Published in final edited form as:

Am J Emerg Med. 2018 July ; 36(7): 1182–1187. doi:10.1016/j.ajem.2017.12.003.

Factors associated with advanced cardiac care in prehospital chest pain patients

Adam Frisch, MD, MS^{a,*}, Kenneth J. Heidle, DO^b, Stephanie O. Frisch^c, Ashar Ata, PhD^d, Brandon Kramer, DO^b, Caroline Colleran, DO^b, and Jestin N. Carlson, MD, MS^b

^aUPMC, Department of Emergency Medicine, Pittsburgh, PA, United States

^bAllegheny Health Network, Department of Emergency Medicine, Erie, PA, United States

^cUniversity of Pittsburgh School of Nursing, Pittsburgh, PA, United States

^dAlbany Medical Center, Department of Emergency Medicine, Albany, NY, United States

Abstract

Introduction: Many patients transported by emergency medical services (EMS) may require advanced cardiac care but do not have ST-segment elevation (STEMI) on the initial prehospital EKG. We sought to identify factors associated with the need for advanced cardiac care in undifferentiated EMS patients reporting chest pain in the absence of STEMI on EKG.

Methods: We performed a retrospective analysis of all adult patients, reporting atraumatic chest pain from a single EMS agency, presenting to a single, urban hospital over a 10-year period. Patients with STEMI on prehospital electrocardiogram were excluded. Patient demographics, chest pain characteristics and prehospital factors were abstracted for all patients. We identified those patients that required advanced cardiac care and performed regression analysis to determine associated factors.

Results: A total of 956 charts were analyzed. Of this total, 193 patients (20.2%) met the primary composite outcome. Of the outcome group, 185 patients (95.9%) had coronary artery disease documented on cardiac catheterization, 22 patients (11.4%) underwent CABG, and seven patients (3.6%) died in the hospital. Most significant variables (multivariable IRR) included age (1.02), male gender (1.65), history of MI (1.47), PCI (1.66), hyperlipidemia (1.40), diaphoresis (1.51), home aspirin (1.53), and improvement with EMS treatment (1.60).

Conclusion: We have identified several factors that could be considered when risk stratifying prehospital patients reporting chest pain. While potentially predictive, the factors are broad and support the need for other objective factors that could augment prediction of patients who may benefit from early advanced cardiac care.

Keywords

Prehospital; EMS; Chest pain

*Corresponding author at: UPMC Emergency Medicine, Iroquois Building, Suite 400A, 3600 Forbes Ave., Pittsburgh, PA 15261, United States. frischan@upmc.edu (A. Frisch).

1. Introduction

In the United States, approximately 8 million people per year present to an Emergency Department (ED) with chest pain [1]. Many of these patients are transported by Emergency Medical Services (EMS) [2]. For EMS to be most effective, these patients must be rapidly evaluated and transported to an appropriate hospital for further evaluation and management. Prehospital evaluation for chest pain includes a history, physical exam, and electrocardiogram (EKG) [3]. Prehospital providers are taught to look for ST segment elevations on EKG as this may indicate a time dependent issue requiring emergent percutaneous intervention (PCI) and transfer to a facility with PCI capabilities [4].

There are less defined EMS guidelines for hospital selection in patients where the EKG does not show evidence of ST elevation myocardial infarction (STEMI) [5]. These patients may still have cardiac disease or injury requiring advanced cardiac care (PCI, CABG, etc.). More than 780,000 people in the U.S. each year experience acute coronary syndrome (ACS) and about 70% are of the non ST segment elevation variety (NSTEMI-ACS) [6]. At six months, the mortality of NSTEMI-ACS may equal or even exceed that of STEMI and delays in care may worsen patient outcomes [4]. Therefore, as regionalization and specialization of many cardiac services continues, the need to identify and differentiate patients reporting chest pain without evidence of STEMI, but who may still require advanced cardiac care becomes increasingly important.

Hospital based assessment tools such as the Thrombolysis in Myocardial Infarction (TIMI) score [7,8], the Emergency Department Assessment of Chest Pain Score (EDACS) [9], and the HEART score [10], have been established, to help risk-stratify patients in the absence of STEMI. All of these scoring systems however, require blood testing of cardiac biomarkers [7–10], a capability currently not readily available in the prehospital setting. As such, there are limited tools to assist prehospital providers in identifying which patients reporting chest pain, but without STEMI on EKG, will require advanced cardiac care [5]. We sought to identify factors associated with the need for advanced cardiac care in undifferentiated EMS patients reporting chest pain in the absence of STEMI on EKG.

