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Delay in Presentation and Reperfusion Therapy in ST-Elevation Myocardial Infarction

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Abstract

Background—We studied the relationship between longer delays from symptom onset to hospital presentation and the use of any reperfusion therapy, door-to-balloon time, and door-to-drug time.

Methods—Cohort study of patients with ST-elevation myocardial infarction enrolled in the National Registry of Myocardial Infarction from January 1, 1995 to December 31, 2004. Delay in hospital presentation was categorized into 1 hour intervals as ≤ 1 hour, >1 to 2 hours, >2 to 3 hours, etc., and >11 to 12 hours. The study analyzed 3 groups: 440,398 patients for the association between delay and use of any reperfusion therapy; 67,207 patients for the association between delay and door-to-balloon time; 183,441 patients for the association between delay and door-to-drug time.

Results—In adjusted analyses, patients with longer delays between symptom onset and hospital presentation were less likely to receive any reperfusion therapy, had longer door-to-balloon times, and had longer door-to-needle times (all p<0.0001 for linear trend). For patients presenting ≤ 1 hour, >1 to 2 hours, and >2 to 3 hours, >9 to 10 hours, >10 to 11 hours, and >11 to 12 hours after symptom onset, the use of any reperfusion therapy were 77%, 77%, 73%, 53%, 50%, and 46% respectively; door-to-balloon times were 99, 101, 106, 123, 125, and 123 minutes respectively; door-to-drug times were 33, 34, 36, 46, 44, and 47 minutes respectively.

Conclusions—Longer delays from symptom onset to hospital presentation were associated with reduced likelihood of receiving primary reperfusion therapy, and even among those treated, late presenters had significantly longer door-to-balloon and door-to-drug times.

Keywords

myocardial infarction; reperfusion; angioplasty; fibrinolysis; quality

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Introduction

Timely reperfusion therapy with fibrinolytic therapy or primary percutaneous coronary intervention reduces infarct size and adverse clinical consequences, including mortality, for patient with ST-elevation myocardial infarction.^{1–11} The guidelines state that patients with ST-elevation myocardial infarction who present within 12 hours from onset of symptoms should be treated with reperfusion therapy and target a door-to-balloon time <90 minutes and door-to-drug time <30 minutes.¹² Recently, quality improvement initiatives have focused attention on where hospital delays occur and strategies to reduce door-to-balloon time.^{13–14}

Rapid and appropriate treatment with reperfusion therapy, in accordance with the guidelines, requires a consistent approach to all eligible patients. In particular, patients who are eligible for reperfusion therapy but who present later after the onset of symptoms may not elicit the same response from the health care system. According to the guidelines, recommendations for reperfusion therapy are not different for patients with ST-elevation myocardial infarction presenting earlier versus later within the 12 hours interval after the onset of symptoms.¹² However, whether patients presenting later in the interval are less likely to be treated with reperfusion therapy is not known. Moreover, among those who are treated, whether there is less urgency associated with their care, resulting in longer door-to-balloon and door-to-drug times has not been documented. If present, these gaps may contribute to worse outcomes in late presenting patients. Knowledge of these patterns would emphasize the importance of earlier presentation and focus attention on logistical and system issues that contribute to lower use of any reperfusion therapy and longer delays in treatment for patients presenting later after the onset of symptoms.

To address these issues, we undertook a study to evaluate the relationship between longer delays from symptom onset to hospital presentation and the use of any reperfusion therapy, door-to-balloon time, and door-to-drug time among patients with ST-elevation myocardial infarction between 1995 to 2004 from National Registry of Myocardial Infarction. This database is ideally positioned to address this question because it is comprised of contemporary, diverse, and national data.

Methods

Study Design and Sample

The study sample included patients enrolled in National Registry of Myocardial Infarction, a voluntary, prospective registry of patients with acute myocardial infarction, from January 1, 1995 to December 31, 2004. Participating hospitals, data collection methods, verification methods, and reliability have been previously described.^{15–16} Criteria for diagnosis of acute myocardial infarction used the *International Classification of Diseases*, 9th Revision, Clinical Modifications discharge diagnosis code of 410.X1 and was confirmed with one of the following criteria: (1) two-fold or greater elevation of cardiac biomarkers; (2) electrocardiogram evidence; and (3) echocardiographic, scintigraphic, or autopsy evidence. Participating hospitals, if required, obtained Institutional Review Board approval for data abstraction.

During our study period from 1995 to 2004, there were 1,926,108 admissions for acute myocardial infarction. The following patients were excluded sequentially: patients who did not have new or presumed new ST-segment elevation in 2 or more leads or left bundle branch block on the first electrocardiogram (n=1,161,187); patients who developed symptoms for acute myocardial infarction after hospital admission date and time (n=14,433); patients who had an unknown time of symptom onset (n=173,051); patients who had a first electrocardiogram time that was not the diagnostic electrocardiogram time for ST-elevation

myocardial infarction (n=71,842); patients who had an unknown time of first electrocardiogram (n=23,268); and patients who had a delay from symptom onset to hospital arrival >12 hours (n=41,929). The remaining group of 440,398 patients with ST-elevation myocardial infarction who presented to the hospital within \leq 12 hours from symptom onset comprised our study population for the analysis of the association between delay and use of any reperfusion therapy.

To analyze the relationship between delay in hospital presentation and timeliness of reperfusion therapy, the following patients were additionally excluded from the previous study population: patients who were transferred-in from another hospital (n=98,064) and patients who received reperfusion therapy >12 hours after hospital arrival (n=2,491). Then, patients who did not receive primary percutaneous coronary intervention (n=272,636) were excluded to create a study group of 67,207 patients to analyze the association between delay and door-to-balloon time. Similarly, patients who did not receive fibrinolytic therapy (n=156,402) were excluded to create a oreate a study group of 183,441 patients to analyze the association between delay and door-to-drug time.

