating hospitals.
- Of the 38,981 episodes of care for heart attack that occurred:
  - 60.3% involved patients who either transported themselves or were transported by family to the hospital where they were first evaluated;
  - 77.2% involved patients receiving their first ECG upon arriving at the hospital;
• 32.0% involved care for STEMI heart attacks.

• Between 2009 and 2015, the percent of STEMI patients receiving a pre-hospital ECG within 10 minutes of first medical contact ranged from a low of 70.8% in 2012 to a high of 87.9% in 2009. This may be due to the increase in the number of reporting hospitals from 2009 to 2015.

• Between 2009 and 2015, the median time to first ECG for directly admitted patients who arrived to the hospital by ambulance ranged from a low of 6 minutes in 2013 to a high of 10 minutes in 2015.

• Among patients who arrived at a STEMI referral hospital by ambulance, the percent of patients who received an ECG within 10 minutes of arrival at the STEMI referral hospital before being transferred to a STEMI receiving hospital ranged from a low of 49.7% in 2015 to a high of 75.6% in 2009.

• Among directly admitted patients, the percent of patients who received an ECG within 10 minutes of arrival by ambulance ranged from a low of 52.4% in 2015 to a high of 68.2% in 2009. Between 2009 and 2015, the number of hospitals reporting on this measure increased each year, increasing from 10 to 45 hospitals overall.

• Between October 2008 and December 2015, the median time spent awaiting transfer from the STEMI referral hospital to the STEMI receiving hospital for PCI was 45 minutes among those who arrived by personal vehicle and 48 minutes among those who arrived by ambulance.

• Between 2009 and 2015, the number of receiving hospitals reporting on ED dwell time among transfer patients increased each year, from 2 to 25 hospitals overall. Among patients who arrived at a STEMI referral hospital by ambulance and were then transferred to a STEMI receiving hospital, the median ED dwell time at the STEMI receiving hospital ranged from a low of 29 minutes in 2009 to a high of 67 minutes in 2012.

• Among directly admitted patients who arrived at a STEMI receiving hospital by ambulance, the median ED dwell time ranged from a low of 30 minutes in 2015 to a high of 35 minutes in 2009 and 2010.

• Between October 2008 and December 2015, 37.5% of patients who arrived to the first hospital either by a personal vehicle or by an ambulance received fibrinolytic therapy within 30 minutes of arrival to the first hospital.

• From 2011 to 2015, the number of receiving hospitals reporting on median time from hospital arrival to primary PCI increased each year. Among directly admitted patients who arrived at a STEMI receiving hospital by personal vehicle, the median time from hospital arrival to primary PCI ranged from a low of 66 minutes in 2011 and 2014 to a high of 68 minutes in 2012, 2013 and 2015. Among directly admitted patients who arrived at a STEMI receiving hospital by ambulance, the median time from hospital arrival to primary PCI ranged from a low of 49 minutes in 2015 to a high of 54 minutes in 2011. Patients who arrived by ambulance had a lower median time to PCI than those who arrived by personal vehicle.

• From 2011 to 2015, the number of receiving hospitals reporting on number of patients receiving primary PCI within 90 minutes increased each year. Among patients who directly presented to a STEMI receiving hospital by personal vehicle, the percent who received primary PCI within 90 minutes ranged from a low of 88.9% in 2013 to a high of 92.1% in 2014. Among patients who directly presented to a STEMI receiving hospital by ambulance, the percent who received primary PCI within 90 minutes ranged from a low of 96.1% in 2012 to a high of 98.5% in 2013.

• From 2011 to 2015, the number of hospitals reporting on number of transfer patients who received primary PCI within 120 minutes of arrival increased each year. Among patients who arrived at a STEMI referral hospital by personal vehicle, the percent who received primary PCI at a STEMI receiving hospital
within 120 minutes of arrival to the STEMI referral hospital ranged from a low of **60.3%** in 2015 to a high of **66.3%** in 2014.

- From 2011 to 2015, among patients who arrived at a STEMI receiving hospital by ambulance, the **median** time from first medical contact to primary PCI at the STEMI receiving hospital ranged from a low of **79 minutes** in 2015 to a high of **83 minutes** in 2011.

- From 2011 to 2015, total ischemic time among STEMI transfer patients was calculated. Among patients who arrived by ambulance at the first hospital, **20.0%** had a total ischemic time less than 120 minutes, while among patients who arrived at the first hospital by personal vehicle, **10.1%** had a total ischemic time less than 120 minutes.

- From 2011 to 2015, total ischemic time among directly admitted STEMI patients was calculated. Among patients who arrived by ambulance in 2015, **42.2%** had a total ischemic time less than 120 minutes, while among patients who arrived by personal vehicle in 2015, **29.0%** had a total ischemic time less than 120 minutes.

- In 2015, among 259 STEMI transfer patients who arrived at the first hospital either by a personal vehicle or by an ambulance, the catheterization lab was activated prior to arrival for **44.0%**.

- In 2015, among 1,105 directly admitted STEMI patients who arrived at the hospital either by a personal vehicle or by an ambulance, the catheterization lab was activated prior to arrival for **28.2%** of patients.

- In 2015, among 587 directly admitted STEMI patients who arrived at the hospital by ambulance, pre-catheterization lab activation occurred for **53.0%** of patients.

- Between 2008 and 2015 and among 11,635 STEMI patients, **63%** were referred to a cardiac rehabilitation program, **25%** were not referred to a cardiac rehabilitation program, and **12%** were ineligible for referral at discharge.

- Between 2008 and 2015, the percentage of comorbidities among AMI patients was evaluated. Among AMI patients, **77.3%** were hypertensive, **61.0%** had dyslipidemia, **41.5%** were obese, **39.3%** were diabetic, and **31.1%** were current or recent smokers.
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 or heart attack. An ST-Elevated Myocardial Infarction (STEMI) heart attack 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. This type of heart attack requires immediate treatment to restore blood flow to the heart.

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. The data collection initiative focuses on pre-hospital and hospital data elements. This report includes de-identified, aggregate data for hospitals who have agreed to share NCDR Acute Coronary Treatment and Intervention Outcomes Network (ACTION) Registry-Get with the Guidelines (GWTG) data with DSHS. All data is 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 objective of the data collection is to gain an understanding of the prevalence of heart attack in Texas, and evaluate pre-hospital components of the systems of care and treatment of heart attack patients. The findings will be used to assess policies and practices regarding delivery of care across the state and identify areas of opportunity for quality improvement.

HEART ATTACK IN TEXAS

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 2014 (Table 1). In 2014, the prevalence of heart attack was twice as high among white adults (4.7%; 95% CI: 4.1-5.4) compared to Hispanic adults (2.4%; 95% CI: 1.8-3.0).

Table 1. Estimated number and unadjusted prevalence of adults, ages 18 years and older, that report ever having had a heart attack in Texas, by race/ethnicity and year

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Adults</th>
<th>% of Adults (95% CI)</th>
<th>% White Only (95% CI)</th>
<th>% Black Only (95% CI)</th>
<th>% Hispanic (95% CI)</th>
<th>% Other only/ Multiracial (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>740,234</td>
<td>4.1 (3.6-4.5)</td>
<td>4.6 (4.0-5.2)</td>
<td>4.6 (2.4-6.7)</td>
<td>2.9 (2.2-3.7)</td>
<td>4.2 (2.1-6.2)</td>
</tr>
<tr>
<td>2012</td>
<td>718,735</td>
<td>3.8 (3.3-4.2)</td>
<td>4.3 (3.7-4.9)</td>
<td>4.3 (2.7-5.9)</td>
<td>2.4 (1.7-3.1)</td>
<td>4.9 (2.3-7.5)</td>
</tr>
<tr>
<td>2013</td>
<td>763,932</td>
<td>3.9 (3.4-4.5)</td>
<td>4.4 (3.7-5.2)</td>
<td>6.2 (3.9-8.5)</td>
<td>2.6 (1.9-3.3)</td>
<td>--</td>
</tr>
<tr>
<td>2014</td>
<td>729,812</td>
<td>3.7 (3.2-4.1)</td>
<td>4.7 (4.1-5.4)</td>
<td>4.1 (2.2-6.0)</td>
<td>2.4 (1.8-3.0)</td>
<td>--</td>
</tr>
</tbody>
</table>

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

However, using myocardial infarction (MI) hospitalization rates as an approximation of the incidence of disease, the overall rate of heart attacks has decreased since 2008 from 17.6 per 10,000 to 15.2 per 10,000 in 2013 (Table 2). Rates among whites and blacks have showed a similar decrease over time. The heart attack rate among...
Hispanics was significantly lower each year compared to whites or blacks, and the rate decreased significantly from 2008 (14.7 per 10,000) to 2013 (13.5 per 10,000). The rate of heart attacks among the other race category has fluctuated over the years but was significantly lower in 2013 than in 2008. 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.

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

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Hospitalizations</th>
<th>Age-Adjusted Hospitalization Rate (95% CI)</th>
<th>Race/Ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>White (95% CI)</td>
</tr>
<tr>
<td>2008</td>
<td>36,983</td>
<td>17.6 (17.4-17.8)</td>
<td>18.0 (17.8-18.2)</td>
</tr>
<tr>
<td>2009</td>
<td>34,606</td>
<td>16.1 (15.9-16.2)</td>
<td>16.4 (16.2-16.6)</td>
</tr>
<tr>
<td>2010</td>
<td>35,675</td>
<td>16.0 (15.8-16.1)</td>
<td>16.0 (15.8-16.2)</td>
</tr>
<tr>
<td>2011</td>
<td>35,878</td>
<td>15.5 (15.4-15.7)</td>
<td>15.9 (15.7-16.1)</td>
</tr>
<tr>
<td>2012</td>
<td>37,911</td>
<td>15.9 (15.7-16.0)</td>
<td>15.1 (14.9-15.9)</td>
</tr>
<tr>
<td>2013</td>
<td>37,287</td>
<td>15.2 (15.0-15.3)</td>
<td>15.1 (14.9-15.3)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval.