2. Methods

2.1. Setting and selection of participants

We identified patients transported by a single suburban EMS agency, with roughly 8500 annual emergency calls transported to a single, urban Emergency Department with an annual volume of 65,000 visits. The EMS agency is a third party, private, paid EMS agency. All potential cardiac calls have a paramedic dispatched. The receiving hospital has 24-hour cardiac catheterization and cardiothoracic surgery capability. Only patients transported with the initial dispatch diagnosis of “chest pain” were included. Calls for “palpitations”, “shortness of breath”, or other potential anginal equivalents were not included. We excluded cases with patients <18 years of age, those transported from another facility, or those diagnosed with STEMI in the prehospital setting. Patients that did not have any ED record, such as those directly admitted to the hospital, had a documented traumatic etiology of pain,

or found in cardiac arrest prior to EMS arrival were also excluded. The study was approved by our hospital's Institutional Review Board.

2.2. Study design

We performed a retrospective chart review linking both prehospital and in-hospital electronic health records for all EMS calls for “chest pain” that were transferred to our Emergency Department over a 10-year period from January 1, 2005 through December 31, 2014. The list of prehospital charts was initially generated by an EMS administrator based on the chief complaint of “chest pain”. We linked these EMS medical records to their respective hospital records using the date of EMS transport, the date of ED visit, patient name, and patient birthdate.

Two research assistants (RAs) were tasked with data abstraction after several training sessions with the principal investigators. Each RA was assigned to abstract data exclusively from either the hospital (McKesson, San Francisco, CA) or prehospital (EMSCarts, Pittsburgh, PA) records. The RAs each used a single standardized data collection form containing the predefined variables to be abstracted throughout the length of the study. Each RA remained blinded to the data collected by the other RA but was not blinded to the primary hypothesis. Regular meetings were held throughout the length of the study to address any questions or concerns. Medical records with ambiguous recordings were identified by the RAs and discussed among the investigators until a consensus regarding the correct interpretation was reached. After data was collected by the RAs, the investigators, to ensure consistency, reviewed a 10% random subset.

2.3. Definitions and data elements

We defined “chest pain in the absence of STEMI” as cases that were documented to have a chief complaint of “chest pain” on the prehospital medical record, and did not meet STEMI criteria on a prehospital EKG. While previously established risk assessment tools have not been directly applied to the prehospital setting [5], there are elements within these that are routinely documented in the prehospital phase. Based upon this, a list of potential risk factors was generated a priori for abstraction.

Data were abstracted as coded in the prehospital medical record on age, gender, vital signs, pain score, past medical history, signs and symptoms, medications administered prior to EMS arrival and during EMS care, improvement during EMS care, and if the prehospital EKG was abnormal as defined below. Age and gender were predefined and abstracted using standard definitions [11]. Both initial and final sets of vital signs taken by EMS were abstracted. Specific past medical history elements and signs and symptoms were abstracted (Table 1). The administration and dosages of aspirin and nitroglycerin were recorded as either self-administered prior to EMS arrival or as given by an EMS provider. An abnormal EKG was predefined as any EKG that was not normal sinus rhythm.

The same categorical information for patient demographics, vital signs, and past medical history were also collected from the inpatient side, however this was done to ensure correct linkage between the in-hospital and prehospital charts [12] and not used in the statistical analysis. Both prehospital and in-hospital data were entered into the standardized collection

form as documented from the records in the following formats. Quantitative variables and outcomes, such as age, vital signs, and pain score, were entered numerically. Descriptive findings such as nature of pain and EKG findings were entered in writing.

2.4. Study outcomes

As we sought to determine which prehospital factors associated with the need of advanced cardiac care, a priori, we chose a primary composite outcome including any of the following during the patient's hospital stay: abnormal cardiac catheterization, performance of coronary artery bypass graft (CABG), or all cause death. Performance of cardiac catheterization and the presence of abnormalities on catheterization were abstracted from the in hospital record. Abnormal coronary findings, defined as stenosis or lumen irregularities documented on the cardiac catheterization report, were considered abnormal cardiac catheterizations. The performance of PCI, CABG, and the number of grafts placed were recorded. Death in the hospital was also measured. We believe that patients with an abnormal cardiac catheterization or in need of CABG required a health care facility with a high level of cardiac care capabilities. We have elected to not include normal cardiac catheterizations in the composite outcome as we were concerned that patients may have been "over triaged" simply because the catheterization lab existed. We believe the combination of these three outcomes best represents a subset of patients with the greatest need for advanced cardiac care (Table 2).