Data Collection and Measures

Delay in hospital presentation was calculated from the documented date and time of symptom onset to the documented date and time of hospital arrival. Use of any reperfusion was defined as receiving either fibrinolytic therapy or primary percutaneous coronary intervention as a primary reperfusion strategy within ≤ 12 hours of hospital arrival. Door-to-balloon time was defined as time from hospital arrival to first balloon inflation and door-to-drug time was defined as time from hospital arrival to administration of fibrinolytic therapy. For the outcomes of door-to-balloon time and door-to-drug time, we log transformed the outcome measures and performed parametric analysis because their distributions were skewed. To improve the clinical interpretability of the results, we converted the logged values from the models back to their original units, i.e., minutes, using geometric means^{17–18} and simulation with 10,000 reiterations.¹⁹ The geometric mean gives less weight to outlying values and thus better reflects the median as compared with the arithmetic mean.

To evaluate the independent effect of delay in hospital presentation on use of any reperfusion, door-to-balloon time, door-to-drug time, and in-hospital mortality, we adjusted for the following patient and hospital variables. Patient variables included: sociodemographic (age; gender; race/ethnicity classified as white, Black, Hispanic, Asian, and other; and payer type categorized as commercial insurance, Medicare only, Medicare and any other insurance, Medicaid or self pay, and other); medical history (current smoker, diabetes, hypertension, hypercholesterolemia, family history of coronary artery disease, prior myocardial infarction, prior congestive heart failure, prior percutaneous coronary intervention, prior coronary artery bypass surgery, prior stroke, prior angina, absence of chest pain at presentation, congestive heart failure at time of presentation, cardiogenic shock at presentation, systolic blood pressure <90 mmHg at presentation, heart rate >100 beats per minute at presentation); time of day and day of week at presentation (weekdays were defined as Monday to Friday and included daytime from >8am– 4pm, evening from >4pm–12midnight, and night from >12 midnight-8am; weekends were defined as Saturday and Sunday and included daytime from >8am-4pm, evening from >4pm-12midnight, and night from >12 midnight-8am). Hospital variables included: U.S. census region (West, South, Midwest, Northeast), teaching hospitals defined as participation in an accredited residency or fellowship training program, and type of cardiac facilities (interventional, interventional without surgery on site, invasive but not interventional, and non-invasive). All these variables were selected based on their clinical and statistical significance from previous studies.^{11,20-21}

Statistical Analyses

For the outcomes of door-to-balloon time and door-to-drug time as a function of delay in hospital presentation, multivariable generalized linear models were constructed for each outcome to estimate the associations between delay in hospital presentation adjusted for all patient and hospital characteristics. The time from symptom onset to hospital presentation was categorized into 1 hour intervals as ≤ 1 hour, >1 to 2 hours, >2 to 3 hours, etc., and >11 to 12 hours. By introducing 11 dummy variables representing these categories into the generalized linear models (with the first category as reference group), we estimated the unadjusted outcomes and adjusted outcomes in these categories. We constructed the test of overall differences and also linear trend in outcomes among these categories in the models.

For the outcome of use of any reperfusion, multivariable logistic regression models were constructed to estimate the associations between delay in hospital presentation adjusted for all patient and hospital characteristics. The multivariate models were repeated after excluding patients who were transferred in from another hospital and after excluding patients who had documented contraindications to fibrinolytic therapy or who were treated with emergent coronary artery bypass surgery. These results were not reported separately because the direction and magnitude of the effects were similar to the prior analyses and did not change the conclusions.

For the outcome of in-hospital mortality, multivariable logistic regression models were constructed in the group of patients who were treated with primary percutaneous coronary intervention and in the group who were treated fibrinolytic therapy as the primary reperfusion strategy, and the associations between delay in hospital presentation and in-hospital mortality were estimated and adjusted for all patient and hospital characteristics as well as door-toballoon time or door-to-drug time respectively.

Statistical analyses were performed using SAS versions 9.1 (SAS, Inc, Cary, NC) and Stata version 8.0 (Stata Corp, College Station, TX).

Results

Study Population

Baseline characteristics of the 3 groups, namely for the use of any reperfusion therapy, those treated with primary percutaneous coronary intervention, and those treated with fibrinolytic therapy are shown in Table 1. Patient and hospital characteristics were generally similar for all 3 groups with a majority being younger (age <70 years), men, and white patients. Diabetic patients comprised 18% to 21% and those with prior myocardial infarction comprised 17% to 19%. Patients treated with primary percutaneous coronary intervention were more likely to be treated during weekday daytime hours 8am-4pm (41%) or have cardiogenic shock (3%) as compared with patients treated with fibrinolytic therapy during weekday daytime (29%) or have cardiogenic shock (1%).

Multivariable Analysis of Delay and Use of Any Reperfusion

In adjusted analyses, patients with longer times between symptom onset and hospital presentation were significantly less likely to receive any reperfusion therapy (Figure 1, p<0.0001 for linear trend). For early presenters with times from symptom onset to hospital presentation of ≤ 1 hour, >1 to 2 hours, and >2 to 3 hours, patients with ST-elevation myocardial infarction were treated with any reperfusion therapy in 77% (reference group), 77% (odds ratio 1.0, p=0.81), and 73% (odds ratio 0.88, p<0.0001) respectively. In late presenters with times >9 to 10 hours, >10 to 11 hours, and >11 to 12 hours, the use of any reperfusion therapy was

53% (odds ratio 0.36, p<0.0001), 50% (odds ratio 0.33, p<0.0001), and 46% (odds ratio 0.27, p<0.0001) respectively.

Multivariable Analysis of Delay and Timeliness of Reperfusion Therapy

In adjusted analyses, among patients who were treated with primary percutaneous coronary intervention, those with longer time from symptom onset to hospital presentation had significantly longer door-to-balloon times (Figure 2, p<0.0001 for linear trend). For early presenters with times from symptom onset to hospital presentation of ≤ 1 hour, >1 to 2 hours, and >2 to 3 hours, patients were treated with door-to-balloon times of 99, 101, 106 minutes respectively. In late presenters with times of >9 to 10 hours, >10 to 11 hours, and >11 to 12 hours, door-to-balloon times were 123, 125, and 123 minutes respectively.

Among patients who received fibrinolytic therapy, those with longer delay in hospital presentation also had significantly longer door-to-drug times (Figures 3, p<0.0001 for linear trend). For time intervals from symptom onset to hospital presentation of ≤ 1 hour, >1 to 2 hours, >2 to 3 hours, >9 to 10 hours, >10 to 11 hours, and >11 to 12 hours, patients were treated with door-to-drug times of 33, 34, 36, 46, 44, and 47 minutes respectively.