Looking at the geographic distribution of death rates, the highest rates emerge in counties located in east and northeast Texas (Figure 1).

Figure 1. Age-adjusted average annual number of deaths due to heart attack per 100,000 people of all ages during 2009-2013, by county, in Texas.

For every 100,000 people, an average of 43 persons died of a heart attack annually in Texas from 2009 to 2013.
PRE-HOSPITAL MEASURES FOR HEART ATTACK IN TEXAS

The objective of collecting pre-hospital data is to gain an understanding and evaluate the pre-hospital care component of heart attack in Texas. The findings will be used to assess policies and practices regarding delivery of care across the state and identify areas of opportunity for quality improvement. The data reported by Emergency Medical Service (EMS) providers, collected through the Texas EMS & Trauma Registries reflects pre-hospital care for 2014. In an effort to include all possible heart attack runs, we defined a possible heart attack run as follows: EMS 911 run in Texas for a patient with chest pain, cardiac rhythm disturbances, or cardiac arrest as either a primary or associated symptom. Standard guidelines were not available to define possible heart attack runs.

The following tables display pre-hospital performance measures for potential heart attack patients reported in 2014 through the Texas EMS & Trauma Registries. This report includes the following pre-hospital measures for heart attack:

1. Response Time
2. Scene Time
3. Transport Time
4. Total Pre-hospital Time
5. Destination Type
6. Pre-hospital Deaths

POSSIBLE HEART ATTACK EMS RUNS

In 2014, there were a total of 1,120,047 reported EMS 911 runs for incidents that occurred in Texas among adults 18 years and older. Of those, 75,950 EMS runs were categorized as possible heart attack runs (Table 3). Therefore, in 2014, 7.0% of reported EMS runs among adults were possible heart attack cases (Figure 2).

<table>
<thead>
<tr>
<th>Incident Location</th>
<th>Total EMS 911 Response Runs (n)</th>
<th>Total EMS Possible Heart Attack Runs (n)</th>
<th>Percent of Possible EMS Heart Attack Runs (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas</td>
<td>1,120,047</td>
<td>75,950</td>
<td>6.8</td>
</tr>
<tr>
<td>Urban County*</td>
<td>897,725</td>
<td>57,319</td>
<td>6.4</td>
</tr>
<tr>
<td>Rural County*</td>
<td>177,149</td>
<td>15,808</td>
<td>8.9</td>
</tr>
<tr>
<td>Missing County</td>
<td>45,173</td>
<td>2,823</td>
<td>6.2</td>
</tr>
</tbody>
</table>

*see appendix for urban and rural classification definition
Table 4 shows the demographic characteristics of possible heart attack EMS runs. Half of the possible heart attack EMS runs were among men. The median age of the cases was 60 years, and 38.3% of the total cases were in the age range between 46 and 65. Among possible heart attack runs, 75.5% occurred in urban areas, and 20.8% occurred in the rural areas.

### Table 4. Demographics of reported possible heart attack runs, 2014.

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Possible Heart Attack Runs (n= 75,950)</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median age = 60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 – 45</td>
<td>17,518 (23.1)</td>
<td></td>
</tr>
<tr>
<td>46 – 65</td>
<td>29,051 (38.3)</td>
<td></td>
</tr>
<tr>
<td>66 – 85</td>
<td>23,646 (31.1)</td>
<td></td>
</tr>
<tr>
<td>&gt;85</td>
<td>5,735 (7.6)</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>37,413 (49.3)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>38,231 (50.3)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>300 (0.4)</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>6 (0.01)</td>
<td></td>
</tr>
<tr>
<td><strong>County Classification</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban*</td>
<td>57,321 (75.5)</td>
<td></td>
</tr>
<tr>
<td>Rural*</td>
<td>15,821 (20.8)</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>2,823 (3.7)</td>
<td></td>
</tr>
</tbody>
</table>

*see appendix for urban and rural classification definition
RESPONSE TIME

Response time is the time interval from the time the responding unit was notified by dispatch to the time the responding unit arrived on the scene. The average response time among possible heart attack runs in 2014 was 8 minutes 33 seconds; the median time was 6 minutes (Table 5).

Table 5. Response times among possible heart attack runs, in Texas overall and by county type, 2014.

<table>
<thead>
<tr>
<th>Incident Location</th>
<th>Possible Heart Attack Runs (n)</th>
<th>Average Response Time (Min:Sec)</th>
<th>Median (Min)</th>
<th>90th Percentile (Min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas</td>
<td>74,410</td>
<td>8:33</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>Urban County*</td>
<td>56,261</td>
<td>7:59</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>Rural County*</td>
<td>15,362</td>
<td>10:17</td>
<td>7</td>
<td>20</td>
</tr>
</tbody>
</table>

*see appendix for urban and rural classification definition

SCENE TIME

Scene time is the time interval from the time the responding unit arrived on the scene to the time the responding unit left the scene with a patient. The average scene time among possible heart attack runs in 2014 was 19 minutes and 13 seconds; the median time was 17 minutes (Table 6). According to American Heart Association, the scene time for heart attack runs with in-the-field ECG should be less than 15 minutes.10

Table 6. Scene times among possible heart attack runs, in Texas overall and by county type, 2014.

<table>
<thead>
<tr>
<th>Incident Location</th>
<th>Possible Heart Attack Runs (n)</th>
<th>Average Scene Time (Min:sec)</th>
<th>Median (Min)</th>
<th>90th Percentile (Min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas</td>
<td>69,715</td>
<td>19:13</td>
<td>17</td>
<td>28</td>
</tr>
<tr>
<td>Urban County*</td>
<td>52,275</td>
<td>19:27</td>
<td>17</td>
<td>28</td>
</tr>
<tr>
<td>Rural County*</td>
<td>14,827</td>
<td>18:46</td>
<td>17</td>
<td>28</td>
</tr>
</tbody>
</table>

*see appendix for urban and rural classification definition

TRANSPORT TIME

Transport time is the time interval from the time the responding unit left the scene with a patient to the time the responding unit arrived with the patient at the destination or transfer point. The average transport time among possible heart attack runs in 2014 was 17 minutes; the median time was 12 minutes (Table 7).

Table 7. Transport times among possible heart attack runs, in Texas overall and by county type, 2014.

<table>
<thead>
<tr>
<th>Incident Location</th>
<th>Possible Heart Attack Runs (n)</th>
<th>Average Transport Time (Min:sec)</th>
<th>Median (Min)</th>
<th>90th Percentile (Min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas</td>
<td>66,219</td>
<td>17:01</td>
<td>12</td>
<td>32</td>
</tr>
<tr>
<td>Urban County*</td>
<td>49,617</td>
<td>15:21</td>
<td>12</td>
<td>26</td>
</tr>
<tr>
<td>Rural County*</td>
<td>14,151</td>
<td>22:22</td>
<td>14</td>
<td>50</td>
</tr>
</tbody>
</table>

*see appendix for urban and rural classification definition
TOTAL PRE-HOSPITAL TIME

The total pre-hospital time is the time interval from the time when responding EMS unit was notified by dispatch to the time the responding unit arrived with the patient at the destination or transfer point. The average total pre-hospital time among possible heart attack runs in 2014 was 43 minutes and 24 seconds; the median time was 38 minutes (Table 8). In Texas the median total pre-hospital time among possible heart attack runs in urban areas was 37 minutes versus 42 minutes in rural areas.

Table 8. Total pre-hospital time among possible heart attack runs, in Texas overall and by county type, 2014.

<table>
<thead>
<tr>
<th>Incident Location</th>
<th>Possible Heart Attack Runs (n)</th>
<th>Average Pre-hospital Time (Min:sec)</th>
<th>Median (Min)</th>
<th>90th Percentile (Min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas</td>
<td>66,813</td>
<td>43:24</td>
<td>38</td>
<td>64</td>
</tr>
<tr>
<td>Urban County*</td>
<td>49,979</td>
<td>41:25</td>
<td>37</td>
<td>58</td>
</tr>
<tr>
<td>Rural County*</td>
<td>14,348</td>
<td>49:44</td>
<td>42</td>
<td>84</td>
</tr>
</tbody>
</table>

*see appendix for urban and rural classification definition

DESTINATION TYPE

The table below shows the distribution of possible heart attack runs by type of destination the patient was delivered or transferred to. The most common destination type among heart attack runs in 2014 was hospital emergency department with 54,096 cases (71.2%) (Table 9).

Table 9. Possible Heart attack runs by type of destination, 2014.

<table>
<thead>
<tr>
<th>Destination Type</th>
<th>Possible Heart Attack Runs (n)</th>
<th>Percent of Possible Heart Attack Runs (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital Emergency Department</td>
<td>54,096</td>
<td>71.2</td>
</tr>
<tr>
<td>Hospital Inpatient Bed</td>
<td>7,813</td>
<td>10.3</td>
</tr>
<tr>
<td>Other</td>
<td>2,498</td>
<td>3.3</td>
</tr>
<tr>
<td>Nursing Home Assisted Living Facility</td>
<td>76</td>
<td>0.1</td>
</tr>
<tr>
<td>Other EMS Responder Ground</td>
<td>79</td>
<td>0.1</td>
</tr>
<tr>
<td>Medical Office Clinic</td>
<td>161</td>
<td>0.2</td>
</tr>
<tr>
<td>Home</td>
<td>64</td>
<td>0.1</td>
</tr>
<tr>
<td>Other EMS Responder Air</td>
<td>48</td>
<td>0.1</td>
</tr>
<tr>
<td>Mortuary</td>
<td>46</td>
<td>0.1</td>
</tr>
<tr>
<td>Police Jail</td>
<td>5</td>
<td>0.01</td>
</tr>
<tr>
<td>Not Applicable</td>
<td>9,277</td>
<td>12.2</td>
</tr>
<tr>
<td>Not Recorded</td>
<td>1,777</td>
<td>2.3</td>
</tr>
<tr>
<td>Missing</td>
<td>10</td>
<td>0.01</td>
</tr>
</tbody>
</table>
The number of pre-hospital deaths among heart attack runs is determined by the reported patient disposition. There were 3,183 (4.2%) pre-hospital deaths reported among possible heart attack runs in 2014 (Table 10).