2.5. Statistical analysis

Using a standardized data collection form, both the prehospital and in-hospital records were matched according to the patient's name, date of birth, and date of visit. Continuous variables were reported as means and categorized whether or not the composite outcome was met. Confidence intervals of 95% were calculated. Variables with a p -value of <0.05 were considered significant. Categorical variables were presented as totals within each category. We then calculated the percentages of patients with each variable who did and did not meet the composite outcome out of the total patients in each respective group. Bivariate analysis and modified Poisson regression for all factors were performed. Using backward elimination, factors with a $p < 0.1$ were included in the multivariable regression. Results are presented as Incident Risk Ratios (IRR) secondary to common composite outcome prevalence.

3. Results

A total of 1136 patient charts were initially transported by EMS with the chief complaint of "chest pain". After applying predefined exclusionary criteria, we were able to match 956 prehospital and in-hospital patient records for analysis (Fig. 1). Of this total, 193 patients (20.2%) met the primary composite outcome. Of the outcome group, 185 patients (95.9%) had an abnormal cardiac catheterization, 22 patients (11.4%) underwent CABG, and seven patients (3.6%) died in the hospital (Table 3).

The mean age for patients meeting the outcome was 69.2 years versus 64.2 years for those that did not (Table 4). Patients meeting our primary outcome had higher rates of past history

of MI, coronary artery disease (CAD), PCI, cardiac stent, CABG, hypertension, and hyperlipidemia, and more frequently reported dyspnea (39.9%), diaphoresis(32.6%), and arm pain (23.3%).

Multiple factors had significant univariable incident risk ratios including; male gender (1.74, 95% CI 1.34–2.24), CAD (2.09, 1.63–2.68), history of PCI (2.16, 1.66–2.79), and jaw pain (2.01, 1.35–2.99) (Table 5). A history of anxiety or panic attacks had an IRR of 0.30. For the multivariable regression model, the significant variables were age, male gender, first diastolic blood pressure, history of myocardial infarction (MI), PCI, hyperlipidemia, anxiety/panic attacks, diaphoresis, home aspirin, EMS morphine, and improvement with EMS treatment (Table 6). The highest incident ratios were seen in patients with a history of PCI (1.66), male gender (1.65), had improvement with EMS treatment (1.60), took aspirin at home (1.53) and had diaphoresis (1.51), arm pain (1.49) or a history of MI (1.47). History of anxiety was also associated with a reduced IRR of 0.41.

4. Discussion

EMS is tasked with rapidly stabilizing and transporting patients to the appropriate level of care that includes patient with potential cardiac conditions in the setting of a non-diagnostic EKG. In this retrospective analysis, we found that there are multiple prehospital factors that may indicate a need for advanced cardiac care, however the presence of these factors is broad and often may not be available at the beginning of the call when the transport decision needs to be made.

Based on our multivariable regression, we have found that the strongest predictors of our composite outcome were history of PCI, male gender, improvement with EMS care, home aspirin use, diaphoresis, arm pain, and history of MI. Given that EMS care continues throughout the ambulance transport, it would be difficult to make an assessment on EMS administered medications or improvement with treatment in a timely manner, and rerouting the patient later may not be feasible.

These easily identifiable factors may be used in conjunction with newer objective measures (blood tests, heart rate variability, etc.) to improve the accuracy in identifying which patients would benefit from primary transfer to an advanced cardiac center. This may allow for a rapid and clear decision for patients who require additional intervention. Patients could then be transported more efficiently to the appropriate health care facility, ideally resulting in improved patient outcomes.

Compared to the current in-hospital assessment tools, our study did find similar factors associated with severe cardiac disease, morbidity, and mortality. The TIMI, EDACS, and HEART scores all use age within their scoring systems, as well as CAD risk factors such as hyperlipidemia [7–10]. Known CAD such as a history of MI or PCI is used in both the TIMI and EDACS score [7–9]. Home aspirin use is assessed in the TIMI score [7,8]. Male gender, diaphoresis, and arm pain are used in the EDACS score [9]. None of the current systems use blood pressure measurements, although the EDCAS score is only for patients with vital signs within normal limits. Notably absent from the current systems are: EMS treatments,

improvement with EMS treatment, or history of anxiety/panic attacks, which may have the potential to improve the accuracy of these tools.