Multivariable Analysis of Delay and In-hospital Mortality

Among patients with ST-elevation myocardial infarction treated with primary percutaneous coronary intervention, the time interval from symptom onset to hospital presentation was associated with increased in-hospital mortality even after adjusting for door-to-balloon time (Figure 4, p<0.0001 for linear trend). For early presenters with times from symptom onset to hospital presentation of ≤ 1 hour, >1 to 2 hours, and >2 to 3 hours, in-hospital mortality rates were 4.9% (reference group), 4.0% (odds ratio 0.82, p<0.0001), and 4.0% (odds ratio 0.76, p<0.0001) respectively. In comparison, late presenters with times >9 to 10 hours, >10 to 11 hours, and >11 to 12 hours had in-hospital mortality rates of 5.4% (odds ratio 0.91, p=0.62), 6.9% (odds ratio 1.2, p=0.34), and 6.6% (odds ratio 1.2, p=0.37) respectively.

Among patients with ST-elevation myocardial infarction treated with fibrinolytic therapy, the time interval from symptom onset to hospital presentation was associated with increased inhospital mortality even after adjusting for door-to-drug time (Figure 5, p<0.0001 for linear trend). For early presenters with times from symptom onset to hospital presentation of ≤ 1 hour, >1 to 2 hours, and >2 to 3 hours, in-hospital mortality rates were 4.1% (reference group), 4.1% (odds ratio 0.93, p=0.022), and 4.8% (odds ratio 0.98, p=0.52) respectively. In comparison, late presenters with times of >9 to 10 hours, >10 to 11 hours, and >11 to 12 hours had inhospital mortality rates of 7.1% (odds ratio 1.5, p<0.0001), 6.7% (odds ratio 1.3, p=0.067), and 6.3% (odds ratio 1.2, p=0.17) respectively.

Discussion

In our study of patients with ST-elevation myocardial infarction spanning a 10 year period (1995–2004), we found that longer time intervals from symptom onset to hospital presentation were associated with reduced likelihood of receiving primary reperfusion therapy, and even among those treated, late presenters had significantly longer door-to-balloon and door-to-drug times. Although guidelines state that patients with ST-elevation myocardial infarction who present within 12 hours after onset of symptoms should be treated with rapid reperfusion therapy, we found longer times to hospital presentation may contribute to downstream hospital delays in administration of reperfusion therapy and consequently, delay may represent a novel risk factor associated with poorer quality of hospital care for ST-elevation myocardial infarction.

Our study is the largest contemporary report of the relationship between time from symptom onset to hospital presentation and subsequent treatment with and timeliness of reperfusion therapy and advances the existing research in several respects. Previous studies have shown that patients with longer door-to-balloon times^{6,11}, longer door-to-drug times², and longer total ischemic times between symptom onset and reperfusion therapy^{3,8} were associated with higher in-hospital mortality rates. However, our study is the first to demonstrate the independent effect of longer time intervals from symptom onset to hospital presentation among patients with ST-elevation myocardial infarction. We demonstrated that longer times to hospital presentation therapy, longer door-to-balloon times, and longer door-to-drug times. The novel finding from our study is that longer times to hospital presentation is a risk factor for additional downstream hospital delays in treatment with and timeliness of any reperfusion therapy.

Furthermore, among patients treated with primary percutaneous coronary intervention or fibrinolytic therapy, longer times to hospital presentation were associated with increased in-hospital mortality rates, even after adjusting for other clinical factors and door-to-balloon time or door-to-drug time respectively. The high mortality rates observed among patients presenting within <2 hours of symptom onset may represent those who are at highest clinical risk such as those with cardiogenic shock. Despite the survival bias among late presenters (some late presenters who died out of hospital would not be included in this observational registry), there was still a linear trend for increased mortality rates among patients who presented late.

Possible explanations for the relationship between delay in hospital presentation and use of any reperfusion and timeliness of reperfusion therapy include: (a) patients who present early after onset of symptoms may elicit more urgency from providers to initiate reperfusion therapy; and (b) patients who present late may exhibit more atypical or no symptoms which subsequently lead to missed or late diagnosis as well as confusion or reluctance to administer reperfusion therapy. Among patients with ST-elevation myocardial infarction eligible to receive reperfusion, an optimal system of care should not exclude patients from reperfusion therapy or incur incremental delays in door-to-balloon or door-to-drug times simply because of longer times to hospital presentation.

Recently, there is great interest in strategies to reduce door-to-balloon time¹³ and to develop systems of care to transfer and increase number of patients who are eligible to receive primary percutaneous coronary intervention across large geographic regions.¹⁴ These innovative approaches have focused on coordinating and streamlining processes within a hospital and between hospital networks to reduce door-to-balloon time. In concert with these initiatives, reliable systems that deliver timely reperfusion to all eligible ST-elevation myocardial infarction patients should be developed regardless of the duration of delay in hospital presentation.^{22–23} With the knowledge that delay in hospital presentation negatively impacts use of any and timeliness in administering reperfusion therapy, attention should be focused on logistical and system issues for providers and patients. Providers should seek to eliminate hospital delays in reperfusion therapy for patients who present late after the onset of symptoms. Moreover, it will also be important to understand which patient groups are at greatest risk for longer delays^{24–27} as well as to evaluate novel interventions aimed at reducing delays in hospital presentation.

