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Recent Trends in the Incidence, Treatment, and Outcomes of Patients with ST and Non-ST-Segment Acute Myocardial Infarction

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Abstract

Background—Despite the widespread use of electrocardiographic changes to characterize patients presenting with acute myocardial infarction, little is known about recent trends in the incidence rates, treatment, and outcomes of patients admitted for acute myocardial infarction further classified according to the presence of ST-segment elevation. The objectives of this population-based study were to examine recent trends in the incidence and death rates associated with the 2 major types of acute myocardial infarction in residents of a large central Massachusetts metropolitan area.

Methods—We reviewed the medical records of 5,383 residents of the Worcester (MA) metropolitan area hospitalized for either ST-segment elevation acute myocardial infarction (STEMI) or non-ST-segment acute myocardial infarction (NSTEMI) between 1997 and 2005 at 11 greater Worcester medical centers.

Results—The incidence rates (per 100,000) of STEMI declined appreciably (121 to 77), whereas the incidence rates of NSTEMI increased slightly (126 to 132), between 1997 and 2005. Although in-hospital and 30-day case-fatality rates remained stable in both groups, 1-year post discharge death rates declined between 1997 and 2005 for patients with STEMI and NSTEMI.

Conclusions—The results of this study demonstrate recent declines in the magnitude of STEMI, slight increases in the incidence rates of NSTEMI, and declines in long-term mortality in patients with STEMI and NSTEMI. Our findings suggest that acute myocardial infarction prevention and treatment efforts have resulted in favorable declines in the frequency of STEMI and death rates from the major types of acute myocardial infarction.

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All authors had access to the data and had a role in writing this manuscript.

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Keywords

Acute myocardial infarction trends; community study; preventive cardiology

Introduction

The acute coronary syndrome model espoused by the American College of Cardiology places unstable angina, non-ST-segment elevation myocardial infarction (NSTEMI), and ST-segment elevation myocardial infarction (STEMI) at increasingly severe points along a disease continuum.^{1,2} Clinical trial and registry data have supported this conceptual model by showing that individuals with NSTEMI and STEMI have differing short-term prognoses and responses to therapies.^{3,4}

Given the aging of the U.S. population, and increasing population burden of obesity and diabetes, the characteristics of patients hospitalized with acute myocardial infarction have changed during recent years.^{5,6} Moreover, increasing use of high-sensitivity biomarkers to define NSTEMI has resulted in the reclassification of many individuals previously diagnosed with unstable angina.⁷ Concomitantly, improved hospital treatments have reduced acute myocardial infarction-associated morbidity and in-hospital mortality.^{6,8}

While several community and more select population-based studies have provided information about trends in the magnitude, management, and outcomes of patients hospitalized with acute myocardial infarction,^{9–12} few have examined trends in the incidence rates, hospital treatment, and prognosis of individuals experiencing STEMI and NSTEMI during a contemporary period when high-sensitivity biomarkers were introduced. The objectives of our study were to describe changes in the magnitude of, and outcomes associated with, STEMI and NSTEMI in residents of central Massachusetts.

Methods

The Worcester Heart Attack Study is an ongoing population-based investigation which is examining long-term trends in the incidence rates, in-hospital, and post-discharge case-fatality rates (CFRs) of greater Worcester (MA) (2000 census = 478,000) residents hospitalized with acute myocardial infarction at all metropolitan Worcester medical centers. In brief, the medical records of greater Worcester residents admitted to all 11 hospitals throughout central Massachusetts with a discharge diagnosis of acute myocardial infarction and related coronary disease rubrics were individually reviewed and validated according to pre-established diagnostic criteria.^{6,13,14} The 5 years under study included 1997, 1999, 2001, 2003, and 2005.

Classification of Acute Myocardial Infarction

A diagnosis of STEMI was made when new ST segment elevation was present at the J point in two or more contiguous leads. A diagnosis of NSTEMI was accepted when, in the absence of ST-segment elevation, ischemic ST segment or T wave changes were present for at least 24 hours with positive cardiac enzymes and/or a typical clinical presentation. From 2003 on, in the absence of ECG abnormalities, a diagnosis of NSTEMI was accepted when elevation in various cardiac biomarker assays, including troponin, was accompanied by typical clinical presentation. Trained nurse and physician study personnel reviewed all baseline and serial ECGs and quality control activities were routinely conducted with respect to ECG interpretation and abstraction of data from hospital medical records. Computer systems at all area hospitals also over-read all ECGs and were reviewed by study personnel.

Troponin assays were infrequently used prior to 2003 and were not considered in the diagnosis of acute myocardial infarction at that time. In contrast, troponin was commonly measured from 2003 on and was incorporated into the diagnostic criteria for acute myocardial infarction in 2003. Ninety-seven percent of patients with troponin had concomitant measures of total creatinine kinase or its isoenzyme subfraction.