Table 10. Pre-hospital deaths among possible heart attack runs, 2014.

<table>
<thead>
<tr>
<th>Pre-hospital Deaths</th>
<th>Possible Heart Attack Runs (n)</th>
<th>Percent of Possible Heart Attack Runs (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Dead at Scene (Transported by EMS)</td>
<td>9</td>
<td>0.01</td>
</tr>
<tr>
<td>Patient Dead at Scene (Transported by EMS with Resuscitation)</td>
<td>5</td>
<td>0.01</td>
</tr>
<tr>
<td>Patient Dead at Scene (Not Transported by EMS)</td>
<td>3,162</td>
<td>4.2</td>
</tr>
<tr>
<td>Patient Dead at Scene (Not Transported by EMS with Resuscitation)</td>
<td>7</td>
<td>0.01</td>
</tr>
</tbody>
</table>
Percutaneous coronary intervention, or PCI, is the preferred reperfusion strategy for STEMI patients. There are approximately 154 PCI-capable hospitals in Texas that have a catheterization lab ready to perform PCI, 24 hours a day, 7 days a week. These are often called “STEMI receiving hospitals.” For hospitals that do not have this capability, often referred to as “STEMI referral hospitals,” STEMI patients must be transferred to a PCI-capable hospital. Figure 3 illustrates the time to treatment goals for primary PCI for patients who have been directly admitted to a STEMI receiving hospital and for those who have been transferred from a STEMI referral hospital.

The STEMI patients who are directly admitted to a STEMI receiving hospital are referred as directly admitted patients in the report and the STEMI patients who have been transferred from a STEMI referral hospital to a STEMI receiving hospital are referred as transfer patients.

Figure 3. Time to treatment goals for primary PCI

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 agreed to participate in this data collection initiative. The data were collected by the NCDR ACTION Registry-GWTG from the fourth quarter of 2008 through the fourth quarter of 2015. Currently 134 PCI-capable hospitals are participating in the NCDR ACTION Registry-GWTG. In 2015, when the highest number of hospitals were reporting for each measure, at most 47 out of these 134 PCI-capable hospitals were included (35%). General findings from these data are as follows:
• 47 participating hospitals, distributed across 29 cities in Texas, provided data on individual episodes of care for heart attack.

• The majority of participating hospitals were located in urban or suburban communities, 8 of which were located in the city of Dallas; only 5 were located in rural communities.

• 38,981 individual episodes of care for heart attack occurred among 37,296 patients at participating hospitals.

• Of the 38,981 episodes of care for heart attack that occurred:
  • 60.3% involved patients who either transported themselves or were transported by family to the hospital where they were first evaluated;
  • 77.3% involved patients receiving their first ECG upon arriving at the hospital;
  • 32.0% involved care for STEMI heart attacks.
  • 83.4% had health insurance.
  • 95.6% were alive at discharge.

Table 11 shows the number of participating hospitals and the reported heart attack cases from the year 2008 to 2015. The participating sites ranged from as few as 1 in 2008 to 46 in 2015. The reported heart attack cases were 97 in the year 2008 and 8,460 in the year 2015.

Table 11. Site participation and number of heart attack cases by year

<table>
<thead>
<tr>
<th>Year</th>
<th>Participating sites</th>
<th>Reported Heart Attack Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>1</td>
<td>97</td>
</tr>
<tr>
<td>2009</td>
<td>5</td>
<td>792</td>
</tr>
<tr>
<td>2010</td>
<td>22</td>
<td>2,930</td>
</tr>
<tr>
<td>2011</td>
<td>27</td>
<td>5,082</td>
</tr>
<tr>
<td>2012</td>
<td>35</td>
<td>6,384</td>
</tr>
<tr>
<td>2013</td>
<td>37</td>
<td>7,024</td>
</tr>
<tr>
<td>2014</td>
<td>44</td>
<td>8,212</td>
</tr>
<tr>
<td>2015</td>
<td>46</td>
<td>8,460</td>
</tr>
</tbody>
</table>

Table 12 displays the distribution of reported cases by subtype of heart attack. From 2008-2015, STEMI cases accounted for 32% of all reported cases and Non-STEMI accounted for 68%.

Table 12. Distribution of reported cases by heart attack subtype, 2008-2015

<table>
<thead>
<tr>
<th>Heart Attack Type</th>
<th>Reported cases N=38,981</th>
<th>Percent of reported cases (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEMI</td>
<td>12,477</td>
<td>32.0</td>
</tr>
<tr>
<td>Non-STEMI</td>
<td>26,504</td>
<td>68.0</td>
</tr>
</tbody>
</table>
Table 13 shows the demographic characteristics of patients reported between 2008 and 2015. Median age of the heart attack patients was 63. More than half of the patients (65.1%) in the database were men (n=25,352).

**Table 13. Demographic characteristics of heart attack patients, 2008-2015**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
</tr>
<tr>
<td>Median (interquartile range)</td>
<td>63 (19)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>25,352 (65.1)</td>
</tr>
<tr>
<td>Women</td>
<td>13,629 (34.9)</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>32,239 (82.7)</td>
</tr>
<tr>
<td>Black</td>
<td>5,037 (12.9)</td>
</tr>
<tr>
<td>Asian</td>
<td>727 (1.9)</td>
</tr>
<tr>
<td>American Indian</td>
<td>271 (0.7)</td>
</tr>
<tr>
<td>Native Hawaiian</td>
<td>24 (0.1)</td>
</tr>
<tr>
<td>Multiracial</td>
<td>69 (0.2)</td>
</tr>
<tr>
<td>No Race Reported</td>
<td>614 (1.6)</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>9,328 (23.9)</td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>29,527 (75.7)</td>
</tr>
<tr>
<td><strong>Health Insurance Status</strong></td>
<td></td>
</tr>
<tr>
<td>Health insurance</td>
<td>32,524 (83.4)</td>
</tr>
<tr>
<td>Without health insurance</td>
<td>6,457 (16.6)</td>
</tr>
</tbody>
</table>

The graphs and tables that follow display either percentages or medians for specific measures of effective care for heart attack. For measures with more than 100 cases reported for each mode of hospital arrival, the data are displayed by year using seven full years of data from the first quarter of 2009 through the fourth quarter of 2015 (January 2009-December 2015). 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 2015 (October 2008-December 2015). These estimates are stratified by patient type, that is, whether the patient was transferred in from another hospital or directly presented to a PCI-capable hospital. 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 emergency department of referral hospital
   b. Dwell time in the emergency department 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 AMI with comorbidities
16. Smoking cessation advice at discharge

Additional information, including data source, inclusion criteria, and exclusion criteria can be found in Appendix I.
PRE-HOSPITAL ECG WITHIN 10 MINUTES OF FIRST MEDICAL CONTACT

The ability to diagnose a STEMI early is the initial and one of the most important steps impacting heart attack survival. An Emergency Medical Services (EMS) unit equipped with 12-lead equipment (ECG capability) is able to 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 a heart attack 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 more timely the communication of results to the receiving hospital, and the more time the receiving hospital has to prepare for the incoming patient.

**Figure 4 and Table 14** below displays 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 patients included in this measure arrived at the hospital by an ambulance equipped to perform pre-hospital ECGs.

**Figure 4.** Pre-Hospital ECG within 10 minutes of first medical contact among those arriving by ambulance and by year

![Graph showing the percentage of eligible episodes of care for heart attack in which patients received their first ECG within 10 minutes of first medical contact from 2009 to 2015. The percentage ranges from 71.0% to 87.9%.]

**Table 14.** Pre-Hospital ECG within 10 minutes of first medical contact among those arriving by ambulance and by year

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases with pre-hospital ECG (n)</th>
<th>Cases with pre-hospital ECG within 10 minutes of first medical contact (n)</th>
<th>% of cases with pre-hospital ECG within 10 minutes of first medical contact</th>
<th>Reporting hospitals (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>91</td>
<td>80</td>
<td>87.9</td>
<td>5</td>
</tr>
<tr>
<td>2010</td>
<td>270</td>
<td>197</td>
<td>73.0</td>
<td>17</td>
</tr>
<tr>
<td>2011</td>
<td>721</td>
<td>512</td>
<td>71.0</td>
<td>25</td>
</tr>
<tr>
<td>2012</td>
<td>1,067</td>
<td>755</td>
<td>70.8</td>
<td>33</td>
</tr>
<tr>
<td>2013</td>
<td>1,279</td>
<td>956</td>
<td>74.7</td>
<td>37</td>
</tr>
<tr>
<td>2014</td>
<td>1,677</td>
<td>1,202</td>
<td>71.7</td>
<td>43</td>
</tr>
<tr>
<td>2015</td>
<td>1,865</td>
<td>1,416</td>
<td>75.9</td>
<td>46</td>
</tr>
</tbody>
</table>

Between 2009 and 2015, the number of hospitals reporting on this measure increased each year, increasing from 5 to 46 hospitals overall. The percent of AMI patients receiving an ECG within 10 minutes of first medical contact...
ranged from a low of 70.8% in 2012 to a high of 87.9% in 2009. Pre-hospital ECG within 10 minutes of first medical contact occurs in every 3 among 4 patients in Texas during the year, 2015. There is an opportunity for improvement 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, in particular for rural areas, greatly affects the timeliness of care for heart attack patients. For those with 12-lead equipment, implementation of a standard EMS protocol for care of suspected heart attack patients should include performance of an ECG within 10 minutes of first medical contact.

