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Ischaemic Symptoms, Quality of Care, and Mortality during Myocardial Infarction

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Abstract

Objective—In myocardial infarction (MI), we studied whether documentation of ischemic symptoms is associated with quality of care and outcomes, and compared patient reports of ischaemic symptoms during interviews with chart documentation

Design—Observational acute myocardial infarction study from 2003–2004 (Prospective Registry Evaluating Myocardial Infarction: Event and Recovery)

Setting—19 diverse US hospitals

Patients—2,094 consecutive MI patients (10,911 patients screened; 3,953 patients were eligible and enrolled) with both positive cardiac enzymes and other evidence of infarction (e.g., symptoms, electrocardiographic changes). Transferred patients and those with confounding noncardiac comorbidity were not included (n=1859).

Main outcome measures—Quality of care indicators and adjusted in-hospital survival

Results—The records of 10% of all MI patients (217/2094) contained no documented ischaemic symptoms at presentation. Patients without documented symptoms were less likely ($p<0.05$) to: receive aspirin (89% vs. 96%) or beta-blockers (77% vs. 90%) within 24hr, reperfusion therapy for STEMI (7% vs. 58%) or to survive their hospitalization (adjusted OR=3.2, 95% CI 1.8–5.8). Survivors without documented symptoms were also less likely ($p<0.05$) to be discharged with aspirin (87% vs. 93%), beta-blockers (81% vs. 91%), ACE/ARB (67% vs. 80%), or smoking cessation counseling (46% vs. 66%). In the subset of 1,356 (65%) interviewed patients, most of those without documented ischaemic symptoms (75%) reported presenting symptoms consistent with ischaemia.

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Conclusions—Failure to document patients' presenting MI symptoms is associated with poorer quality of care from admission to discharge, and higher in-hospital mortality. Symptom recognition may represent an important opportunity to improve the quality of MI care.

INTRODUCTION

Eliciting and documenting potentially ischaemic symptoms are important events in the early treatment of an evolving acute myocardial infarction (MI).[1] Indeed, prior studies have shown lower quality of care and worse in-hospital survival when ischaemic symptoms were not noted on admission.[2–4] However, these studies focused solely upon the presence or absence of chest pain and did not consider the full spectrum of ischaemic symptoms (e.g., dyspnoea or referred pain). More importantly, these studies relied entirely upon chart abstraction of documented symptoms at the time of presentation, and did not validate the findings of chart abstraction with patient interviews to quantify patients' perspectives of why they presented for care. It therefore remains unclear whether these studies dealt with unrecognised, or absent, ischaemic symptoms.

These distinctions are important to resolve if quality improvement efforts to increase symptom recognition are to have the potential to improve care and outcomes. If patients truly lack symptoms of ischaemia at the time of presentation, then it is difficult to imagine how recognition could be improved. Conversely, if patients do present with potentially ischaemic symptoms that providers fail to recognise and document, then quality improvement efforts targeting improved interviewing and sensitivity to possible ischaemic symptoms might be an important opportunity to improve care and outcomes. Disentangling these possibilities requires collecting data from both clinicians' and patients' perspectives. Underscoring the importance of collecting both sources of data, prior studies have noted that clinicians sometimes fail to elicit and document atypical symptoms from patients presenting with an acute coronary syndrome.[5–7]

To address these issues, we studied MI patients' presentation, care, and outcomes in the multi-center, prospective PREMIER (Prospective Registry Evaluating Myocardial Infarction: Event and Recovery) study. First, we examined the association of documented ischaemic symptoms on initial care, inpatient mortality and the quality of care at the time of hospital discharge. Then, we studied prospectively collected patient interviews designed to capture the symptoms that prompted patients to seek medical care initially and compared patient-reported symptoms to chart documentation of ischaemic symptoms. Together, these analyses can clarify the importance of recognizing ischaemic symptoms in MI patients and suggest whether improvements in symptom recognition may translate into improved care and outcomes.