Data Collection

Trained physicians and nurses abstracted demographic and clinical data from the medical records of greater Worcester residents with confirmed acute myocardial infarction. Abstracted information included patient's age, sex, medical history, acute myocardial infarction order (initial vs. prior) and type (Q wave vs. non-Q wave), physiologic factors, length of hospital stay, time interval between patient-reported acute symptom onset and emergency department arrival, hospital-associated delay to receipt of a percutaneous coronary intervention (PCI), and discharge status.¹⁵ Information about the use of important cardiac medications, coronary angiography, PCI, and coronary artery bypass graft surgery was collected.^{6,13,14} Development of various clinical complications during hospitalization was defined according to standardized criteria.^{6,13,14} Survival status after hospital discharge was determined through a review of medical records and search of death certificates. Some form of follow-up after hospital discharge was obtained for the vast majority (>99%) of discharged patients.

Data analysis

Differences in the characteristics of patients hospitalized for STEMI and NSTEMI were examined through the use of chi-square tests for discrete variables and *t* tests for continuous variables. The prognosis of patients with acute myocardial infarction was examined by calculating in-hospital, 30-day, and 1-year CFRs separately for patients with STEMI and NSTEMI.

Analyses were initially performed for all patients with confirmed acute myocardial infarction, and then repeated for patients with an initial myocardial infarction only (*n* = 3,494); the latter analyses were carried out for purposes of determining whether the presence of a prior myocardial infarction would change observed trends in our principal study outcomes. We accounted for the effect of potentially confounding demographic and clinical covariates in examining changes over time in hospital and post-discharge CFRs by means of a logistic multiple regression approach. Multivariable adjusted odds ratios for in-hospital, 30-day, and 1-year CFRs were calculated, together with 95% confidence intervals, controlling for differences in several clinical and demographic factors (age, sex, history of atrial fibrillation, heart failure, angina, diabetes mellitus, stroke, estimated glomerular filtration rate, acute myocardial infarction type, and presenting systolic blood pressure), separately for patients with STEMI and NSTEMI. In our regression models we did not control for the use of adjunctive medical therapy since the timing of medication administration could not be determined from our methods of data abstraction nor could we account for confounding by treatment indication given the study's non-randomized nature.

The incidence rates of STEMI and NSTEMI were calculated in a standard manner using 2000 census data for the greater Worcester population. We carried out intercensal extrapolations in constructing population denominators for purposes of calculating annual incidence rates of STEMI and NSTEMI. We also carried out a series of regression analyses for purposes of examining changes over time in the odds of developing STEMI and NSTEMI while controlling for the covariates described previously.

Results

Characteristics of study patients

A total of 5,383 greater Worcester residents were hospitalized with confirmed acute myocardial infarction during the 5 biennial study years (Table 1). Individuals hospitalized for STEMI were more likely to be younger, male, and were less likely to have a prior history of several comorbidities in comparison to patients with NSTEMI. Patients with STEMI were also more likely to undergo cardiac catheterization or PCI and to be treated with aspirin, beta-blockers, and either an angiotensin converting enzyme inhibitor (ACEI) or angiotensin receptor blocker (ARB) during hospitalization. Patients with STEMI were more likely to develop a Q-wave myocardial infarction, have a shorter pre-hospital and PCI-related delay, a higher body mass index and estimated glomerular filtration rate, a lower initial systolic blood pressure, and a higher initial diastolic blood pressure.

Trends in hospital incidence rates

The incidence rates (per 100,000 population) (121 to 77) of STEMI declined appreciably between 1997 and 2005 ($p < 0.05$; Figure 1). After adjusting for several demographic and clinical factors that could affect the likelihood of developing STEMI, the multivariable-adjusted odds of developing STEMI declined from 2001 to 2005 relative to the referent year of 1997 (Table 2).

A slight increase in the incidence rates of NSTEMI was observed between 1997 and 2005 (126 to 132) (Figure 1). A significant increase in the NSTEMI incidence rates occurred in 2001, after which point NSTEMI incidence rates declined. The multivariable-adjusted odds of NSTEMI remained relatively stable between 1997 and 1999, after which point the odds of developing NSTEMI increased (Table 2).

Hospital Treatment Practices

Overall, there were slight, but statistically significant, differences between our 2 primary comparison groups in the proportion of patients receiving ACE inhibitors/ARB's (62% vs 56%), aspirin (94% vs 90%), and beta-blockers (90% vs 84%) during hospitalization. On the other hand, there were marked differences in the proportion of patients undergoing cardiac catheterization (65% vs 43%), PCI (46% vs 23%), and thrombolytic therapy (26% vs 1%) in patients with STEMI versus NSTEMI.

Patients with STEMI were increasingly more likely to be prescribed each of the effective cardiac medications examined, with the exception of thrombolytic therapy, and were increasingly more likely to undergo cardiac catheterization or PCI (Table 3) over time. Similar patterns, albeit at lower utilization rates, were observed in patients with NSTEMI. There were, however, notable differences in treatment utilization trends. A greater increase in the hospital use of beta-blockers was noted among patients with NSTEMI over time, whereas a greater increase in the use of ACEI/ARBs, cardiac catheterization, and PCI was noted in patients with STEMI.