**TIME FROM HOSPITAL ARRIVAL TO FIRST ECG AMONG TRANSFER PATIENTS**

Current Texas data shows that a STEMI is found on the first ECG over 85% of the time.4 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 arrival.7 Rapid performance of ECG and interpretation can lead to reduced dwell time in the ED for a heart attack patient and timely activation of the catheterization lab.

**Figure 5 and Table 15** below display the median time (in minutes) elapsed from hospital arrival to receipt of first ECG among transfer patients with eligible episodes of care for heart attack, by mode of arrival to the first hospital and year. Episodes of care in which a patient received an ECG prior to arriving at the hospital were excluded.

**Figure 5.** Median time from first hospital arrival to first ECG among transfer patients by mode of arrival to first hospital and year
Table 15. Median time from first hospital arrival to first ECG among transfer patients by mode of arrival to first hospital and year

<table>
<thead>
<tr>
<th>Year</th>
<th>Personal vehicle</th>
<th></th>
<th>Ambulance</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases with ECG at</td>
<td>Median minutes</td>
<td>Cases with ECG at</td>
<td>Median minutes</td>
</tr>
<tr>
<td></td>
<td>STEMI referral hospital (n)</td>
<td></td>
<td>STEMI referral hospital (n)</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>269</td>
<td>7</td>
<td>78</td>
<td>5.5</td>
</tr>
<tr>
<td>2010</td>
<td>535</td>
<td>7</td>
<td>174</td>
<td>7</td>
</tr>
<tr>
<td>2011</td>
<td>835</td>
<td>7</td>
<td>229</td>
<td>9</td>
</tr>
<tr>
<td>2012</td>
<td>997</td>
<td>8</td>
<td>232</td>
<td>9</td>
</tr>
<tr>
<td>2013</td>
<td>1,201</td>
<td>7</td>
<td>249</td>
<td>8</td>
</tr>
<tr>
<td>2014</td>
<td>1,201</td>
<td>6</td>
<td>211</td>
<td>8</td>
</tr>
<tr>
<td>2015</td>
<td>1,368</td>
<td>7</td>
<td>193</td>
<td>11</td>
</tr>
</tbody>
</table>

Between 2009 and 2015, the number of hospitals reporting on this measure increased each year, increasing from 5 to 43 hospitals overall. The median time to first ECG for transfer patients who arrived by personal vehicle to the first hospital ranged from a low of 6 minutes in 2014 to a high of 8 minutes in 2012. The median time for those who arrived by ambulance ranged from a low of 5.5 minutes in 2009 to a high of 11 minutes in 2015.

TIME FROM HOSPITAL ARRIVAL TO FIRST ECG AMONG DIRECTLY ADMITTED PATIENTS

Figure 6 and Table 16 below display the median time (in minutes) elapsed from hospital arrival to receipt of first ECG among directly admitted patients with eligible episodes of care for heart attack, by mode of arrival to the hospital and year. Episodes of care in which a patient received an ECG prior to arriving at the hospital were excluded.

Figure 6. Median time from first hospital arrival to first ECG among directly admitted patients by mode of arrival to hospital and year
Table 16. Median time from hospital arrival to first ECG among directly admitted patients by mode of arrival to hospital and year

<table>
<thead>
<tr>
<th>Year</th>
<th>Reporting hospitals (n)</th>
<th>Cases with ECG at STEMI receiving hospital (n)</th>
<th>Median minutes</th>
<th>Cases with ECG at STEMI receiving hospital (n)</th>
<th>Median minutes</th>
<th>Reporting hospitals (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>10</td>
<td>199</td>
<td>7</td>
<td>85</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>2010</td>
<td>22</td>
<td>1,076</td>
<td>8</td>
<td>514</td>
<td>8</td>
<td>22</td>
</tr>
<tr>
<td>2011</td>
<td>28</td>
<td>2,072</td>
<td>7</td>
<td>796</td>
<td>8</td>
<td>28</td>
</tr>
<tr>
<td>2012</td>
<td>35</td>
<td>2,717</td>
<td>6</td>
<td>912</td>
<td>7</td>
<td>35</td>
</tr>
<tr>
<td>2013</td>
<td>40</td>
<td>2,937</td>
<td>7</td>
<td>1,079</td>
<td>6</td>
<td>40</td>
</tr>
<tr>
<td>2014</td>
<td>44</td>
<td>3,704</td>
<td>7</td>
<td>1,097</td>
<td>9</td>
<td>44</td>
</tr>
<tr>
<td>2015</td>
<td>45</td>
<td>3,745</td>
<td>7</td>
<td>878</td>
<td>10</td>
<td>45</td>
</tr>
</tbody>
</table>

Between 2009 and 2015, the number of hospitals reporting on this measure increased each year, increasing from 10 to 45 hospitals overall. The median time to first ECG for directly admitted patients who arrived by personal vehicle to the hospital ranged from a low of 6 minutes in 2012 to a high of 8 minutes in 2010. The median time for those who arrived by ambulance ranged from a low of 6 minutes in 2013 to a high of 10 minutes in 2015.

HOSPITAL ECG WITHIN 10 MINUTES OF ARRIVAL AMONG TRANSFER PATIENTS

Figure 7 and Table 17 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 and year. Episodes of care in which a patient received an ECG prior to arriving at the hospital were excluded.

Figure 7. Hospital ECG within 10 minutes of first hospital arrival among transfer patients by mode of arrival to first hospital and year
**Table 17.** Hospital ECG within 10 minutes of first hospital arrival among transfer patients by mode of arrival to first hospital and year

<table>
<thead>
<tr>
<th>Year</th>
<th>Personal vehicle</th>
<th></th>
<th>Ambulance</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases with ECG at STEMI referral hospital (n)</td>
<td>Cases with ECG within 10 minutes of arrival at STEMI referral hospital (n)</td>
<td>% of cases with ECG within 10 minutes of arrival at STEMI referral hospital</td>
<td>Cases with ECG at STEMI referral hospital (n)</td>
</tr>
<tr>
<td>2009</td>
<td>269</td>
<td>207</td>
<td>77.0</td>
<td>78</td>
</tr>
<tr>
<td>2010</td>
<td>535</td>
<td>354</td>
<td>66.2</td>
<td>174</td>
</tr>
<tr>
<td>2011</td>
<td>835</td>
<td>550</td>
<td>65.9</td>
<td>229</td>
</tr>
<tr>
<td>2012</td>
<td>997</td>
<td>618</td>
<td>62.0</td>
<td>232</td>
</tr>
<tr>
<td>2013</td>
<td>1,201</td>
<td>775</td>
<td>64.5</td>
<td>249</td>
</tr>
<tr>
<td>2014</td>
<td>1,201</td>
<td>781</td>
<td>65.0</td>
<td>211</td>
</tr>
<tr>
<td>2015</td>
<td>1,368</td>
<td>885</td>
<td>64.7</td>
<td>193</td>
</tr>
</tbody>
</table>

Between 2009 and 2015, the number of hospitals reporting on this measure increased each year, increasing from 5 to 43 hospitals overall. Among patients who arrived at a STEMI referral hospital by a personal vehicle the percent of patients who received an ECG within 10 minutes of arrival at the STEMI referral hospital before being transferred to a STEMI receiving hospital ranged from a low of 62.0% in 2012 to a high of 77.0% in 2009. Among patients who arrived at the STEMI referral hospital by ambulance, the percent of patients who received an ECG within 10 minutes of arrival ranged from a low of 49.7% in 2015 to a high of 75.6% in 2009.

There is opportunity for improvement in this vital component of care. Implementing an appropriate protocol within the hospital ED can lead to more efficient care and improved times on performance of ECG.

**HOSPITAL ECG WITHIN 10 MINUTES OF ARRIVAL AMONG DIRECTLY ADMITTED PATIENTS**

Figure 8 and Table 18 below display the percentage of eligible episodes of care for heart attack in which directly admitted patients received an ECG within 10 minutes of arriving at the hospital, by mode of arrival to the hospital and year. Episodes of care in which a patient received an ECG prior to arriving at the hospital were excluded.

**Figure 8.** Hospital ECG within 10 minutes of arrival among directly admitted patients by mode of arrival to hospital and year
Table 18. Hospital ECG within 10 minutes of arrival among directly admitted patients by mode of arrival to hospital and year

<table>
<thead>
<tr>
<th>Mode of arrival to first hospital</th>
<th>Personal vehicle</th>
<th></th>
<th></th>
<th></th>
<th>Ambulance</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases with ECG at STEMI receiving hospital (n)</td>
<td>Cases with ECG within 10 minutes of arrival at STEMI receiving hospital (n)</td>
<td>% of cases with ECG within 10 minutes of arrival at STEMI receiving hospital</td>
<td>Cases with ECG at STEMI receiving hospital (n)</td>
<td>Cases with ECG within 10 minutes of arrival at STEMI receiving hospital (n)</td>
<td>% of cases with ECG within 10 minutes of arrival at STEMI receiving hospital</td>
<td>Reporting hospitals (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>199</td>
<td>151</td>
<td>75.9</td>
<td>85</td>
<td>58</td>
<td>68.2</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>1,076</td>
<td>671</td>
<td>62.4</td>
<td>514</td>
<td>303</td>
<td>58.9</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>2,072</td>
<td>1,313</td>
<td>63.4</td>
<td>796</td>
<td>475</td>
<td>59.7</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>2,717</td>
<td>1,814</td>
<td>66.8</td>
<td>912</td>
<td>570</td>
<td>62.5</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>2,937</td>
<td>1,913</td>
<td>65.1</td>
<td>1,079</td>
<td>721</td>
<td>66.8</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>3,704</td>
<td>2,429</td>
<td>65.6</td>
<td>1,097</td>
<td>619</td>
<td>56.4</td>
<td>44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>3,745</td>
<td>2,492</td>
<td>66.5</td>
<td>878</td>
<td>460</td>
<td>52.4</td>
<td>45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Between 2009 and 2015, the number of hospitals reporting on this measure increased each year, increasing from 10 to 45 hospitals overall. Among directly admitted patients, the percent of patients who received an ECG within 10 minutes of arrival by personal vehicle ranged from a low of 62.4% in 2010 to a high of 75.9% in 2009. The percent of patients who arrived by ambulance and received an ECG within 10 minutes of arrival ranged from a low of 52.4% in 2015 to a high of 68.2% in 2009.