5. Limitations

This was a retrospective review of prehospital and in-hospital charts. Further work will be needed to prospectively validate these findings. Second, only patients with “chest pain” chief complaints were included. Other complaints commonly associated with CAD including palpitations, shortness of breath, etc., were not included in the analysis. Third, while a moderate sample size was used from the initial generated chart list, a fair number of charts needed to be excluded, including 54 where the prehospital and in-hospital records were unable to be matched for unknown reasons. Fourth, the data were only collected from one EMS agency transported to one hospital and did not include patients transported to the other main hospital in the region. For increased generalization, a larger sample size involving multiple agencies, hospitals, settings, and patient populations needs to be investigated. Finally, we chose the composite outcome that we thought would best represent a need for advanced cardiac care. We chose not to use PCI as part of the composite outcome in part because of the belief that PCI centers may be more likely than non-PCI centers to perform interventions. We sought to reduce this bias by using abnormal catheterization in the outcome instead of PCI alone.

6. Conclusion

We identified factors that may be considered when risk stratifying prehospital patients with chest pain, however these factors alone should not obviate additional cardiac care in their absence. These factors may help prehospital providers identify patients at greatest need for additional cardiac care and, with other tools, may help to determine which patients would benefit from transport to a facility with more appropriate resources.

References

- [1]. Mahler S In: Tintinalli JE, editor. Tintinalli's emergency medicine: A comprehensive study guide. Eighth ed United States: McGraw-Hill Professional; 12 1, 2015 325 chap 48.
- [2]. Galinski M, Saget D, Ruscev M, Gonzalez G, Ameer L, Lapostolle F, et al. Chest pain in an out-of-hospital emergency setting: no relationship between pain severity and diagnosis of acute myocardial infarction. *Pain Pract* 2015;15(4):343–7. [PubMed: 24646436]
- [3]. Herlitz J, Hansson E, Ringvall E, Starke M, Karlson BW, Waagstein L. Predicting a life-threatening disease and death among ambulance-transported patients with chest pain or other symptoms raising suspicion of an acute coronary syndrome. *Am J Emerg Med* 2002;20:588–94. [PubMed: 12442235]
- [4]. Grzybowski M, Zalenski RJ, Ross MA, Bock B. A prediction model for prehospital triage of patients with suspected cardiac ischemia. *Electrocardiology* 2000;33:253–8.
- [5]. Grijseels EW, Deckers JW, Hoes AW, et al. Pre-hospital triage of patients with suspected myocardial infarction. Evaluation of previously developed algorithms and new proposals. *Eur Heart J* 1995;16:325–32. [PubMed: 7789374]
- [6]. Amsterdam EA, Wenger NK, Brindis RG, et al. 2014 AHA/ACC guideline for the management of patients with non–ST-elevation acute coronary syndromes. *J Am Coll Cardiol* 2014;64(24):e139–228. 10.1016/j.jacc.2014.09.017. [PubMed: 25260718]

- [7]. Antman EM, Cohen M, Bernink PM, et al. The TIMI risk score for unstable angina/ non-ST elevation MI: a method for prognostication and therapeutic decision making. *JAMA* 2000;284(7): 835–42. 10.1001/jama.284.7.835. [PubMed: 10938172]
- [8]. Pollack CV, Sites FD, Shofer FS, Sease KL, Hollander JE. Application of the TIMI risk score for unstable angina and non-ST elevation acute coronary syndrome to an unselected emergency department chest pain population. *Acad Emerg Med* 2006;13: 13–8. 10.1197/j.aem.2005.06.031. [PubMed: 16365321]
- [9]. Than M, Flaws D, Sanders S, et al. Development and validation of the emergency department assessment of chest pain score and 2 h accelerated diagnostic protocol. *Emerg Med Australas* 2014;26(1):34–44. 10.1111/1742-6723.12164. [PubMed: 24428678]
- [10]. Six AJ, Backus BE, Kelder JC. Chest pain in the emergency room: value of the HEART score. *Neth Hear J* 2008;16(6):191–6. 10.1007/bf03086144.
- [11]. Gilbert EH, Lowenstein SR, Koziol-McLain J, Barta DC, Steiner J. Chart reviews in emergency medicine research: where are the methods? *Ann Emerg Med* 1996; 27:305–8. [PubMed: 8599488]
- [12]. Coventry LL, Bremner AP, Williams TA, Jacobs IG, Finn J. Symptoms of myocardial infarction: concordance between paramedic and hospital records. *Prehosp Emerg Care* 2014;18:393–401. [PubMed: 24669962]

-Flowchart of Patients Included/Excluded for Data Analysis

Fig. 1.
Patient exclusionary criteria.