In-hospital, Thirty-Day, and One-Year Death Rates

Although a greater proportion of patients with NSTEMI developed atrial fibrillation and heart failure while hospitalized (Table 4), in-hospital CFRs were similar for patients with STEMI and NSTEMI (Figure 2). The in-hospital and 30-day death rates for patients with STEMI remained relatively stable between 1997 and 2005 (Table 5). In-hospital death rates declined only slightly in patients presenting with NSTEMI. Results were quantitatively similar for models evaluating 30-day death rates.

In examining all-cause death rates during the first year after hospital discharge for patients with STEMI and NSTEMI, encouraging declines in 1-year death rates were observed in both patient groups (Table 5; p for trend <0.005). In multivariable-adjusted models, the odds of dying during the first year after discharge declined steadily among patients with STEMI between 1997 and 2005. By 2005, the odds of dying within 1 year after discharge was 50% lower among STEMI patients in comparison to those admitted in 1997; a non-significant and inconsistent trend toward a lower odds of dying within 1 year of hospitalization was noted among patients with NSTEMI.

Discussion

Trends in Hospitalization Rates

Hospitalization rates for acute myocardial infarction have remained largely stable or slightly increased over time in the U.S. population.^{6,16,17} Our results provide relatively recent insights into these trends by suggesting that recent declines in hospitalization for STEMI have been counter-balanced by slight increases in hospitalization for NSTEMI.

Improved coronary risk factor awareness and treatment practices may have contributed to the declines in the incidence of STEMI observed in the present study.¹⁸ That a similar decline was not observed in the incidence of NSTEMI may reflect a greater benefit of primary prevention measures for those at risk for STEMI. Alternatively, changes in the prevalence of emerging cardiovascular risk factors, such as diabetes and obesity, or changing demographic characteristics of patients hospitalized with acute myocardial infarction, may have differentially promoted the development of NSTEMI.^{5,19}

The most likely explanation for our findings, however, is that the observed decline in the frequency of patients hospitalized with STEMI is part of a larger trend toward fewer patients with electrocardiographically diagnosed acute myocardial infarction. Indeed, the Framingham investigators have reported an approximate 50% decline in the frequency of electrocardiographically-diagnosed cases of acute myocardial infarction over a forty-year period.²⁰ In our cohort, only 40% of NSTEMI cases diagnosed since 2003 had evidence of ECG abnormalities. These data suggest that had high-sensitivity cardiac biomarkers, particularly troponin, not been introduced into the greater Worcester community during recent years, the number of NSTEMI cases may have decreased over time.

Hospital Treatment Practices

Despite being considerably older, and having a higher prevalence of cardiovascular comorbidities, patients with NSTEMI were less likely to receive effective cardiac medications and to undergo cardiac catheterization or PCI during their hospitalization than were patients with STEMI. However, prescription of these medications and procedures increased significantly, with the exception of thrombolytic therapy and coronary artery bypass surgery, over the years under study among both patient groups.

Reasons for these differences are unclear since indications for the use of aspirin, beta blockers, lipid-lowering agents and ACEI/ARBs are generally similar, irrespective of acute myocardial infarction subtype. Although the guidelines for treatment of STEMI and NSTEMI differ with respect to timing of cardiac catheterization and PCI,²¹ data support the in-hospital use of these procedures in patients with NSTEMI.²² Thus, patterns in the use of cardiac catheterization and PCI cannot be explained solely on the basis of differential indications. In our analysis, no disease level factors could be identified to explain why differences in the use of effective cardiac medications, cardiac catheterization, and PCI persisted between the study groups over time.

Patient, provider, and hospital level factors, however, may offer greater insights into the treatment disparities observed in our investigation. Since NSTEMI patients were generally older and more likely to have important comorbidities present, providers may have been less aggressive in managing NSTEMI patients due to concerns about adverse effects.^{23,24} Older patients may also have been less likely to agree to undergo invasive procedures or take multiple medications.^{19,25} Hospital-based initiatives may have contributed to differences in treatment practices observed between our respective comparison groups. Further investigation into these areas is warranted, particularly since the number of older patients with NSTEMI appears to be increasing.

In-hospital, 30-Day, and 1-Year Death Rates

It is notable that in-hospital death rates in our study were higher for both NSTEMI and STEMI than has been reported elsewhere.²⁶ This likely relates to differences in age as well as to the number and severity of comorbidities in patients participating in our community-based study relative to patients eligible for participation in randomized controlled trials.²⁶ Use of more restrictive inclusion criteria, particularly upper age limits, may partially explain why clinical trials have not demonstrated similar death rates for NSTEMI and STEMI.