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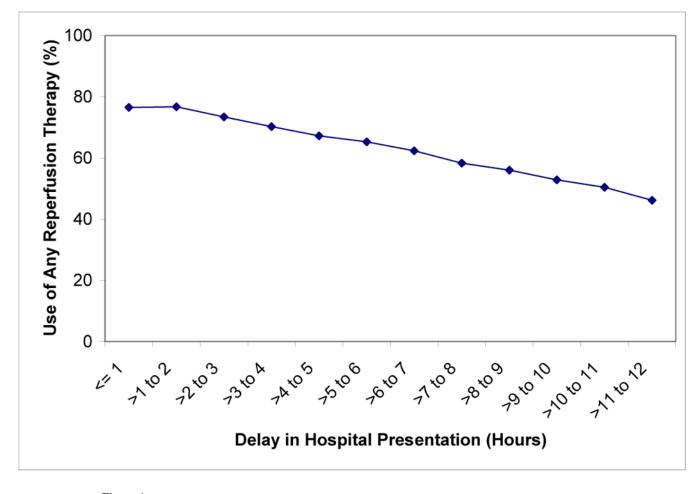


Figure 1. Delay in Hospital Presentation and Use of Any Reperfusion Therapy

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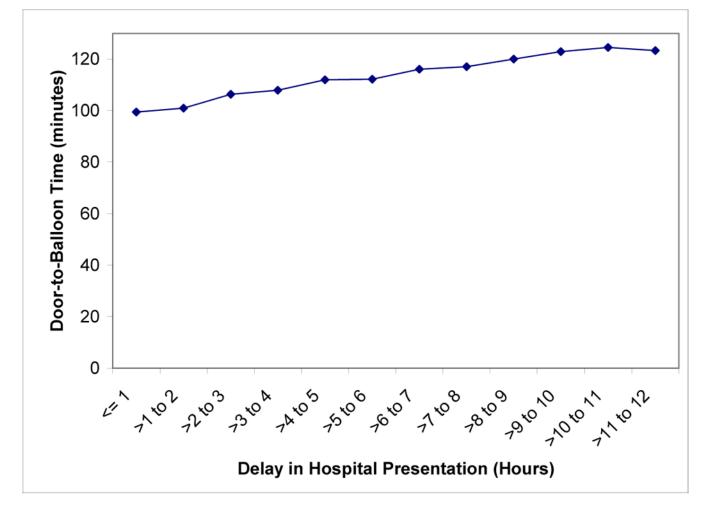
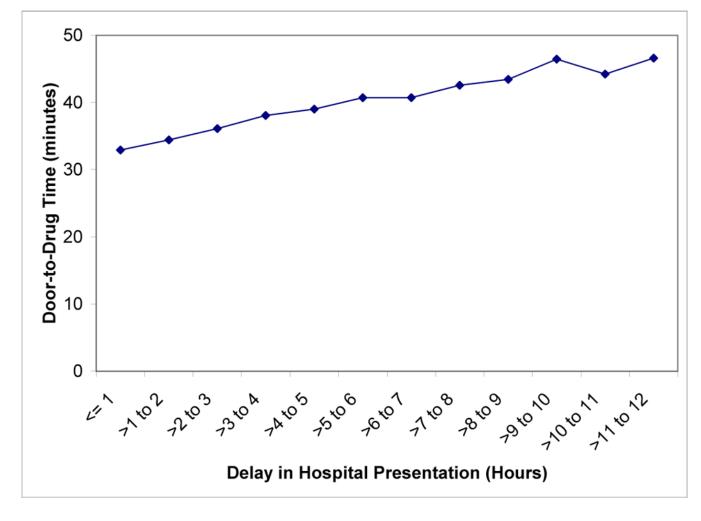


Figure 2. Delay in Hospital Presentation and Door-to-Balloon Time

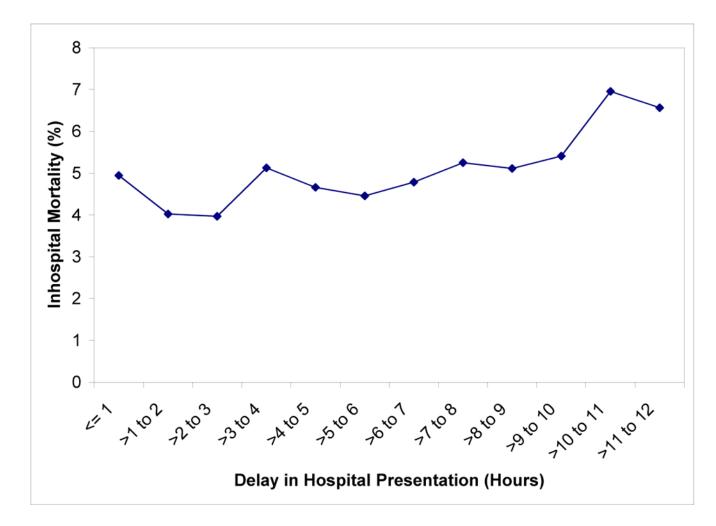
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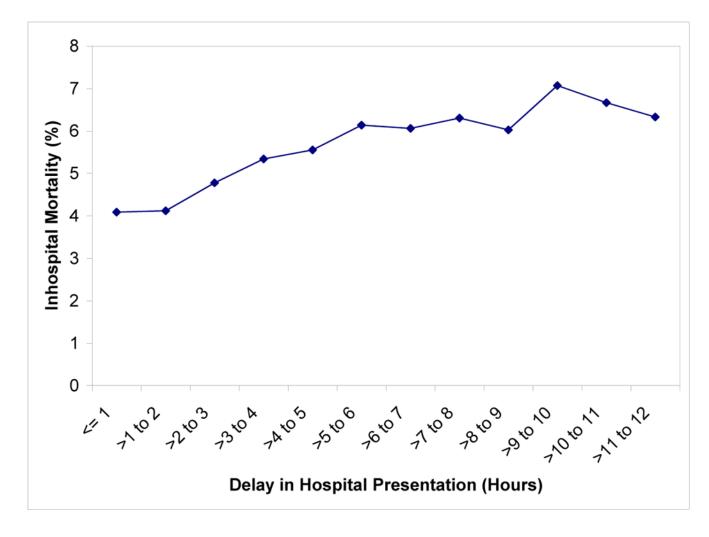


Figure 4.