Table 1

Prehospital variables abstracted.

Past medical history elements	Signs/symptoms
Myocardial infarction	Dyspnea
Coronary artery disease	Diaphoresis
Percutaneous coronary intervention	Nausea and Vomiting
Cardiac stent	Lightheadedness
Coronary artery bypass grafting	Dizziness
Hypertension	Jaw Pain
Hyperlipidemia	Shoulder Pain
Diabetes mellitus	Arm Pain
Atrial fibrillation	Back Pain
Congestive heart failure	
Mitral valve prolapse	
Deep vein thrombosis/pulmonary embolism	
Gastroesophageal reflux disease	
Anxiety/panic attacks	

-List of prehospital factors that were abstracted from EMS records.

Table 2

Outcomes measured.

Primary outcome elements
Abnormal cardiac catheterization
Coronary artery bypass grafting
Death in hospital

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 3

Incidence of outcomes measured.

Outcome	Total Number n	% of Studied n/956	% of Met Outcome n/193
Thrombolysis/Anticoagulation Started in ER	111	11.6%	
Admitted to Hospital	703	73.6%	
Admitted to Critical Care Floor	109	11.4%	
Cardiology Consultation	352	36.8%	
Troponin Elevation	201	21.0%	
New Arrhythmia Diagnosis	66	6.9%	
Pacemaker/AICD Implanted	7	0.7%	
Echocardiogram Performed	316	33.1%	
Echocardiogram Abnormality	284	29.7%	
Stress Test Performed	228	23.8%	
Stress Test Abnormality	127	13.3%	
Cardiac Catheterization Performed	199	20.8%	
Cardiac Catheterization Abnormality *	185	19.4%	95.9%
Percutaneous Coronary Intervention Performed	76	8.0%	
CABG Performed *	22	2.3%	11.4%
New CAD Diagnosis	171	17.9%	
Death In Hospital *	7	0.7%	3.6%

* Part of the primary composite outcome; others listed were secondary outcomes measured

Table 4

Bivariate analysis.

Variable	Combined mean (95% CI)	Mean that did not meet outcome (95% CI)	Mean that did meet outcome (95% CI)	P value
Age (years)	65.2 (64.1–66.4)	64.2 (62.9–67.3)	69.2 (67.3–71.1)	< 0.01
First HR (bpm)	87.1 (85.6–88.6)	87.8 (86.2–89.5)	84.3 (80.9–87.6)	0.05
First SBP (mm Hg)	147.2 (145.3–149.1)	145.9 (143.9–148.0)	152.2 (147.5–157.0)	< 0.01
First DBP (mm Hg)	84.2 (83.1–85.3)	83.3 (82.2–84.5)	87.5 (84.7–90.3)	< 0.01
Initial CP Severity	5.2 (5.0–5.4)	5.0 (4.8–5.3)	5.9 (5.4–6.3)	< 0.01
Disposition CP severity	2.2 (2.1–2.4)	2.1 (1.9–2.4)	2.7 (2.2–3.1)	0.04
Variable	Total with variable	% that did not meet outcome n/763 (n)	% that did meet outcome n/193 (n)	P value
Past history				
Myocardial infarction	162	14.4% (110)	26.9% (52)	< 0.01
CAD	325	29.5% (225)	51.8% (100)	< 0.01
PCI	149	12.3% (94)	28.5% (55)	< 0.01
Cardiac stent	147	12.3% (94)	27.5% (53)	< 0.01
CABG	143	13.5% (103)	20.7% (40)	0.01
Hypertension	423	41.9% (320)	53.3% (103)	< 0.01
Hyperlipidemia	168	15.2% (116)	26.9% (52)	< 0.01
Diabetes mellitus	223	22.8% (174)	25.4% (49)	0.45
Atrial fibrillation	88	10.1% (77)	5.7% (11)	0.07
CHF	116	12.3% (94)	11.4% (22)	0.73
Mitral valve prolapse	48	5.4% (41)	3.6% (7)	0.34
DVT/PE	11	1.3% (10)	0.5% (1)	0.40
GERD	112	12.7% (97)	7.8% (15)	0.07
Anxiety/panic Attacks	91	11.1% (85)	3.1% (6)	< 0.01
Signs/symptoms				
Dyspnea	312	30.8% (235)	39.9% (77)	0.02
Diaphoresis	164	13.2% (101)	32.6% (63)	< 0.01
Nausea/vomiting	182	18.3% (140)	21.8% (42)	0.28
Lightheadedness	28	3.1% (24)	2.1% (4)	0.45
Dizziness	120	12.7% (97)	11.9% (23)	0.77