Mortality from NSTEMI remained significantly higher than STEMI at both 30-days and 1-year. The higher long-term death rates observed in patients discharged after NSTEMI may have resulted from the fact that patients with NSTEMI were older and had a greater burden of cardiovascular comorbidities. Under-utilization of effective cardiac medications and PCI, as well as greater delays in the time to receipt of PCI in patients with NSTEMI, may also have contributed to differences in the post-discharge death rates observed in these patients.²⁷

Our results are consistent with the notion that differences in mortality in patients hospitalized with STEMI and NSTEMI strongly relate to patients' clinical characteristics and less so to the presence (or absence) of ST-segment elevation.²⁸ The significant influence of heart failure, atrial fibrillation, diabetes, and kidney function on the outcomes assessed in our study also suggests that clinicians might further impact hospital and long-term death rates in patients with acute myocardial infarction by improving the treatment of these and other modifiable factors.²⁸

Despite increasing rates of atrial fibrillation and heart failure over time, and an increasingly older patient population, 1-year death rates declined for all greater Worcester residents discharged after acute myocardial infarction between 1997 and 2005. This finding is consistent with prior data that have demonstrated declining long-term CFRs for both NSTEMI and STEMI.²⁶ Although we did not control for differences in hospital treatment practices between study groups, nor was information available regarding the use of cardiac medications after hospital discharge, we have previously demonstrated increasing application of effective cardiac medications in greater Worcester residents hospitalized for acute myocardial infarction.⁶ Increasing use of these therapies, and reductions in pre-hospital delay to PCI among patients with both STEMI and NSTEMI, may have contributed to the improved 1-year survival rates noted.²⁹

Study Limitations

Although trends in the incidence and death rates for STEMI and NSTEMI may have been affected by the use of coronary interventional procedures and medical therapies, we did not adjust for differences in the management of these patients. Our study was underpowered to examine differences between patients with NSTEMI with diagnostic ECG changes from those without such changes. An electrocardiographic core laboratory was not employed, perhaps resulting in some misclassification of acute myocardial infarction. The number of

deaths during several time periods was relatively small, limiting any inferences that might be drawn.

Conclusions

The incidence rates of STEMI declined significantly between 1997 and 2005. Incidence rates of NSTEMI increased slightly during this period, likely as a result of high-sensitivity biomarker introduction. Encouraging trends were noted in the post-discharge death rates for both STEMI and NSTEMI at 1 year, suggesting that acute myocardial infarction treatment practices have likely improved the long-term outlook for all patients hospitalized with acute myocardial infarction. Increased attention needs to be directed to secondary prevention practices in the hospital and post-discharge management of patients hospitalized with NSTEMI since the proportion of NSTEMI patients receiving effective cardiac therapies lags behind those with STEMI.

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References

1. Alpert JS, Thygesen K, Antman E, Bassand JP. Myocardial infarction redefined--a consensus document of The Joint European Society of Cardiology/American College of Cardiology Committee for the redefinition of myocardial infarction. *J Am Coll Cardiol* 2000;36:959–969. [PubMed: 10987628]
2. Antman EM, Anbe DT, Armstrong PW, et al. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction--executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 1999 Guidelines for the Management of Patients With Acute Myocardial Infarction). *Circulation* 2004;110:588–636. [PubMed: 15289388]
3. Cox DA, Stone GW, Grines CL, et al. Comparative early and late outcomes after primary percutaneous coronary intervention in ST-segment elevation and non-ST-segment elevation acute myocardial infarction (from the CADILLAC trial). *Am J Cardiol* 2006;98:331–337. [PubMed: 16860018]
4. Abbott JD, Ahmed HN, Vlachos HA, et al. Comparison of outcome in patients with ST-elevation versus non-ST-elevation acute myocardial infarction treated with percutaneous coronary intervention (from the National Heart, Lung, and Blood Institute Dynamic Registry). *Am J Cardiol* 2007;100:190–195. [PubMed: 17631068]
5. Mokdad AH, Bowman BA, Ford ES, et al. The continuing epidemics of obesity and diabetes in the United States. *JAMA* 2001;286:195–200.
6. Floyd KC, Yarzebski J, Spencer FA, et al. A 30 year perspective (1975–2005) into the changing landscape of patients hospitalized with initial acute myocardial infarction: Worcester Heart Attack Study. *Circ Cardiovasc Qual Outcomes* 2009;2:88–95. [PubMed: 20031820]
7. Goodman SG, Steg PG, Eagle KA, et al. The diagnostic and prognostic impact of the redefinition of acute myocardial infarction: lessons from the Global Registry of Acute Coronary Events (GRACE). *Am Heart J* 2006;151:654–660. [PubMed: 16504627]
8. Goldberg RJ, Spencer FA, Okolo J, et al. Long-term trends (1986–2003) in the use of coronary reperfusion strategies in patients hospitalized with acute myocardial infarction in Central Massachusetts. *Int J Cardiol* 2008;131:83–89. [PubMed: 18191479]