Figure 4A. Delay in Hospital Presentation and In-Hospital Mortality Among Patients Treated with Primary PCI

Figure 4B. Delay in Hospital Presentation and In-Hospital Mortality Among Patients Treated with Fibrinolytic Therapy

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	Cohort for Use of The	Cohort for Use of Any Reperfusion Therapy	Cohort Treated	Cohort Treated with Primary PCI	Cohort Treated The	Cohort Treated with Fibrinolytic Therapy
Description	#	%	#	%	#	%
N Demographics	440398	100.00	67207	100.00	183441	100.00
Age	100001	11 52	01210		04140	10 31
Age 60 to 69	104765	23.79	16100	23.96	04140 45809	24.97
Age 70 to 79	96045	21.81	13118	19.52	37683	20.54
Age ≥80 Female	56694	12.87	6270	9.33	15809	8.62
No	297095	67.46	47950	71.35	127956	69.75
Yes	143303	32.54	19257	28.65	55485	30.25
White	380685	86.44	57060	84.90	159283	86.83
Black	21966	4.99	3626	5.40	1606	4.96
Hispanic Asian	12424 6292	2.82	2114 1273	3.15 1 80	5591 2722	3.05 1 48
Other/Unknown	19031	4.32	3134	4.66	6754	3.68
Health insurance Commercial (HMO/PPO) only	175229	39.79	30240	45.00	81202	44.27
Medicare only	126381	28.70	15013	22.34	48112	26.23
Medicare with any other insurance	57409	13.04	9024 8042	13.43	18139	9.89
Other/Unknown	4/004 33775	10.01 7.67	4887	7.27	14963	8.16
Medical history						
No	279099	63.37	40743	60.62	110986	60.50
Yes Diahetes	161299	36.63	26464	39.38	72455	39.50
No	348944	79.23	55174	82.10	148966	81.21
Yes Prior MI	91454	20.77	12033	17.90	34475	18.79
No	355765	80.78	55932	83.22	152256	83.00
Yes Urmortonion	84633	19.22	11275	16.78	31185	17.00
No	226786	51.50	35316	52.55	100187	54.62
Yes	213612	48.50	31891	47.45	83254	45.38
1) PETCHOLESICE OF ETHILA No	299441	61.99	43165	64.23	126308	68.85
Yes	140957	32.01	24042	35.77	57133	31.15
anniy mstory of CAD No	303735	68.97	47098	70.08	122896	66.99
Yes	136663	31.03	20109	29.92	60545	33.01
No	411373	93.41	65058	96.80	176629	96.29
Yes Prior PCI	29025	6.59	2149	3.20	6812	3.71
No Ves	396519 43879	90.04 9 96	57705 9502	85.86 14 14	167642 15799	91.39 8.61
Prior CABG				-		
No Yes	406665 33733	92.34 7.66	63173 4034	94.00 6.00	171814 11627	93.66 6.34
Stroke						

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Baseline Characteristics of Study Cohorts