Hospital ECG within 10 minutes of arrival is recommended both in transfer and directly admitted patients irrespective of their mode of arrival. Even if the report shows that higher number of patients arriving by a personal vehicle had a hospital ECG within 10 minutes of arrival, it is always recommended for the patients of heart attack to arrive by an ambulance. This is because recognition of STEMI when ECG is performed in an ambulance, can lead to timely activation of cardiac catheterization lab, which can decrease the total ischemic time and improve the patient 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. This 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 through streamlined processes and protocols, whereas transport time is more difficult to address due to other factors such as distance to closest receiving hospital.

Figure 9 and Table 19 below display the median time (in minutes) spent awaiting transfer from the STEMI referral hospital to the STEMI receiving hospital for PCI among eligible episodes of care for STEMI heart attack, by mode of arrival to the STEMI referral hospital.
Table 19. Median time spent in the ED of the STEMI referral hospital among transfer patients

<table>
<thead>
<tr>
<th>Patient Type</th>
<th>Median Time (in minutes)</th>
<th>Reporting hospitals (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer from other hospital</td>
<td>45.0</td>
<td>6</td>
</tr>
</tbody>
</table>

The median time spent awaiting transfer from the STEMI referral hospital to the STEMI receiving hospital for PCI was 45 minutes among those who arrived by personal vehicle and 48 minutes among those who arrived by ambulance. For referral hospitals, there should be appropriate protocols set in place for identifying a STEMI patient and transferring and transporting them to a receiving hospital. Implementing such a protocol requires rapid performance and interpretation of ECG and communication to the receiving hospital for activation of its catheterization lab.

**DWELL TIME IN THE EMERGENCY DEPARTMENT OF RECEIVING HOSPITAL AMONG TRANSFER PATIENTS**

Figure 10 and Table 20 below display the median time (in minutes) spent waiting in the ED of the STEMI receiving hospital among transfer patients with eligible episodes of care for STEMI heart attack, by mode of arrival to first hospital and year.
**Figure 10.** Median time spent in the ED of the STEMI receiving hospital among transfer patients by mode of arrival to first hospital and year

![Graph showing median time spent in the ED of the STEMI receiving hospital among transfer patients by mode of arrival to first hospital and year.]

**Table 20.** Median time spent in the ED of the STEMI receiving hospital among transfer patients by mode of arrival to first hospital and year

<table>
<thead>
<tr>
<th>Year</th>
<th>Personal VehicleSTEMI cases (n)</th>
<th>Median minutes</th>
<th>STEMI cases (n)</th>
<th>Median minutes</th>
<th>Reporting hospitals (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>20</td>
<td>22.5</td>
<td>5</td>
<td>29</td>
<td>2</td>
</tr>
<tr>
<td>2010</td>
<td>43</td>
<td>24</td>
<td>34</td>
<td>35.5</td>
<td>10</td>
</tr>
<tr>
<td>2011</td>
<td>101</td>
<td>26</td>
<td>28</td>
<td>40</td>
<td>15</td>
</tr>
<tr>
<td>2012</td>
<td>112</td>
<td>37.5</td>
<td>39</td>
<td>67</td>
<td>17</td>
</tr>
<tr>
<td>2013</td>
<td>120</td>
<td>43</td>
<td>21</td>
<td>46</td>
<td>18</td>
</tr>
<tr>
<td>2014</td>
<td>120</td>
<td>37.5</td>
<td>31</td>
<td>63</td>
<td>23</td>
</tr>
<tr>
<td>2015</td>
<td>120</td>
<td>27.5</td>
<td>29</td>
<td>36</td>
<td>25</td>
</tr>
</tbody>
</table>

Between 2009 and 2015, the number of hospitals reporting on this measure increased each year, increasing from 2 to 25 hospitals overall. Among patients who arrived at a STEMI referral hospital by personal vehicle and were then transferred to a STEMI receiving hospital, the **median ED dwell time** at the STEMI receiving hospital ranged from a low of 22.5 minutes in 2009 to a high of 43 minutes in 2013. Among patients who arrived at a STEMI referral hospital by ambulance and were then transferred to a STEMI receiving hospital, the median ED dwell time at the STEMI receiving hospital ranged from a low of 29 minutes in 2009 to a high of 67 minutes in 2012. There is opportunity for improvement of communication and placement of protocols between STEMI receiving and referral hospitals, in order to reduce dwell time in the ED of the STEMI receiving hospital.
Figure 11 and Table 21 below display the median time (in minutes) spent waiting in the ED of STEMI receiving hospital among directly admitted patients with eligible episodes of care for STEMI heart attack, by mode of arrival to hospital and year.

Figure 11. Median time spent in the ED of the STEMI receiving hospital among directly admitted patients by mode of arrival to hospital and year

<table>
<thead>
<tr>
<th>Year</th>
<th>Personal vehicle</th>
<th>Ambulance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>STEMI Cases (n)</td>
<td>Median minutes</td>
</tr>
<tr>
<td>2009</td>
<td>57</td>
<td>38</td>
</tr>
<tr>
<td>2010</td>
<td>255</td>
<td>47</td>
</tr>
<tr>
<td>2011</td>
<td>450</td>
<td>47</td>
</tr>
<tr>
<td>2012</td>
<td>564</td>
<td>45</td>
</tr>
<tr>
<td>2013</td>
<td>606</td>
<td>45</td>
</tr>
<tr>
<td>2014</td>
<td>731</td>
<td>44</td>
</tr>
<tr>
<td>2015</td>
<td>743</td>
<td>45</td>
</tr>
</tbody>
</table>

Between 2009 and 2015, the number of hospitals reporting on this measure increased each year, increasing from 8 to 45 hospitals overall. Among directly admitted patients who arrived at a STEMI receiving hospital by personal vehicle, the median ED dwell time ranged from a low of 38 minutes in 2009 to a high of 47 minutes in 2010 and 2011. Among directly admitted patients who arrived at a STEMI receiving hospital by ambulance, the median ED dwell time ranged from a low of 30 minutes in 2015 to a high of 35 minutes in 2009 and 2010.
FIRST DOOR TO NEEDLE TIME

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 or for patients ineligible for PCI. Fibrinolytic therapy should be administered within 30 minutes of hospital arrival.7

Figure 12 and Table 22 below display the median time (in minutes) elapsed from arrival at first hospital to receipt of fibrinolytic therapy as primary reperfusion treatment among eligible episodes of care for STEMI heart attack, by mode of arrival to first hospital. The patients included in this measure were later transferred to another hospital. The measure reflects median time from arrival at the first hospital to receipt of fibrinolytic therapy as primary reperfusion treatment at the first hospital. It is important to note the number of eligible patients for this measure was less than 100.

Figure 12. Median time from first hospital arrival to primary fibrinolysis among transfer patients by mode of arrival to first hospital

![Graph showing median time from first hospital arrival to primary fibrinolysis among transfer patients by mode of arrival to first hospital]

Table 22. Median time from first hospital arrival to primary fibrinolysis among transfer patients by mode of arrival to first hospital

<table>
<thead>
<tr>
<th>Patient Type</th>
<th>Mode of arrival to first hospital</th>
<th>Reporting hospitals (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Personal vehicle</td>
<td>Ambulance</td>
</tr>
<tr>
<td></td>
<td>Cases receiving fibrinolysis at STEMI referral hospital (n)</td>
<td>Median minutes</td>
</tr>
<tr>
<td>Transfer from other hospital</td>
<td>72</td>
<td>37.0</td>
</tr>
</tbody>
</table>

Among patients who arrived at the first hospital by personal vehicle, the median time to fibrinolytic therapy was 37 minutes from first hospital arrival, compared to a median time of 35 minutes to fibrinolytic therapy for those arriving by ambulance.
DOOR TO NEEDLE TIME WITHIN 30 MINUTES AMONG TRANSFER PATIENTS

Figure 13 and Table 23 below display the percentage of eligible patients receiving primary fibrinolysis within 30 minutes, by mode of arrival to first hospital. The patients included in this measure were later transferred to another hospital. The measure reflects the percent of patients who received fibrinolytic therapy as the primary reperfusion strategy within 30 minutes from arrival at the first hospital. It is important to note the number of eligible patients for this measure was less than 100.

Figure 13. Fibrinolysis within 30 minutes of hospital arrival among transfer patients by mode of arrival to first hospital

Table 23. Fibrinolysis within 30 minutes of hospital arrival among transfer patients by mode of arrival to first hospital

<table>
<thead>
<tr>
<th>Patient Type</th>
<th>Mode of arrival to first hospital</th>
<th>Personal vehicle</th>
<th>Ambulance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases receiving fibrinolysis</td>
<td>% of cases</td>
<td>Cases</td>
</tr>
<tr>
<td></td>
<td>within 30 minutes of arrival at</td>
<td>receiving</td>
<td>within 30</td>
</tr>
<tr>
<td></td>
<td>STEMI referral hospital (n)</td>
<td>fibrinolysis</td>
<td>minutes of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>within 30</td>
<td>arrival at</td>
</tr>
<tr>
<td></td>
<td></td>
<td>minutes of</td>
<td>STEMI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>arrival at</td>
<td>referral</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STEMI</td>
<td>hospital</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hospital</td>
<td>(n)</td>
</tr>
<tr>
<td>Transfer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>from other</td>
<td>72</td>
<td>27</td>
<td>24</td>
</tr>
<tr>
<td>hospital</td>
<td>37.5</td>
<td>37.5</td>
<td>37.5</td>
</tr>
</tbody>
</table>

The recommended door to needle time in referral hospitals is 30 minutes. In Texas, between the years 2008 and 2015, only 37.5% of the patients who arrived at a referral hospital either by a personal vehicle or ambulance met this criteria. There is an opportunity for improvement. The rapid performance of ECG and reduction of dwell times in the emergency departments of referral hospitals can improve this measure.
DOOR TO BALLOON TIME FOR DIRECTLY ADMITTED PATIENTS

PCI is the preferred reperfusion strategy for STEMI patients. The standard of care for time from hospital arrival to PCI or device activation, commonly referred to as door to balloon time, is 90 minutes. Figure 14 and Table 24 below display the median time (in minutes) elapsed from arrival at a STEMI receiving hospital to primary PCI among eligible episodes of care for STEMI heart attack, by mode of arrival and year. This measure is significant because it encompasses all the previous steps that are required for care of STEMI patients from arrival at the hospital, time in ED, arrival in the catheterization lab, and device activation.