9. McGovern PG, Jacobs DR Jr, Shahar E, et al. Trends in acute coronary heart disease mortality, morbidity and medical care from 1985 through 1997: the Minnesota Heart Survey. *Circulation* 2001;104:19–24. [PubMed: 11435332]
10. Roger VL, Jacobsen SJ, Weston SA, et al. Trends in the incidence and survival of patients with hospitalized myocardial infarction. Olmsted County, Minnesota, 1979 to 1994. *Ann Intern Med* 2002;136:341–348. [PubMed: 11874305]
11. Ergin A, Muntner P, Sherwin H, He J. Secular trends in cardiovascular disease mortality, incidence, and case fatality rates in adults in the United States. *Am J Med* 2004;117:219–227. [PubMed: 15308430]
12. Rogers WJ, Canto JG, Lambrew CT, et al. Temporal trends in the treatment of over 1.5 million patients with myocardial infarction in the U.S. from 1990 through 1999. *J Am Coll Cardiol* 2000;36:2056–2063. [PubMed: 11127441]
13. Goldberg RJ, Gore JM, Alpert JS, Dalen JE. Recent changes in attack and survival rates of acute myocardial infarction (1975 through 1981). The Worcester Heart Attack Study. *JAMA* 1986;255:2774–2779. [PubMed: 3701991]
14. Goldberg RJ, Spencer FA, Yarzebski J, et al. A 25-year perspective into the changing landscape of patients hospitalized with acute myocardial infarction (the Worcester Heart Attack Study). *Am J Cardiol* 2004;94:1373–1378. [PubMed: 15566906]
15. Goldberg RJ, Yarzebski J, Lessard D, Gore JM. Decade-long trends and factors associated with time to hospital presentation in patients with acute myocardial infarction: the Worcester Heart Attack study. *Arch Intern Med* 2000;160:3217–3223. [PubMed: 11088081]
16. Fox CS, Evans JC, Larson MG, et al. Temporal trends in coronary heart disease mortality and sudden cardiac death from 1950 to 1999: the Framingham Heart Study. *Circulation* 2004;110:522–527. [PubMed: 15262842]
17. Fox KA, Steg PG, Eagle KA, et al. Decline in rates of death and heart failure in acute coronary syndromes, 1999–2006. *JAMA* 2007;297:1892–1900. [PubMed: 17473299]
18. Sprafka JM, Burke GL, Folsom AR, et al. Continued decline in cardiovascular disease risk factors: results of the Minnesota Heart Survey, 1980–1982 and 1985–1987. *Am J Epidemiol* 1990;132:489–500. [PubMed: 2389753]
19. Goch A, Misiewicz P, Rysz J, Banach M. The clinical manifestation of myocardial infarction in elderly patients. *Clin Cardiol* 2009;32:E46–51. [PubMed: 19382276]
20. Parikh NI, Gona P, Larson MG, et al. Long-term trends in myocardial infarction incidence and case fatality in the National Heart, Lung, and Blood Institute's Framingham Heart study. *Circulation* 2009;119:1203–1210. [PubMed: 19237656]
21. Anderson JL, Adams CD, Antman EM, et al. ACC/AHA 2007 guidelines for the management of patients with unstable angina/non ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 2002 Guidelines for the Management of Patients With Unstable Angina/Non ST-Elevation Myocardial Infarction): developed in collaboration with the American College of Emergency Physicians, the Society for Cardiovascular Angiography and Interventions, and the Society of Thoracic Surgeons: endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation and the Society for Academic Emergency Medicine. *Circulation* 2007;116:e148–304. [PubMed: 17679616]
22. Chan MY, Sun JL, Newby LK, et al. Long-term mortality of patients undergoing cardiac catheterization for ST-elevation and non-ST-elevation myocardial infarction. *Circulation* 2009;119:3110–3117. [PubMed: 19506116]
23. Dziewierz A, Siudak Z, Rakowski T, et al. In-hospital management and mortality in elderly patients with non-ST-segment elevation acute coronary syndromes treated in centers without on-site invasive facilities. *Cardiol J* 2008;15:451–457. [PubMed: 18810721]
24. Krumholz HM, Radford MJ, Wang Y, et al. National use and effectiveness of beta-blockers for the treatment of elderly patients after acute myocardial infarction: National Cooperative Cardiovascular Project. *JAMA* 1998;280:623–629. [PubMed: 9718054]
25. Agarwal S, Bennett D, Smith DJ. Predictors of warfarin use in atrial fibrillation patients in the inpatient setting. *Am J Cardiovasc Drugs* 2010;10:37–48. [PubMed: 20104933]