Variable	Combined mean (95% CI)	Mean that did not meet outcome (95% CI)	Mean that did meet outcome (95% CI)	P value
Jaw pain	44	3.5% (27)	8.8% (17)	0.01
Shoulder pain	67	7.2% (55)	6.2% (12)	0.64
Arm pain	154	14.3% (109)	23.3% (45)	<0.02
Back pain	140	14.5% (111)	15.0% (29)	0.87
Treatments				
Home aspirin	214	19.1% (146)	35.2% (68)	<0.01
Home nitroglycerin	173	15.9% (121)	26.9% (52)	<0.01
EMS aspirin	469	48.8% (372)	50.3% (97)	0.71
EMS nitroglycerin	505	49.8% (380)	64.8% (125)	<0.01
EMS oxygen	621	62.9% (480)	73.1% (141)	0.01
EMS morphine	9	0.3% (3)	3.1% (6)	<0.01
Improvement with EMS	494	48.2% (368)	65.3% (126)	<0.01

-List of prehospital variable means (top) and incident percentages (bottom) for the outcome and non-outcome groups; P-value <0.05 was considered significant.

Table 5

Univariate IRR.

Variable	IRR	95% CI
Demographics		
Age	1.01	1.01-1.02
Male gender	1.74	1.34-2.24
Vital signs		
First heart rate	0.99	0.99–1.00
First systolic blood pressure	1.00	1.00–1.00
First diastolic blood pressure	1.01	1.00–1.02
Initial chest pain severity	1.04	0.98–1.10
Disposition chest pain severity	1.02	0.98–1.07
Past history		
Myocardial infarction	1.81	1.38-2.37
Coronary artery disease	2.09	1.63-2.68
Percutaneous coronary intervention	2.16	1.66-2.79
Cardiac stent	2.08	1.60-2.71
Coronary artery bypass grafting	1.48	1.10-2.00
Hypertension	1.44	1.12-1.86
Hyperlipidemia	1.73	1.32-2.27
Diabetes mellitus	1.12	0.84–1.49
Atrial fibrillation	0.60	0.34–1.05
Congestive heart failure	0.93	0.62–1.39
Mitral valve prolapse	0.71	0.35–1.43
Deep vein thrombosis/pulmonary embolism	0.45	0.07–2.91
Gastroesophageal reflux disease	0.64	0.39–1.04
Anxiety/panic attacks	0.30	0.14-0.67
Signs/symptoms		
Diaphoresis	1.72	1.30-2.28
Nausea/vomiting	1.19	0.88–1.61
Dizziness	0.94	0.64–1.40
Jaw pain	2.01	1.35-2.99
Shoulder pain	0.88	0.52–1.50
Arm pain	1.59	1.19-2.12
Back pain	1.04	0.73–1.48
Treatments		
Home aspirin	1.88	1.46-2.43
Home nitroglycerin	1.67	1.27-2.19
EMS aspirin	1.05	0.82–1.35
EMS nitroglycerin	1.69	1.30-2.21
EMS oxygen	1.46	1.10-1.95
EMS morphine	1.35	1.10-1.65

Variable	IRR	95% CI
Improvement with EMS treatment	1.74	1.33-2.27

-List of prehospital variables and their Incidence Rate Ratio (IRR) for the primary composite outcome; IRR of significant variables are bolded.

Table 6**Multivariable IRR**

Variable	IRR	95% CI
Age	1.02	1.01–1.02
Male gender	1.65	1.28–2.12
First diastolic blood pressure	1.01	1.00–1.02
Myocardial infarction	1.47	1.11–1.97
Percutaneous coronary intervention	1.66	1.25–2.18
Hyperlipidemia	1.40	1.07–1.84
Anxiety/panic attacks	0.41	0.19–0.89
Diaphoresis	1.51	1.17–1.96
Arm pain	1.49	1.13–1.95
Home aspirin	1.53	1.20–1.95
EMS morphine	1.39	1.18–1.84
Improvement with EMS treatment	1.60	1.23–2.09

-List of significant prehospital variables and their Incidence Rate Ratio (IRR) for the primary composite outcome using multivariable regression analysis.