Figure 14. Median time from hospital arrival to primary PCI among directly admitted patients by mode of arrival and year

<table>
<thead>
<tr>
<th>Year</th>
<th>Personal Vehicle</th>
<th>Ambulance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases receiving primary PCI at hospital (n)</td>
<td>Median minutes</td>
</tr>
<tr>
<td>2009</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2010</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2011</td>
<td>272</td>
<td>66</td>
</tr>
<tr>
<td>2012</td>
<td>402</td>
<td>68</td>
</tr>
<tr>
<td>2013</td>
<td>452</td>
<td>68</td>
</tr>
<tr>
<td>2014</td>
<td>533</td>
<td>66</td>
</tr>
<tr>
<td>2015</td>
<td>516</td>
<td>68</td>
</tr>
</tbody>
</table>

-- No data available

There were no hospitals that reported on this measure in 2009 or 2010. From 2011 to 2015, the number of hospitals reporting on this measure increased each year, increasing from 27 to 44 hospitals overall. Among patients who arrived at a STEMI receiving hospital by personal vehicle, the median time from hospital arrival to primary PCI ranged from a low of 66 minutes in 2011 and 2014 to a high of 68 minutes in 2012, 2013 and 2015. Among patients who arrived at a STEMI receiving hospital by ambulance, the median time from hospital arrival to primary PCI ranged from a low of 49 minutes in 2015 to a high of 54 minutes in 2011. Patients who arrived by ambulance had a lower median time to PCI than those who arrived by personal vehicle. In order to further improve
the median time to PCI, hospitals can evaluate the 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 15 and Table 25 below display the percentage of eligible episodes of care for STEMI heart attack and patients who received primary PCI within 90 minutes of direct presentation to a STEMI receiving hospital, by mode of arrival and year.

Figure 15. Primary PCI within 90 minutes of hospital arrival among directly admitted patients by mode of arrival and year

![Graph showing door to balloon time within 90 minutes for directly admitted patients]

Table 25. Primary PCI within 90 minutes of hospital arrival among directly admitted patients by mode of arrival and year

<table>
<thead>
<tr>
<th>Year</th>
<th>Personal vehicle</th>
<th>Ambulance</th>
<th>Reporting hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases receiving primary PCI at hospital (n)</td>
<td>Cases receiving primary PCI within 90 minutes of hospital arrival (n)</td>
<td>% of cases receiving primary PCI within 90 minutes of hospital arrival</td>
</tr>
<tr>
<td>2009</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2010</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2011</td>
<td>272</td>
<td>243</td>
<td>89.3</td>
</tr>
<tr>
<td>2012</td>
<td>402</td>
<td>360</td>
<td>89.6</td>
</tr>
<tr>
<td>2013</td>
<td>452</td>
<td>402</td>
<td>88.9</td>
</tr>
<tr>
<td>2014</td>
<td>533</td>
<td>491</td>
<td>92.1</td>
</tr>
<tr>
<td>2015</td>
<td>516</td>
<td>467</td>
<td>90.5</td>
</tr>
</tbody>
</table>

-- No data available

There were no hospitals that reported on this measure in 2009 or 2010. From 2011 to 2015, the number of hospitals reporting on this measure increased each year, increasing from 27 to 44 hospitals overall. Among patients who directly presented to a STEMI receiving hospital by personal vehicle, the percent who received...
primary PCI within 90 minutes ranged from a low of 88.9% in 2013 to a high of 92.1% in 2014. Among patients who directly presented to a STEMI receiving hospital by ambulance, the percent who received primary PCI within 90 minutes ranged from a low of 96.1% in 2012 to a high of 98.5% in 2013. A higher percent of patients who arrived by ambulance received primary PCI within 90 minutes of hospital arrival than those who arrived by personal vehicle.

**FIRST DOOR TO BALLOON TIME FOR TRANSFER PATIENTS**

STEMI heart attack patients who arrive at a STEMI referral hospital and 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. Figure 16 and Table 26 below display the median time (in minutes) elapsed from arrival at a STEMI referral hospital to receipt of primary PCI at a STEMI receiving hospital among eligible episodes of care for STEMI heart attack, by mode of arrival to the STEMI referral hospital.

**Figure 16.** Median time from first hospital arrival to primary PCI for transfer patients by mode of arrival to first hospital and year

**Table 26.** Median time from first hospital arrival to primary PCI for transfer patients by mode of arrival to first hospital and year

<table>
<thead>
<tr>
<th>Year</th>
<th>Personal vehicle</th>
<th>Ambulance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases receiving primary PCI at STEMI receiving hospital (n)</td>
<td>Cases receiving primary PCI at STEMI receiving hospital (n)</td>
<td>Median minutes</td>
</tr>
<tr>
<td>2009</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2010</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2011</td>
<td>152</td>
<td>99</td>
</tr>
<tr>
<td>2012</td>
<td>184</td>
<td>98</td>
</tr>
<tr>
<td>2013</td>
<td>198</td>
<td>97.5</td>
</tr>
<tr>
<td>2014</td>
<td>202</td>
<td>100.5</td>
</tr>
<tr>
<td>2015</td>
<td>219</td>
<td>104</td>
</tr>
</tbody>
</table>

-- No data available
There were no hospitals that reported on this measure in 2009 or 2010. From 2011 to 2015, the number of hospitals reporting on this measure increased each year, increasing from 17 to 27 hospitals overall. Among patients who arrived at the STEMI referral hospital by personal vehicle, the median time from arrival at the referral hospital to primary PCI at the STEMI receiving hospital ranged from a low of 97.5 minutes in 2013 to a high of 104 minutes in 2015. Among patients who arrived at a STEMI referral hospital by ambulance, the median time from arrival at the referral hospital to primary PCI at the STEMI receiving hospital ranged from a low of 66.5 minutes in 2011 to a high of 100.5 minutes in 2014. Patients who arrived at a STEMI referral hospital by ambulance had a lower median time to primary PCI than those who arrived at the referral hospital by personal vehicle.

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

*Figure 17* and *Table 27* below display the percentage of eligible episodes of care for STEMI heart attack patients 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 STEMI referral hospital and year.

*Figure 17.* Primary PCI within 120 minutes of first hospital arrival among transfer patients by mode of arrival to first hospital and year
There were no hospitals that reported on this measure in 2009 or 2010. From 2011 to 2015, the number of hospitals reporting on this measure increased each year, increasing from 17 to 27 hospitals overall. Among patients who arrived at a STEMI referral hospital by personal vehicle, the percent who received primary PCI at a STEMI receiving hospital within 120 minutes of arrival to the STEMI referral hospital ranged from a low of 60.3% in 2015 to a high of 66.3% in 2014. Among patients who arrived at a STEMI referral hospital by ambulance, the percent who received primary PCI at a STEMI receiving hospital within 120 minutes of arrival to the STEMI referral hospital ranged from a low of 65.6% in 2014 to a high of 84.0% in 2013. A higher percentage of patients who arrived at a STEMI referral hospital by ambulance received primary PCI within 120 minutes of arrival than those who arrived at the referral hospital by personal vehicle.

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

According to American Heart Association, STEMI systems of care recommendations, the door to balloon time for transfer patients including transport time should be within 90 minutes. Figure 18 and Table 28 below display the percentage of eligible episodes of care for STEMI heart attack patients who received primary PCI at a STEMI receiving hospital within 90 minutes of arriving at a STEMI referral hospital, by mode of arrival to the STEMI referral hospital and year.
There were no hospitals that reported on this measure in 2009 or 2010. From 2011 to 2015, the number of hospitals reporting on this measure increased each year, increasing from 17 to 27 hospitals overall. Among patients who arrived at a STEMI referral hospital by personal vehicle, the percent who received primary PCI at a STEMI receiving hospital within 90 minutes of arrival to the STEMI referral hospital ranged from a low of 36.1% in 2015 to a high of 41.9% in 2013. Among patients who arrived at a STEMI referral hospital by ambulance, the percent who received primary PCI at a STEMI receiving hospital within 90 minutes of arrival to the STEMI referral hospital ranged from a low of 37.5% in 2014 to a high of 74.3% in 2011. A higher percentage of patients who arrived at a STEMI referral hospital by ambulance received primary PCI within 90 minutes of arrival than those who arrived at the referral hospital by personal vehicle.
FIRST MEDICAL CONTACT TO BALLOON TIME

According to 2013 American College of Cardiology Foundation and American Heart Association STEMI guidelines, the focus and emphasis has been shifted to targeting first medical contact to balloon time rather than door to balloon time.\textsuperscript{14} Figure 19 and Table 29 below display the median time from first medical contact to balloon time by year for STEMI heart attack patients who arrived by an ambulance to the first hospital. Both the transfers and directly admitted patients were included.