26. Holmes DR Jr. Cardiogenic shock: a lethal complication of acute myocardial infarction. *Rev Cardiovasc Med* 2003;4:131–135. [PubMed: 12949441]
27. Rogers WJ, Frederick PD, Stoeck E, et al. Trends in presenting characteristics and hospital mortality among patients with ST elevation and non-ST elevation myocardial infarction in the National Registry of Myocardial Infarction from 1990 to 2006. *Am Heart J* 2008;156:1026–1034. [PubMed: 19032996]
28. Setoguchi S, Glynn RJ, Avorn J, et al. Improvements in long-term mortality after myocardial infarction and increased use of cardiovascular drugs after discharge: a 10-year trend analysis. *J Am Coll Cardiol* 2008;51:1247–1254. [PubMed: 18371553]
29. Dziewierz A, Siudak Z, Rakowski T, et al. More aggressive pharmacological treatment may improve clinical outcome in patients with non-ST-elevation acute coronary syndromes treated conservatively. *Coron Artery Dis* 2007;18:299–303. [PubMed: 17496494]

Figure 1.
Incidence Rates for STEMI and NSTEMI by Study Year

Figure 2.
In-Hospital, Thirty Days, and One-Year Case-Fatality Rates for STEMI and NSTEMI by Study Year

Table 1

Characteristics of Patients Hospitalized With Acute Myocardial Infarction (AMI)

Variable *	NSTEMI (n=3314)	STEMI (n=2071)	P value
Demographics			
Age (mean, years) ± SD	73.4 ± 13.2	67.1 ± 14.5	<.001
<65	822 (24.8)	874 (42.2)	--
65–74	719 (21.7)	470 (22.7)	--
≥75	1773 (53.5)	727 (35.1)	--
Male (%)	1771 (53.4)	1254 (60.6)	<.001
White race (%)	2970 (92.3)	1862 (92.9)	0.43
Medical history (%)			
Atrial fibrillation	536 (16.2)	153 (7.4)	<.001
Angina	793 (23.9)	366 (17.7)	<.001
Diabetes	1211 (36.5)	551 (26.6)	<.001
Heart failure	1020 (30.8)	227 (13.4)	<.001
Stroke	448 (13.5)	188 (9.1)	<.001
In Hospital Treatment (%)			
Aspirin	2975 (89.8)	1948 (94.1)	<.001
Beta-blockers	2795 (84.3)	1858 (89.7)	<.001
Angiotensin converting enzyme inhibitor or angiotensin receptor blocker	1973 (59.4)	1309 (63.2)	0.007
Lipid lowering medication	1716 (51.8)	1121 (54.1)	0.09
Cardiac catheterization	1406 (42.6)	1339 (64.7)	<.001
Percutaneous intervention	754 (22.8)	946 (45.7)	<.001
Coronary artery bypass grafting	192 (5.8)	124 (6.0)	0.79
Physiologic Parameters (mean, ± SD)			
Body mass index (kg/m ²)	27.2 ± 6.1	27.7 ± 5.9	0.004
Ejection fraction (%)	45.6 ± 14.5	45.1 ± 12.9	0.34
eGFR (ml/min/m ²)	55.7 ± 25.6	66.4 ± 32.4	<.001
Systolic blood pressure (mmHg)	144.2 ± 34.3	139.5 ± 33.3	<.001
Diastolic blood pressure (mmHg)	76.4 ± 20.7	78.8 ± 21.4	<.001
Glucose (mg/dl)	186.0 ± 138.4	180.4 ± 129.0	0.15

Variable*	NSTEMI (n=3314)	STEMI (n=2071)	P value
Total cholesterol (mg/dl)	179.8 ± 53.9	182.2 ± 48.1	0.25
AMI Associated Features (%)			
Initial [†]	1974 (59.6)	1520 (73.4)	<.001
Q wave	319 (9.6)	1030 (49.7)	<.001
Hospital Associated Delays			
Pre-hospital (median hrs, IQR)	2.3 (1.1,5.0)	1.8 (1.0,3.8)	<.001
PCI-related (median hrs, IQR)	32.9 (17.3,69.2)	3.5 (2.2,22.3)	<.001

* Variables presented as proportions (%), means ± SD, or medians with interquartile range (IQR)

eGFR = estimated glomerular filtration rate; NSTEMI = non-ST-segment-elevation myocardial infarction; STEMI = ST-segment elevation myocardial infarction

[†] First AMI = Absence of prior hospitalizations for AMI

Table 2

Odds of Developing ST Segment Elevation Myocardial Infarction (STEMI) and Non-ST Segment Elevation Myocardial Infarction (NSTEMI) by Study Year