Description $#$ $\%$ $\#$ $\%$ $\#$ $\%$ $\#$ $\%$ $\#$ <th< th=""><th></th><th>Cohort for Use of The</th><th>Cohort for Use of Any Reperfusion Therapy</th><th>Cohort Treated</th><th>Cohort Treated with Primary PCI</th><th>Cohort Treated with Therapy</th><th>Cohort Treated with Fibrinolytic Therapy</th></th<>		Cohort for Use of The	Cohort for Use of Any Reperfusion Therapy	Cohort Treated	Cohort Treated with Primary PCI	Cohort Treated with Therapy	Cohort Treated with Fibrinolytic Therapy
475% 94,30 6400 95,31 17702 2500 3,50 3,50 9,53 1760 1770 Sention 40156 84,3 611 9,09 1771 Sention 40156 84,3 84,3 94,3 1764 1770 Sention 40156 84,3 84,3 94,3 1769 600 Action 40156 84,3 94,3 53,3 35,3 35,3 1736 Sentime 84,3 94,4 94,4 94,4 94,4 94,4 94,4 94,4 94,4 94,4 94,4 94,4 94,4 94,4 94,4 94,4 94,4 94,4 94,4 94,4 94,4 <t< th=""><th>Description</th><th>#</th><th>%</th><th>#</th><th>%</th><th>#</th><th>%</th></t<>	Description	#	%	#	%	#	%
94.55 9.5 6106 900 1071 securitin 94.55 9.5 6104 900 1771 securitin 94.55 9.5 6104 900 1771 securitin 94.55 9.1 8.82 6105 9.0 1773 securitin 94.56 9.1 8.82 645 9.1 9.0 9.0 securitin 3183 9.0 9.0 7.9 7.0 7.93 9.0 securitin 3183 9.0 9.0 7.90 9.0 9.0 9.0 securitin 3150 8.18 9.0 9.0 9.0 9.0 securitin 3150 8.18 9.0 9.0 9.0 9.0 securitin 3150 8.18 9.0 9.0 9.0 9.0 securitin 3150 9.0 9.0 9.0 9.0 9.0 securitin 3150 9.0 9.0 9.0 9.0	No Yes	415298 25100	94.30 5.70	64009 3198	95.24 4.76	177402 6039	96.71 3.29
4710 7001 <th< td=""><td>Angina</td><td>22102</td><td>00 50</td><td></td><td>10 00</td><td>0000991</td><td></td></th<>	Angina	22102	00 50		10 00	0000991	
Image: constraint of the state of	No Yes	294205 46135	10.48	01090 6111	16.06 9.09	17171	9.36 9.36
mention 60% 9.18 66% 9.73 15646 9.13 ok 43.85 9.18 9.05 9.13 9.05 9.19 bekaure-50 mmHs 85.3 1.94 9.04 5.39 9.05 9.19 resture-50 mmHs 43.85 1.94 9.04 5.39 9.05 9.13 9.05 resture-50 mmHs 373.99 8.18 9.04 5.00 5.00 9.03 9.05 9.05 resture-50 mmHs 373.99 8.18 9.04 9.12 9.05 <td>Presentation</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	Presentation						
(i) 3884i 882 3551 5.28 7195 Presure -00 mmHg 813 910 6432 930 6193 930 9106 Presure -00 mmHg 813 930 6342 930 6342 936 9136 Presure -00 mmHg 813 500 63427 503 936 936 945 946 945 946	uest pain at presentation Ves	401564	91.18	63656	64 72	176246	96.08
of 4135 80.6 61.9 64.7 1135 81.3 19.6 1136 19.6 resure <00 multi 85.3 1.94 2448 3.05 1136 19.6 resure <00 multi 3533 5.00 3742 24.8 30.6 11346 30.6 11346 30.6 11346 30.6 11346 30.6 11346 20.8 30.6 3146 30.6 3146 30.6 3148 30.6 3146 30.6 3146 30.6 3146 30.6 3126 30.6 3126 30.6	No	38834	8.82	3551	5.28	7195	3.92
Passue -00 mmHg 43853 9406 6159 96.95 19365 Perminue 2307 5.00 3780 5.02 19365 Sperminue 2307 5.00 5.02 94.38 714956 Sperminue 67259 85.18 79612 88.70 10566 67259 13.48 5902 6477 94.38 174956 67259 13.48 5902 84.72 7957 84.87 5903 13.48 5972 81.37 1567 1567 101 5756 11.103 16.80 37905 36905 101 13.48 5321 7376 84.77 1567 101 13.48 5321 7376 84.77 15697 101 3756 14.103 34975 36967 36697 101 3756 13.15 3497 36967 36697 101 3754 11168 11168 1669 3797 <t< td=""><td>ardiogenic shock</td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	ardiogenic shock						
Pressure <00 mmHg S443 L04 Z048 500 190 Pressure <00 mmHg	No	431855	98.06	65159	96.95	181505	98.94
Texane comme 41831 500 6427 94,38 17056 5 per minute 2207 500 5790 562 845 5733 8733 8733 812 5962 813 8652 6127 9438 8455 6373 8128 8128 9117 5667 845 86767 8457 8667 86767 8457 86767 8457 86676 86876 86676 86876 86876 86876 86876 86876 86876 86876 86876 86876 86876 86876 86876 86876 86876 86876 86876 <	Yes	8543	1.94	2048	3.05	1936	1.06
sperminte 2007 500 7760 5.62 9485 sperminte 375139 85.18 96012 88.70 16563 9485 375139 85.18 9602 88.70 16563 9485 37903 14.82 7735 11.30 16563 1667 37801 85.57 13.42 8547 11.30 16667 37903 13.43 9503 13.43 8567 13.95 10 8557 13.42 8567 13.95 15660 11 8158 13.42 8567 13.95 15660 11 8158 13.42 8567 13.95 15660 10 8158 13.42 8567 13.95 1595 10 8158 13.42 8566 14.02 23362 10 8158 13.47 9566 14.02 23352 10 8158 13.47 956 14.97 1495 1	ysionic bioou riessure <90 mining	418381	95.00	63477	94 38	174956	95 37
sper minute 3753 5.18 5.01 5.353 11.30 10.3563 ation 3731 8.652 14.82 7595 11.30 20678 ation 14.1476 32.12 27556 11.30 20678 ation 14.1476 32.12 27566 14.102 35005 new 31583 13.43 3932 8.837 16667 new 31583 13.43 3932 8.83 18767 new 31560 13.43 3935 6.62 36660 1 3260 13.43 3936 6.62 36667 1 3156 13.45 11293 6.64 23993 1 3156 11.293 6.61 2.375 35667 1 3156 11.293 6.61 2.375 3567 1 315 12.34 3133 12.38 3567 1 13.35 5.64 3.366 3567 3567	Yes	22017	5.00	3780	5.62	8485	4.63
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	ilse >100 beats per minute						
(6529) [4.82] 7595 [1.30] 20878 intime 33008 86.23 61775 91.17 16474 38008 86.32 61775 91.17 16474 20766 38018 86.37 19211 11476 32.12 27566 4102 53905 86537 19211 11233 11233 16672 38072 86537 19241 11233 8647 12877 38600 91041 13.42 3756 41123 1662 38600 91041 13.42 3757 38611 1023 38661 11231 8847 91041 13.42 3454 12372 34971 12872 91045 5861 11334 81133 12872 23667 9105 5841 12372 9541 23567 23667 9105 5841 1070 123292 23667 <td>Vo</td> <td>375139</td> <td>85.18</td> <td>59612</td> <td>88.70</td> <td>162563</td> <td>88.62</td>	Vo	375139	85.18	59612	88.70	162563	88.62