Fig 19. Median time from first medical contact to balloon time by year among patients who arrived at the first or only hospital by ambulance, by patient type

Table 29. Median time from first medical contact to balloon time by year among patients who arrived at the first or only hospital by ambulance, by patient type

<table>
<thead>
<tr>
<th>Year</th>
<th>Directly Admitted</th>
<th>Transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases receiving primary PCI at STEMI receiving hospital (n)</td>
<td>Median minutes</td>
</tr>
<tr>
<td>2009</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2010</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2011</td>
<td>275</td>
<td>83</td>
</tr>
<tr>
<td>2012</td>
<td>403</td>
<td>81</td>
</tr>
<tr>
<td>2013</td>
<td>541</td>
<td>82</td>
</tr>
<tr>
<td>2014</td>
<td>562</td>
<td>80.5</td>
</tr>
<tr>
<td>2015</td>
<td>573</td>
<td>79</td>
</tr>
</tbody>
</table>

There were no hospitals that reported on this measure in 2009 or 2010. From 2011 to 2015, the number of hospitals reporting on this measure increased each year, increasing from 24 to 42 hospitals for directly admitted patients and 9 to 11 overall, for transfer patients. Among patients who arrived at a STEMI receiving hospital by ambulance, the median time from first medical contact to primary PCI at the STEMI receiving hospital ranged from a low of 79 minutes in 2015 to a high of 83 minutes in 2011. Among patients who arrived at a STEMI referral hospital by ambulance, the median time from first medical contact to primary PCI at the STEMI receiving hospital...
ranged from a low of 98 minutes in 2011 to a high of 139 minutes in 2014. The median times from first medical contact to primary PCI were higher for transfer patients compared to directly admitted patients.

**TOTAL ISCHEMIC TIME AMONG TRANSFER PATIENTS**

According to some studies, “Ischemic Time is a better predictor than Door-to-Balloon Time for mortality and infarct size in ST-Elevation Myocardial Infarction”.⁸ These studies suggest that the focus of STEMI care should be directed in reducing the ischemic time rather than door-to-balloon time. This can be achieved by early initiation of therapy. **Figure 20** and **Table 30** below display the total ischemic time among STEMI transfer patients from 2011 to 2015, which was divided into three categories: less than 120 minutes, 120 – 239 minutes, and 240 minutes or more. The best clinical outcomes are observed in patients who have total ischemic time < 120 minutes. Total ischemic time less than 120 minutes was more common among patients who arrived at the STEMI referral hospital by ambulance (20.0%) than among patients who arrived by personal vehicle (10.1%). Half of the transfer patients arriving at the STEMI referral hospital by personal vehicle had a total ischemic time of 240 minutes or more while 31.9% of patients arriving by ambulance fell into this category.

**Figure 20**: Total ischemic time among transfer patients by mode of arrival to first hospital

**Table 30**: Total ischemic time among transfer patients by mode of arrival to first hospital

<table>
<thead>
<tr>
<th>Patient Type</th>
<th>Mode of arrival to first hospital</th>
<th>Reporting hospitals (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Personal vehicle</td>
<td>Ambulance</td>
</tr>
<tr>
<td></td>
<td>Total Ischemic Time &lt; 120 Minutes, n (%)</td>
<td>Total Ischemic Time ≥ 240 Minutes, n (%)</td>
</tr>
<tr>
<td>Transfer from other hospital</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>82 (10.1)</td>
<td>54 (20.0)</td>
</tr>
<tr>
<td></td>
<td>321 (39.4)</td>
<td>130 (48.1)</td>
</tr>
<tr>
<td></td>
<td>412 (50.6)</td>
<td>86 (31.9)</td>
</tr>
<tr>
<td></td>
<td>82 (10.1)</td>
<td>54 (20.0)</td>
</tr>
<tr>
<td></td>
<td>321 (39.4)</td>
<td>130 (48.1)</td>
</tr>
</tbody>
</table>
|                               | 412 (50.6)                       | 86 (31.9)               | 34
TOTAL ISCHEMIC TIME AMONG DIRECTLY ADMITTED PATIENTS

Figure 21, Figure 22, Figure 23 and Table 31 display the total ischemic time among STEMI patients from 2011 to 2015, which was divided into three categories: less than 120 minutes, 120 – 239 minutes, and 240 minutes or more. The best clinical outcomes are observed in patients who have total ischemic time < 120 minutes. Figure 21 indicates that from 2011 to 2015, total ischemic time less than 120 minutes was more common among patients who arrived by ambulance than by personal vehicle. Figure 23 indicates that from 2011 to 2015, total ischemic time of 240 minutes or more was more common among patients who arrived by personal vehicle than by ambulance. In 2015, 29.0% of the patients who arrived at the hospital by personal vehicle and 42.2% of the patients who arrived at the hospital by ambulance, had less than 120 minutes of total ischemic time. In 2015 and in the third category, 35.6% of the patients who arrived at the hospital by personal vehicle and 17.9% of the patients who arrived at the hospital by ambulance, had 240 minutes or more of total ischemic time.

Figure 21: Total ischemic time < 120 minutes among directly admitted STEMI patients by mode of arrival and year

Figure 22: Total ischemic time 120 - 239 minutes among directly admitted STEMI patients by mode of arrival and year

Figure 23: Total ischemic time ≥ 240 minutes among directly admitted STEMI patients by mode of arrival and year
There were no hospitals that reported on this measure in 2009 or 2010. From 2011 to 2015, the number of hospitals reporting on this measure increased each year, increasing from 27 to 44 hospitals overall.

**ACTIVATION OF CATHETERIZATION LAB PRIOR TO ARRIVAL AMONG TRANSFER PATIENTS**

Figure 24 and Table 32 show data on activation of the cardiac catheterization lab prior to hospital arrival, known as “pre cath lab activation”, among 259 STEMI transfer patients in 2015 who arrived at the first hospital by personal vehicle or ambulance. The catheterization lab was activated prior to arrival at the receiving hospital for 44.0% of patients, not activated for 7.0% of patients and there were missing observations for 49% of the patients. Implementing an appropriate protocol for “pre cath lab activation” at the receiving hospital for transfer patients can reduce total ischemic time among these patients and improve the outcomes.

**Figure 24:** Activation of catheterization lab among transfer patients whose mode of arrival to the first hospital was by personal vehicle or ambulance

---

**Table 31:** Total Ischemic Time among directly admitted STEMI patients by mode of arrival and year

<table>
<thead>
<tr>
<th>Year</th>
<th>Reporting Hospitals (n)</th>
<th>Mode of arrival to first hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>--</td>
<td>Personal vehicle</td>
</tr>
<tr>
<td></td>
<td>--</td>
<td>Ambulance</td>
</tr>
<tr>
<td>2010</td>
<td>--</td>
<td>Personal vehicle</td>
</tr>
<tr>
<td></td>
<td>--</td>
<td>Ambulance</td>
</tr>
<tr>
<td>2011</td>
<td>67 (27.5) 99 (40.6) 78 (32.0)</td>
<td>Personal vehicle</td>
</tr>
<tr>
<td></td>
<td>112 (42.9) 105 (40.2) 44 (16.9)</td>
<td>Ambulance</td>
</tr>
<tr>
<td>2012</td>
<td>83 (23.3) 173 (48.6) 100 (28.1)</td>
<td>Personal vehicle</td>
</tr>
<tr>
<td></td>
<td>162 (44.0) 150 (40.8) 56 (15.2)</td>
<td>Ambulance</td>
</tr>
<tr>
<td>2013</td>
<td>89 (24.3) 153 (41.7) 125 (34.1)</td>
<td>Personal vehicle</td>
</tr>
<tr>
<td></td>
<td>213 (41.5) 214 (41.7) 86 (16.8)</td>
<td>Ambulance</td>
</tr>
<tr>
<td>2014</td>
<td>133 (30.1) 170 (38.5) 139 (31.4)</td>
<td>Personal vehicle</td>
</tr>
<tr>
<td></td>
<td>201 (41.2) 184 (37.7) 103 (21.1)</td>
<td>Ambulance</td>
</tr>
<tr>
<td>2015</td>
<td>123 (29.0) 150 (35.4) 151 (35.6)</td>
<td>Personal vehicle</td>
</tr>
<tr>
<td></td>
<td>221 (42.2) 209 (39.9) 94 (17.9)</td>
<td>Ambulance</td>
</tr>
</tbody>
</table>

-- No data available
Table 32: Activation of catheterization lab among transfer patients whose mode of arrival to the first hospital was by personal vehicle or ambulance

<table>
<thead>
<tr>
<th>Patient Type</th>
<th>Pre Cath Lab Activation</th>
<th>Number of Cases (n)</th>
<th>Percent of Cases (%)</th>
<th>Reporting Hospitals (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transfer from other hospital</strong></td>
<td>Pre Cath Lab Activation</td>
<td>114</td>
<td>44.0</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>No Pre Cath Lab Activation</td>
<td>18</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>127</td>
<td>49.0</td>
<td></td>
</tr>
</tbody>
</table>

ACTIVATION OF CATHETERIZATION LAB PRIOR TO ARRIVAL AMONG DIRECTLY ADMITTED PATIENTS

Figure 25 and Table 33 show data on activation of the cardiac catheterization lab prior to hospital arrival, known as “pre cath lab activation”, among 587 directly admitted STEMI patients in 2015 who arrived at the hospital by an ambulance. Pre cath lab activation occurred for 53.0% but did not occur for 37.0% of the patients. Prehospital ECG within 10 minutes of first medical contact and accurate diagnoses of STEMI cases, when communicated to the receiving hospital lead to pre cath lab activation. Appropriate protocol should be implemented for “pre cath lab activation” at the receiving hospital for STEMI patients arriving by ambulance. This can reduce the total ischemic time among these patients and improve the outcomes. Collaborative efforts between EMS providers, nursing staff, and physicians can increase the percentage of cases with pre cath lab activation in Texas.