Study Year	All Patients			All Patients		
	STEMI (n = 2071)	Age- and Sex- Adjusted Odds of Developing STEMI* (95% CI)	Fully Adjusted Odds of Developing STEMI† (95% CI)	NSTEMI (n = 3314)	Age- and Sex- Adjusted Odds of Developing NSTEMI* (95% CI)	Fully Adjusted Odds of Developing NSTEMI† (95% CI)
1997	477 (45.0)	1.0	1.0	582 (55.0)	1.0	1.0
1999	493 (48.0)	1.13 (0.95,1.35)	1.09 (0.87,1.36)	534 (52.0)	0.89 (0.74,1.06)	0.92 (0.74,1.15)
2001	443 (35.8)	0.70 (0.59,0.83)	0.76 (0.62,0.94)	796 (64.2)	1.43 (1.20,1.70)	1.31 (1.07,1.62)
2003	368 (31.8)	0.58 (0.48,0.69)	0.63 (0.51,0.78)	789 (68.2)	1.74 (1.46,2.08)	1.60 (1.29,1.98)
2005	290 (32.1)	0.59 (0.48,0.71)	0.65 (0.52,0.82)	613 (67.9)	1.71 (1.41,2.06)	1.53 (1.22,1.92)

* 1997= referent year

† Adjusted for age, sex, history of atrial fibrillation, angina, diabetes mellitus, heart failure or stroke, eGFR, AMI type (Q wave vs non Q wave), and order (initial vs prior), presenting level of systolic blood pressure

Table 3

Changing Trends in Hospital Treatment Practices

Medication	ST Segment Elevation AMI (%)	Non-ST Segment Elevation AMI (%)
Aspirin		
1997	446 (93.5)	515 (88.5)
1999	469 (95.1)	481 (90.0)
2001	400 (90.3)	688 (86.4)
2003	356 (96.7)	714 (90.5)
2005	277 (95.5)	577 (94.1)
% change (1997–2005)	+3.0	+7.2
Beta blockers		
1997	420 (88.1)	439 (75.4)
1999	429 (87.0)	412 (77.2)
2001	392 (88.5)	653 (82.0)
2003	344 (93.5)	708 (89.7)
2005	273 (94.1)	583 (95.1)
% change (1997–2005)	+6.8	+26.1
Lipid lowering therapy		
1997	117 (24.5)	119 (20.5)
1999	207 (42.0)	209 (39.1)
2001	289 (65.2)	415 (52.1)
2003	307 (83.4)	569 (72.1)
2005	201 (69.3)	404 (65.9)
% change (1997–2005)	+182.9	+221.5
ACE inhibitors/ARB's		
1997	246 (51.6)	282 (48.5)
1999	258 (52.3)	260 (48.7)
2001	283 (63.9)	444 (55.8)
2003	284 (77.2)	506 (64.1)
2005	216 (74.5)	368 (60.0)
% change (1997–2005)	+44.4	+23.7
Thrombolytics		

Medication	ST Segment Elevation AMI (%)	Non-ST Segment Elevation AMI (%)
1997	199 (41.7)	22 (3.8)
1999	191 (38.7)	9 (1.7)
2001	114 (26.0)	15 (1.9)
2003	34 (9.2)	6 (0.8)
2005	5 (1.7)	2 (0.3)
% change (1997–2005)	–95.9	–92.1
Cardiac catheterization		
1997	238 (49.9)	185 (31.8)
1999	270 (54.8)	173 (33.0)
2001	299 (67.5)	324 (40.7)
2003	286 (77.7)	372 (47.2)
2005	246 (84.8)	352 (57.4)
% change (1997–2005)	+34.9	+25.6
Percutaneous coronary intervention		
1997	113 (23.7)	50 (8.6)
1999	168 (34.1)	62 (11.9)
2001	202 (45.6)	160 (20.1)
2003	247 (67.1)	240 (30.4)
2005	216 (74.5)	242 (39.5)
% change (1997–2005)	+214.3	+359.3
CABG		
1997	24 (5.0)	37 (6.4)
1999	30 (6.1)	24 (4.6)
2001	37 (8.4)	68 (8.5)
2003	23 (6.3)	39 (4.9)
2005	10 (3.5)	24 (3.9)
% change (1997–2005)	–30.0	–39.1

Table 4

Changing Trends in Various Hospital Outcomes for Patients With ST Segment (STEMI) and Non-ST Segment (NSTEMI) Elevation Myocardial Infarction

STEMI									
		Atrial Fibrillation			Heart Failure			Cardiogenic Shock	
Year	n	% developing	Adjusted O.R.*		% developing	Adjusted O.R.*		% developing	Adjusted O.R.*
1997	477	11.7	1.0		25.8	1.0		8.8	1.0
1999	493	14.0	1.13 (0.74,1.74)		29.4	1.20 (0.86,1.68)		7.9	0.93 (0.55,1.60)
2001	443	21.9	1.84 (1.23,2.77)		31.8	1.25 (0.90,1.76)		9.9	1.14 (0.68,1.91)
2003	368	20.9	2.02 (1.33,3.08)		31.8	1.39 (0.99,1.97)		6.8	0.71 (0.40,1.28)
2005	290	16.9	1.53 (0.97,2.44)		29.7	1.21 (0.83,1.77)		8.6	1.09 (0.61,1.95)