381018 86.52 61.275 91.17 164674 ine 59.380 13.48 59.32 88.3 18767 ine 86.357 13.41 59.32 88.3 18767 18767 ine 86.357 13.41 86.37 11.193 16.60 34972 ine 51.17 11.193 16.80 3497 3497 ine 37670 8.35 11293 16.80 3497 ine 37670 8.35 11293 6.647 3937 ine 37670 8.35 11293 6.647 3937 ine 37670 8.35 12.39 4431 15847 ine 37670 8.35 12.39 5867 15847 ine 5637 12.35 5641 15195 25951 ine 5637 12.35 5641 15195 25951 ine 5637 12.35 5641 10.70 17724	res	65259	14.82	7595	11.30	20878	11.38
ation 59300 6.4.2 9.1.7 1000 ine 83577 9.61 111.08 6.62 3300 ine 83577 9.61 111.08 16.62 3305 ine 81587 19.61 111.08 16.62 3305 ine 81587 13.47 3935 5660 3102 3660 ine 81587 13.47 3936 56.4 10.28 3660 37670 8.55 111.08 6.41 12.87 3660 ine 56930 12.35 5671 12.87 25807 59677 13.35 5671 12.39 6.41 20.39 58677 12.35 5671 12.39 5767 25807 58670 13.34 8133 10.19 22930 25952 58700 12.34 8133 10.30 2734 5714 58700 13.34 13.33 10.30 23935 2944		301010	UZ 70	20012	0117	164674	LL 00
ation 14476 3.12 7566 4.102 53905 in the second set of the set of the sec	vo Yes	59380	00.22 13.48	C/710 2632	8.83	1040/4	10.23
me $[4476]$ 32.12 27566 4.102 5800 ing 8637 9561 11168 16.62 5600 ing 8637 9561 1233 8547 5195 59920 ing 37700 8.537 1293 11233 8547 5195 5997 ing 37700 8.537 1233 8547 5195 5990 ind 56917 12.33 8647 0129 5867 23930 59077 5135 6144 9847 21990 23930 59077 12.31 8133 10.19 17394 27990 54210 12.34 8133 12.10 23932 2993 5470 12.34 8133 10.70 213697 21667 5474 27740 11637 2197 2167 2167 5764 5364 5366 5167 <	me of presentation						
ing 86557 19.61 11168 16.62 3660 ing 81585 19.61 111168 16.62 3660 ing 37670 8.55 19.61 11293 16.80 3972 ing 37670 8.55 9597 12.87 3956 584 1680 3972 ing 56930 12.93 4531 6.14 9.84 25950 56917 12.93 5614 9.84 20957 25667 56917 12.93 5614 9.84 20957 25697 56017 12.93 5614 9.84 20957 25697 57240 10.12 7194 10.70 27936 544 57243 9.14550 6414 9.54 2794 554 57244 1793 9.166 7103 1279 574 57243 1794 0.166 6414 9.54 5874 57246 5.34 1765	Veekday daytime	141476	32.12	27566	41.02	53905	29.39
It 11293 11293 1680 34972 ine 31585 18.53 11293 1680 34972 ine 37670 8.55 4.597 2.867 2.867 in 37670 8.55 4.597 6.847 2.877 2.867 in 5697 12.93 4551 6.74 2.935 2.895 5697 12.93 4560 12.31 8.847 10.19 2.395 56917 12.31 6.847 10.19 2.395 2.293 5691 12.31 8.813 12.10 2.295 5691 12.31 8.13 12.10 2.395 5691 12.31 8.133 12.10 2.395 5604 5.36 6.14 9.34 8.81 2.769 5764 5.36 6.14 9.34 8.81 2.769 5764 5.36 6.14 9.34 8.81 2.769 5764 <	Veekday evening	86357	19.61	11168	16.62	36660	19.98
me 5700 1.542 5601 2.801 initian 3700 1.77 3956 5.86 15195 ition 56930 1.77 3956 5.86 15195 56917 12.92 6614 9.84 2935 56917 12.92 6614 9.84 2935 56917 12.31 8847 2935 5967 58760 13.34 8133 0.19 23930 58760 13.34 8133 0.19 23930 58760 13.34 8133 0.19 23930 58760 13.34 8133 0.19 23930 2364 5.36 7164 0.20 0.716 2364 5.36 6.144 0.20 0.354 237240 5.19 6.144 0.20 0.716 6.74 2364 5.36 7164 0.20 0.76 6.74 $2.$	Veekday night	81585	18.53	11293	16.80	34972	19.06
Image 3.200 7.77 3.97 5.66 1.002 tion 56930 12.93 4531 6.74 29352 5677 12.93 5677 12.93 567 5195 56917 12.331 6614 9.84 29362 5570 12.331 6614 9.84 29363 5571 12.331 6614 9.84 29363 5570 12.331 6614 9.84 27697 5570 12.331 6614 9.34 27697 55604 5.36 71163 10.70 17524 27607 6191 0.716 0.347 2914 27604 5.36 7163 9.454 2914 27607 6191 0.716 0.716 0.716 27604 5.36 7163 9.454 0.716 27604 5.36 9.478 0.716 0.9456 <	Veckend daytime	37670	15.42 0 55	804/	12.8/	/0862	14.10
tion	Veekend night	34206	7.77	3936	5.86	15195	8.28
56930 1293 4531 6.74 29352 5677 13.55 5967 8.87 29950 5697 13.55 5967 8.87 29952 5697 13.34 8133 10.19 22930 58760 13.34 8133 10.19 22930 5471 9.23 6614 9.871 29952 4550 10.12 7163 10.70 17524 27240 5.36 7163 10.70 17574 27240 5.36 7163 10.70 17574 27304 5.36 7163 10.70 17574 2764 5.36 7163 9.47 9.47 2764 5.36 1163 9.47 9.47 2764 5.36 1163 9.47 9.47 271 28833 9046 9.4643 9.4643 1000 10.802	ear of presentation						
9677 13.55 5967 8.88 29950 56917 12.92 6614 9.84 27697 54710 12.92 6614 9.84 27697 5470 12.92 6614 9.84 27697 5470 12.92 6614 9.84 27697 5470 12.92 6614 9.84 27997 40531 9.23 8004 11.91 17724 27240 6.19 6414 9.54 8871 27240 6.19 6414 9.54 8871 27240 6.19 6414 9.54 8871 27240 6.19 6414 9.54 8871 27604 5.56 7163 9.43 2914 27604 5.36 716 9.43 2914 8750 65803 6.841 9.24 60167 84848 19.27	995 Ĉ	56930	12.93	4531	6.74	29352	16.00
5691/1 12.92 6614 9.84 2.067 5720 12.31 6847 0.19 22930 8760 13.34 8133 10.10 22930 8760 13.34 8133 10.10 22930 8760 13.34 8133 10.70 17524 4550 10.32 6144 9.54 2794 27340 6.19 6144 9.54 8471 27364 5.36 7163 10.00 2454 23604 5.36 7163 0.00 46643 8848 9.27 0.00 0.00 46643 9.43 0.004 60167 60167 8848 9.27 14.89 0.14 9.244 8883 21923 4.98 5184 7.71 86803 9.479 9.24 9.24 60167 86033 21923 5192	<u>996</u>	59677	13.55	5967	8.88	29950	16.33
7200 12.21 0.044 10.10 22250 44550 10.12 7194 10.10 23952 44550 10.12 7240 6.19 9.23 8004 11.91 14797 27240 6.19 6.19 6.19 6.14 9.54 8871 27240 5.36 7163 10.70 17524 8871 27240 5.36 7163 10.70 17524 8871 27240 5.36 7163 10.70 17524 2454 2766 5340 5.36 6144 9.43 2914 65567 14.89 0 0 0.00 46643 $n-interventional 84848 19.27 32 0.04 60167 n-interventional 268030 60.86 61991 92.24 60167 n-interventional 28848 19.27 32448 7.71 10357 $	199 / 000	/ 1690	12.92	0014 2017	9.84	169/2	01.01