METHODS

Patient sample

The rationale and methods for the PREMIER study have been previously described.[8] The study recruited consecutive patients presenting with an MI at 19 US hospitals (Appendix) between January 1, 2003 and June 28, 2004. All patients with a positive troponin (or CK-MB) test during the initial 24 hours of admission were screened for possible inclusion. Patients were eligible if they were 18 years or older and only if there was other evidence supporting an MI diagnosis, such as prolonged (> 20 minutes) ischemic signs/symptoms and/or electrocardiographic ST changes. In addition, all of the patients in the cohort had a final discharge diagnosis of myocardial infarction. Thus, elevated troponins alone were insufficient for inclusion. Incarcerated patients and those having elevated cardiac enzymes as a complication of elective coronary revascularisation were not eligible. Institutional

Review Board approval was obtained at each participating institution. Of the 10,911 patients screened, 3,953 patients were eligible and enrolled in PREMIER. We excluded those who were presented with non-cardiac, potentially life-threatening acute illness that might confound the relationship between lack of ischaemia recognition and inhospital mortality, such as concurrent trauma (n=6), stroke (n=24), severe GI bleed/anemia (n=42), and hip fracture (n=4). We also excluded those with dementia (n=52) since inaccurate reporting of symptoms could confound the analyses. Lastly, we excluded those whose data regarding ischaemic symptoms were missing (n=46) and those who were transferred from other facilities (n=1,633). We assumed that inclusion of transferred patients would likely introduce a selection bias in favor of patients with recognised symptoms. The final cohort for this study contained 2,094 patients.

A principal goal of PREMIER was to interview patients for their health status and psychosocial characteristics. For those institutions whose data collection teams could not interview all MI patients, subjects were randomly sampled (using a site-specific, predetermined sampling scheme) to avoid bias introduced by convenience sampling. A final subset of 1,356 (65%) patients were approached and consented to interviews.

Data elements

Documenting Ischaemic Symptoms on Presentation—We assumed that documentation of Is chaemic symptoms represented recognition of ischaemic symptoms. Ischaemic symptoms were broadly defined in order to capture clinicians' documentation of the various potential manifestations of myocardial ischaemia. Patients were classified as having had recognized symptoms of ischaemia if any of the emergency room notes, paramedic transcript records, or initial admitting notes documented any ischaemic symptoms, such as chest pain or pressure, arm, neck, shoulder or jaw pain, dyspnoea, nausea/vomiting, weakness, syncope, or cardiac arrest.

Patient interview—Among the subset of 1,356 patients interviewed, specific symptoms were elicited and recorded by the interviewers only if patients first indicated recollection of their presenting symptom complex to avoid leading questions. Patients indicating symptom recollection were asked whether they experienced chest pain or pressure, arm, neck, shoulder or jaw pain, dyspnoea, nausea/vomiting, and weakness or syncope upon presentation. If they reported chest pain, severity of their pain was rated on a scale of 1–10, with higher scores for more severe symptoms. Median time from admission to interview was 2 days.

Outcome variables—To assess the association of symptom documentation and outcome, we compared in-hospital mortality according to documented ischaemic symptoms on presentation. To compare the quality of care between MI patients with and without documented ischaemic symptoms, we used the same core performance measures used by the Centers for Medicare and Medicaid Services (CMS).[9]

Specifically, we compared the use of beta-blockers and aspirin within the first 24 hours, and use of reperfusion (fibrinolytic therapy or PCI) for ST elevation MI.[9] Among in-hospital survivors, we examined care at discharge by comparing rates of aspirin and beta-blocker use, ACE/ARB use for left ventricular systolic dysfunction, and smoking cessation counseling. The CMS inclusion and exclusion eligibility criteria were applied for all performance measures to ensure that we studied patient treatment variation only in those eligible for treatment, without documented contraindications.[9] Additionally, the frequency of statin use was compared with documentation of ischaemic symptoms. The denominator

for this analysis included both those with elevated LDL cholesterol [>100 mg/dL (>2.59 mmol/L) or >70 mg/dL (>1.81 mmol/L)] as well as those who were on statins at admission.

Statistical Analyses

We compared patient characteristics between patients with and without documented ischaemic symptoms using Chi-square tests for categorical variables and t-tests for continuous variables. Logistic regression models identified whether demographic and clinical characteristics were associated with the absence of documented ischaemic symptoms. We specifically evaluated age, gender, race, chronic renal insufficiency, heart failure, chronic lung disease, diabetes, alcohol abuse, and absence of prior evidence of atherosclerotic disease (MI, stroke, peripheral arterial disease, angina, or prior coronary revascularisation). These variables conditions were chosen *a priori* on clinical grounds based on their potential to mimic (e.g., chronic lung disease) or mask (e.g., diabetes) myocardial ischaemia.

We also defined the risk-adjusted association between documented ischaemic symptoms and in-hospital mortality, using logistic regression analyses. We adjusted for variables related to demographics (age, gender, race); prior comorbidity (cancer, chronic renal insufficiency, diabetes, prior MI, prior angina); disease severity (ST elevation, initial heart rate and blood pressure, initial creatinine, new onset atrial fibrillation); and in-hospital processes of care (reperfusion therapy and use of aspirin and beta-blockers within the first 24 hours of admission). An interaction term for *documentation of ischaemic symptom*s and *chronic renal insufficiency* assessed whether the mortality risk associated with undocumented ischaemic symptoms varied according to the presence or absence of chronic renal insufficiency. To account for variation across hospitals, we used a generalized linear mixed model with a logit-link function[10] that incorporated random effects for hospital intercepts.