NSTEMI									
		Atrial Fibrillation			Heart Failure			Cardiogenic Shock	
Year	n	% developing	Adjusted O.R.*		% developing	Adjusted O.R.*		% developing	Adjusted O.R.*
1997	582	13.4	1.0		36.9	1.0		5.5	1.0
1999	534	17.4	1.19 (0.81,1.75)		43.8	1.21 (0.90,1.63)		5.1	1.04 (0.55,1.96)
2001	796	20.0	1.43 (1.02,2.02)		41.1	1.06 (0.80,1.39)		4.0	0.80 (0.44,1.47)
2003	789	23.3	1.69 (1.21,2.37)		45.1	1.31 (1.00,1.72)		2.8	0.58 (0.31,1.10)
2005	613	25.1	1.96 (1.38,2.79)		41.8	0.99 (0.75,1.33)		4.1	0.85 (0.45,1.60)

* adjusted for age, sex, history of atrial fibrillation, heart failure, stroke, angina, diabetes mellitus, estimated glomerular filtration rate, AMI type (Q wave vs non Q wave), presenting systolic blood pressure

Table 5

Changing Trends in Hospital, 30-Day, and 1-year Case Fatality Rates (CFRs) for Patients With ST Segment (STEMI) and Non-ST Segment (NSTEMI) Elevation Myocardial Infarction

STEMI									
Hospital CFRs				30 Day Post Admission CFR			1-year Post Discharge CFRs		
Year	n (%)	Age and Sex Adjusted O.R. (95% CI)	Multivariable Adjusted O.R. (95% CI)*	n (%)	Age and Sex Adjusted O.R. (95% CI)	Multivariable Adjusted O.R. (95% CI)*	n (%)**	Age and Sex Adjusted O.R. (95% CI)	Multivariable Adjusted O.R. (95% CI)*
1997	477 (11.1)	1.0	1.0	477 (13.2)	1.0	1.0	424 (10.6)	1.0	1.0
1999	493 (9.9)	0.95 (0.65,1.40)	0.82 (0.50,1.35)	493 (13.0)	0.95 (0.65,1.40)	0.96 (0.61,1.51)	444 (14.0)	1.25 (0.92,1.69)	1.07 (0.74,1.54)
2001	443 (13.5)	1.21 (0.83,1.77)	1.08 (0.68,1.72)	443 (15.8)	1.21 (0.83,1.77)	1.12 (0.72,1.74)	383 (15.4)	1.05 (0.79,1.39)	0.98 (0.70,1.36)
2003	368 (8.4)	0.73 (0.47,1.14)	0.66 (0.39,1.12)	368 (10.0)	0.73 (0.47,1.14)	0.67 (0.40,1.10)	337 (8.3)	1.04 (0.79,1.37)	0.88 (0.64,1.23)
2005	289 (9.7)	0.88 (0.55,1.39)	0.81 (0.47,1.41)	289 (11.4)	0.88 (0.55,1.39)	0.78 (0.46,1.33)	261 (8.4)	0.63 (0.46,0.86)	0.50 (0.35,0.72)
NSTEMI									
Hospital CFRs				30 Day CFRs			1-year CFRs		
Year	n (%)	Age and Sex Adjusted O.R. (95% CI)	Multivariable Adjusted O.R. (95% CI)*	n (%)	Age and Sex Adjusted O.R. (95% CI)	Multivariable Adjusted O.R. (95% CI)*	n (%)**	Age and Sex Adjusted O.R. (95% CI)	Multivariable Adjusted O.R. (95% CI)*
1997	582 (12.9)	1.0	1.0	582 (16.0)	1.0	1.0	507 (23.1)	1.0	1.0
1999	534 (13.1)	0.99 (0.70,1.41)	0.98 (0.64,1.49)	534 (17.0)	1.04 (0.75,1.44)	0.93 (0.64,1.37)	464 (27.6)	1.55 (0.91,2.10)	1.47 (0.91,2.40)
2001	796 (10.9)	0.78 (0.56,1.08)	0.75 (0.50,1.11)	796 (16.5)	0.95 (0.70,1.27)	0.88 (0.62,1.25)	709 (26.1)	1.55 (1.00,2.40)	1.62 (1.00,2.63)
2003	789 (8.9)	0.61 (0.43,0.87)	0.62 (0.41,0.93)	789 (13.7)	0.75 (0.55,1.03)	0.71 (0.50,1.02)	719 (25.6)	0.74 (0.44,1.24)	0.80 (0.46,1.39)
2005	613 (9.5)	0.64 (0.44,0.92)	0.65 (0.43,0.99)	613 (14.0)	0.75 (0.54,1.03)	0.69 (0.47,1.01)	555 (18.7)	0.82 (0.47,1.44)	0.80 (0.44,1.46)

* adjusted for age, sex, history of atrial fibrillation, heart failure, stroke, angina, diabetes mellitus, estimated glomerular filtration rate, AMI type (Q wave vs non Q wave), presenting systolic blood pressure

** hospital survivors only