cteristics 7194 10.70 17524 27240 6.19 6.19 6.19 6.19 8871 27240 5.36 7163 10.70 17524 23604 5.36 7163 10.66 5454 23604 5.36 7163 10.66 5454 23604 5.36 7163 10.66 5454 23664 4.06 6340 9.43 2914 s 65567 14.89 0 0.00 46643 $n-interventional$ 83848 19.27 32 0.004 60167 60.86 61991 92.24 60167 0.357 $nihout OHS$ 21953 4.301 32448 48.28 62143 106378 5193 60.86 5184 7.71 10357 10000 66274 92.24 6218 62183 61991 7.71 10357	000	54210	13.34	0047/ 8133	12.10	23952	13.06
40631 9.23 8004 11.91 14797 27240 6.19 6.19 6.414 9.54 8871 27240 6.19 6.19 6.414 9.54 8871 273604 5.36 7163 0.66 5454 5454 17879 4.06 6540 9.43 2914 8871 s 65567 14.89 0 0.00 46643 n-interventional 84848 19.27 32 0.04 60167 mihout OHS 21953 4.98 5184 7.71 10357 without OHS 21953 4.98 5184 7.71 10357 189411 43.01 32448 48.28 62183 6183 106578 56.99 34759 51.72 121258 6183 106578 32448 13243 48.28 62183 65183 106578 23448 29.43 63633 631.34 63683 63683	000	44550	10.12	7194	10.70	17524	9.55
27240 6.19 6414 9.54 8871 23604 5.36 7163 10.66 8871 23604 5.36 7163 10.66 8871 23604 5.36 7163 10.66 5454 8871 2943 2914 86830 6340 0.00 4643 9.27 322 0.00 4643 0.000 60.86 61921 322 0.04 0.167 0.004 60167 0.167 0.04 60167 0.167 0.04 60167 0.167 0.04 60167 0.184 7.71 10357 0.167 0.244 60244 0.184 7.71 10357 0.167 0.004 60167 0.184 0.004 60167 0.184 0.171 0.1248 0.184 0.171 0.024 0.167 0.004 66214 0.172 0.1248 0.1258 0.184 0.172 0.1258 0.1905 0.160 0.1258 0.1007 </td <td>2001</td> <td>40631</td> <td>9.23</td> <td>8004</td> <td>11.91</td> <td>14797</td> <td>8.07</td>	2001	40631	9.23	8004	11.91	14797	8.07
tetristics 23604 5.36 7163 10.66 5454 5454 cteristics 17879 4.06 6340 9.43 2914 2914 s 65567 14.89 0 0.00 46643 2914 s 65567 14.89 0 0.004 66574 60167 n-interventional 268030 60.86 61991 92.24 60167 21953 4.98 5184 7.71 10357 10357 without OHS 21953 4.98 5184 7.71 10357 139411 43.01 32448 48.28 62183 6167 1389411 43.01 32448 48.28 62183 62183 13822 331.34 2905 56633 34.32 66283 13822 301.6 2343 23622 42967 132827 42967 132827 301.6 2	2002	27240	6.19	6414	9.54	8871	4.84
tetristics $1/8/9$ 4.00 0.540 9.45 2.914 s 65567 14.89 0 0.00 46643 2914 s 65567 14.89 0 0.004 66634 60167 n-interventional 84848 19.27 32 0.04 60167 60167 n-interventional 268030 60.86 61991 92.24 60167 60244 without OHS 21953 4.98 5184 7.71 10357 without OHS 21953 43.01 32448 48.28 62183 189411 43.01 32448 48.28 62183 62183 13827 32448 2962 56633 31.34 93752 62183 1383022 31.34 29052 56633 5432 62183 133257 331.34 29052 2962 42967 42967 132827 3016	2003	23604	5.36	7163	10.66	5454	2.97
s s 65567 14.89 0 0 0.00 46643 n-interventional 84848 19.27 32 0.04 660167 268030 60.86 61991 92.24 66157 21953 4.98 5184 7.71 10357 21953 4.98 5184 7.71 10357 10357 1357 12 121258 189411 43.01 32448 48.28 62183 138032 31.34 19905 29.62 42967 3016 23683 34.32 48301 132827 301 23592 56683 132827 301 23582 56683 132827 301 2358 5683 132827 301 23582 5683 132827 301 2358 5683 132828 5683 5683 5683 5683 5683 5683 5683 568	2004 Somital aboundation	1/8/9	4.00	0340	9.43	2914	96.1
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	ospitai cilaracterisucs ardiae facilities						
m-interventional 8484 19.27 32 0.04 60167 m-interventional 268030 60.86 61991 92.24 66274 without OHS 21953 4.98 5184 7.71 10357 250987 56.99 34759 51.72 10357 10578 56.99 34759 51.72 121258 189411 43.01 32448 48.28 62183 138032 31.34 19905 29.62 42967 13327 30.16 2363 34.32 48301	Von-invasive	65567	14.89	0	0.00	46643	25.43
268030 60.86 61991 92.24 66274 without OHS 21953 4.98 5184 7.71 10357 250987 56.99 34759 51.72 121258 189411 43.01 32448 48.28 62183 189411 43.01 32448 48.28 62183 138032 31.34 19905 29.62 42967 13827 30.16 2363 34.32 48301	Invasive but non-interventional	84848	19.27	32	0.04	60167	32.80
without UHS 21953 4.98 5184 1.11 10557 250987 56.99 34759 51.72 121258 189411 43.01 32448 48.28 62183 18951 24.15 1905 29.62 42967 138032 31.34 1905 29.62 42967 13827 30.16 2363 34.32 5683	Interventional	268030	60.86	61991	92.24	66274	36.13 2
250987 56.99 34759 51.72 121258 189411 43.01 32448 48.28 62183 18951 24.15 19905 29.62 42967 138032 31.34 19405 29.62 42967 32827 30.16 2363 34.32 54830	Interventional without OHS	21933	4.98	5184	1./1	1035/	C0.C
189411 43.01 32448 48.28 62183 106378 24.15 1905 29.62 42967 138032 31.34 19439 29.62 42967 132827 30.16 2363 34.32 4330	Vavining Dianas No	250987	56.99	34759	51.72	121258	66.10
106378 24.15 19905 29.62 42967 138032 31.34 19439 28.92 5683 132827 30.16 23063 34.32 48301	Yes	189411	43.01	32448	48.28	62183	33.90
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12827 30,1 12427 2022 48301 132827 30,16 23063 24,32 48301	West	1063/8	24.15	C0661 02701	20.62	4290/ 56602	25.42
	south Mid-West	200001	30.16	73063	20.92	2000 48301	26.90 26.33

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Cohort Treated with Primary PCI Cohort Treated with Fibrinolytic	% # % #	
Cohort for Use of Any Reperfusion Coho	% #	
	Description	

CHF =congestive heart failure; CABG =coronary artery bypass surgery; CAD =coronary artery disease; HMO =health maintenance organization; MI= myocardial infarction; OHS =onsite heart surgery; PCI =percutaneous coronary intervention; PPO = preferred provider organization;

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