Figure 25: Activation of catheterization lab prior to hospital arrival among directly admitted patients whose mode of arrival was by ambulance
Table 33: Activation of catheterization lab prior to hospital arrival among directly admitted patients whose mode of arrival was by ambulance

<table>
<thead>
<tr>
<th>Patient Type</th>
<th>Pre Cath Lab Activation</th>
<th>Number of Cases (n)</th>
<th>Percent of Cases (%)</th>
<th>Reporting Hospitals (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directly admitted</td>
<td>Pre Cath Lab Activation</td>
<td>311</td>
<td>53.0</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>No Pre Cath Lab Activation</td>
<td>220</td>
<td>37.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>56</td>
<td>10.0</td>
<td></td>
</tr>
</tbody>
</table>

CARDIAC REHABILITATION REFERRAL

Figure 26 and Table 34 display the cardiac rehabilitation referral among 11,635 STEMI patients at the time of discharge. About 63% of the patients were referred to a cardiac rehabilitation program while 25% were not referred and 12% were ineligible for referral. The ineligible factors include medical reason, patient factors, and health care system factors. For example, if the patient has a medically unstable, life threatening condition, he is ineligible due to a medical reason. If the patient needs to be discharged to a nursing care facility for a long-term care, he is ineligible due to a patient factor. Health care system factors include no cardiac rehabilitation program within 60 minutes from the patient’s home. 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. According to 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 Recent research suggests that physician referral is the most powerful predictor for cardiac rehabilitation enrollment.9 Appropriate measures should be taken to improve the rates of cardiac rehabilitation referral.

Figure 26: Cardiac Rehabilitation Referral among STEMI Patients

![Cardiac Rehabilitation Referral Chart]

- No Referral: 2,969 (25.5%)
- Referral: 7,274 (62.5%)
- Ineligible: 1,392 (12.0%)
COMORBIDITIES AMONG ACUTE MYOCARDIAL INFARCTION (AMI) PATIENTS

Figure 27 shows the percentage of comorbidities among all heart attack patients between the years 2008 and 2015. The chart indicates that among 38,301 heart attack patients, 77.3% were hypertensive, 61.0% had dyslipidemia, 41.5% were obese, 39.3% had diabetes, 31.1% were current or recent smokers within the past year and 27.0% were found to be anemic. It is not well known about the exact cause of anemia in these patients. Hypertension is a very common and important risk factor for heart attack and efforts should be taken to mitigate the prevalence of hypertension.

Figure 27: Percentage of comorbidities among AMI patients

<table>
<thead>
<tr>
<th>Comorbidities</th>
<th>Reporting Hospitals (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>77.3</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>61.0</td>
</tr>
<tr>
<td>Obesity</td>
<td>41.5</td>
</tr>
<tr>
<td>Diabetes</td>
<td>39.3</td>
</tr>
<tr>
<td>Smoking</td>
<td>31.1</td>
</tr>
<tr>
<td>Anemia</td>
<td>27.0</td>
</tr>
</tbody>
</table>
SMOKING CESSTATION ADVICE UPON DISCHARGE

Smoking is a major modifiable risk factor for heart attack. Smoking increases the risk of atherosclerosis in the arteries, increases the levels of triglycerides, and decreases the levels of HDL cholesterol, and thereby can raise the risk of heart attack.\(^\text{11}\) Smoking causes one of every three deaths from cardiovascular disease.\(^\text{11}\) According to the World Health Organization’s Tobacco Free Initiative, patients who quit smoking after an episode of heart attack reduce their chances of having another heart attack by 50\%.\(^\text{12}\) Out of a total of 11,573 smokers among total heart attack cases, 11,279 (97\%) were advised for smoking cessation at the time of discharge, 294 (2.5\%) were not advised, and 95 (0.8\%) were missing data on the measure.

Figure 28: Smoking cessation advice upon discharge among AMI patients who were current or recent smokers

PRIOR DIABETES TREATMENT UPON ADMISSION

Among 15,421 heart attack cases with a reported diabetes diagnosis, upon arrival at the hospital 11.9\% were not on treatment for diabetes, 4\% were only on diet treatment, 44.6\% were on oral hypoglycemic agents, and 36.3\% were on insulin therapy.

Among patients with diabetes who had health insurance, 10.6\% reported that they were not on treatment for diabetes. And among patients with diabetes but without health insurance, 19.5\% reported that they were on no treatment for diabetes. The results show that there is a gap in the treatment of diabetes in some patients which may have led to complications.
EVALUATION OF TRIGLYCERIDE LEVELS AMONG ACUTE MYOCARDIAL INFARCTION PATIENTS

Hypertriglyceridemia may substantially increase the cardiovascular disease risk among patients when compared to those who have normal triglyceride levels.¹³ Normal triglyceride levels are below 150 mg/dl and levels between 150 and 199 mg/dl are considered as borderline high, levels between 200 and 499 mg/dl are high, and 500 mg/dl or more is considered very high.

Among 38,978 heart attack cases, 68.6% had triglyceride levels below 150 mg/dL, 13.0% had levels between 150 and 200 mg/dL, and 16.4% patients had levels between 200 and 500 mg/dL, and 2.0% of patients had levels of 500 and above. Mild or moderate hypertriglyceridemia may be considered as a risk factor for cardiovascular disease, however severe hypertriglyceridemia is associated with an increased risk of pancreatitis.¹³ It is recommended that patients with primary hypertriglyceridemia should be evaluated for other cardiovascular risk factors such as central obesity, hypertension, liver dysfunction and other glucose metabolism abnormalities.¹³
APPENDIX I – DATA SOURCES AND DEFINITIONS

Glossary

POSSIBLE HEART ATTACK EMS RUNS

Definition
A possible heart attack run was defined by primary signs and symptoms of chest pain, cardiac rhythm disturbances, or cardiac arrest, or associated signs and symptoms of chest pain, cardiac rhythm disturbances, or cardiac arrest. No standard guidelines existed to define a possible heart attack run.

Population includes runs:
- >18 years old
- Incident state of Texas
- 911 EMS runs

COUNTY URBAN-RURAL DEFINITION

The Texas Department of State Health Services (DSHS) follows the Metropolitan and Non-Metropolitan county designations defined by the U.S. Office of Budget and Management (OBM). In Texas, 82 counties are designated as Metropolitan and 172 are designated as Non-Metropolitan. The terms “Non-Metropolitan and Metropolitan” and interchangeable with “Urban and Rural.” [https://www.dshs.texas.gov/chs/hprc/counties.shtm](https://www.dshs.texas.gov/chs/hprc/counties.shtm)

The following are definitions used specifically for this report. The urban and rural categories used are defined based upon the 2013 National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme for Counties. This includes six county-level categories: metropolitan (large central metro, large fringe metro, medium metro, and small metro) and nonmetropolitan (micropolitan and noncore).

Urban
- Large central metro—counties in MSAs of 1 million or more population that: contain the entire population of the largest principal city of the MSA, or have their entire population contained in the largest principal city of the MSA, or contain at least 250,000 inhabitants of any principal city of the MSA.
- Large fringe metro—counties in MSAs of 1 million or more population that did not qualify as large central metro counties.
- Medium metro—counties in MSAs of populations of 250,000 to 999,999.
- Small metro—counties in MSAs of populations less than 250,000.

Rural
- Micropolitan—Counties in micropolitan statistical areas.
- Noncore—Nonmetropolitan counties that did not qualify as micropolitan.

First hospital refers to a facility where a patient is seen initially.

STEMI referral hospital refers to a facility where a patient is seen initially 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.
Table 1 (pg.10)
Data Source: Texas Behavioral Risk Factor Surveillance System Public Use Data File, 2011-14. Texas Department of State Health Services, Center for Health Statistics, Austin, Texas.

Table 2 (pg.11)
Data Sources: Texas Hospital Inpatient Discharge Public Use Data File, 2009-13. Texas Department of State Health Services, Center for Health Statistics, Austin, Texas; and County-Level Population Data, 2009-13. Texas Department of State Health Services, Center for Health Statistics, Austin, Texas.

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; exclude records for HIV and drug/alcohol use patients and non-residents hospitalized in-state; and 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+.

Tables 3 through 10 (Pgs. 12 - 16)
Data Source: Texas EMS & Trauma Registries (2014), Texas Department of State Health Services.

Figure 1 (pg.11)
Data Sources: County-Level Mortality Data, 2009-13. Texas Department of State Health Services, Center for Health Statistics, Austin, Texas; and County-Level Population Data, 2009-13. 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 (pg. 13)
Data Source: Texas EMS & Trauma Registries (2014), Texas Department of State Health Services.

Figure 3 (pg. 17)

PRE-HOSPITAL ECG WITHIN 10 MINUTES OF FIRST MEDICAL CONTACT (pgs. 21-22)
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 PATIENTS (pgs. 22-23)

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 PATIENTS (pgs. 23 - 24)

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 referral hospital via mobile ICU or air
• Received as transfer from STEMI referral hospital 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 TRANSFER PATIENTS (pgs. 24 -25)

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 receiving 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 PATIENTS** (pgs. 25 - 26)

**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** (pg. 27)

**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 Patients** (pgs. 28 - 29)

**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
PATIENTS (pgs.29-30)

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 (pg. 30)

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 PATIENTS (pg. 31)

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 PATIENTS** (pgs. 32-33)

**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 PATIENTS** (pgs. 33 - 34)

**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 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 PATIENTS** (pgs. 34 -35)

**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 PATIENTS (pgs.35 -36)

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 PATIENTS (pgs.36 -38)

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 (pgs.38 -39)

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 PATIENTS (pgs. 39-40)

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 PATIENTS (pgs. 40-42)

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

**ACTIVATION OF CATHETERIZATION LAB PRIOR TO ARRIVAL AMONG TRANSFER PATIENTS** (pg.42)

**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 PATIENTS** (pg.43)

**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** (pgs. 44)

**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 AMI PATIENTS (pgs. 45)
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 (pgs.45-46)
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 (pg.46)
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 ACUTE MYOCARDIAL INFARCTION PATIENTS (pg.47)
Definition
High triglyceride levels above 150 mg/dl has been linked to an increased risk of heart disease.

Population excludes patients:
• <18 years old
REFERENCES


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