In a secondary analysis of those 1,356 patients with interviews during their index hospitalization, we compared their description of presenting symptoms to chart documentation of ischaemic symptoms. Because more than one symptom can be experienced by a patient, we sequentially calculated the *cumulative* proportion of patients who indicated that they experienced: chest pain (with or without radiation to neck, shoulder or jaw); isolated referred pain (to neck, shoulder, jaw, arm, or back); shortness of breath; nausea or diaphoresis; weakness, or lightheadedness. These latter symptoms may all indicate early symptoms of MI as described in current guidelines.[1]

Missing data resulted in the exclusion of only 14 patients (0.4% of the sample) and therefore imputation and/or propensity analyses were not performed. Model discrimination for logistic regression models was determined using the c statistic.[11] Statistical analysis was performed using the SAS software system for Windows Version 8 (SAS Institute, Cary, NC). The Corresponding Author has the right to grant on behalf of all authors and does grant on behalf of all authors, an exclusive licence (or non exclusive for government employees) on a worldwide basis to the BMJ Publishing Group Ltd and its Licensees to permit this article to be published in HEART editions and any other BMJPGL products to exploit all subsidiary rights.

RESULTS

Patient characteristics

The mean age of the cohort was 62±14 years. Women accounted for 36% (753/2,094) of the sample and 58% (1,221/2,094) were Caucasian. Of the 2,094 patients studied, 10% (N=217) patients' had no documentation of ischaemic symptoms on presentation. Bivariate comparisons between patients with and without documented ischaemic symptoms are shown

in Table 1. Patients without documented ischaemic symptoms were more likely to be female, of non-white race, and have a greater burden of comorbidity. In multivariable analysis, patient characteristics associated ($p<0.05$) with an absence of documented ischaemic symptoms were: non-STelevation MI, older age, a history of diabetes, chronic renal insufficiency, prior stroke and a lack of prior coronary artery disease (Table 2); the c statistic was 0.85.

Adherence to Acute Care Quality Indicators

Among eligible patients, those without documented ischaemic symptoms were less likely to be treated with aspirin (89% vs. 96%, $p<0.001$) or beta-blockers (77% vs. 90%, $p<0.001$) within the first 24 hours of their admission. In the subset of eligible patients with ST elevation MI, patients without documented ischaemic symptoms at presentation were significantly less likely to receive reperfusion therapy (7% vs. 58%, $p<0.001$; Table 3).

Association with Inpatient Mortality

Crude in-hospital mortality rates were significantly higher in those without documented ischemic symptoms (15 vs. 3%, $p<0.001$). Multivariable analyses demonstrated that failure to document ischaemic symptoms on presentation remained a strong predictor of in-hospital mortality, (OR=3.21, 95% CI 1.76 – 5.84) after adjustment for age, gender, non Caucasian race, cancer, diabetes, chronic renal insufficiency, chronic heart failure, initial heart rate (per 10 unit increase), initial systolic blood pressure (per 10 unit decrease), initial creatinine, Killip class 4, acute reperfusion therapy (for ST elevation MI), aspirin and/or beta-blocker within 24 hours of admission, and clustering of patients within hospitals (Table 4). The c statistic was 0.83. The interaction term between chronic renal insufficiency and documentation of ischaemic symptoms was not statistically significant ($p=0.99$) indicating that the excess mortality in those with undocumented ischaemic symptoms did not differ significantly according to the presence or absence of chronic renal insufficiency.

Adherence to Discharge Quality Indicators

At the time of discharge (Table 3), eligible patients without documented ischaemic symptoms were less likely to be discharged with aspirin (87% vs. 93%, $p=0.009$), beta-blockers (81% vs. 91%, $p<0.001$), or ACE inhibitors (or angiotensin receptor blockers) for LV dysfunction (67% vs. 80%). Patients without documented ischaemic symptoms were also less likely to receive smoking cessation counseling (46% vs. 66%, $p=0.004$) or statin therapy if their LDL was > 100mg/dL or >70 mg/dL (65% vs. 84%, 71% vs. 88%, respectively; $p<0.001$ for both).

Patients' Perspectives of their Presenting Symptoms

A major goal of this study was to establish whether the absence of ischaemic symptom documentation was due to the true absence of symptoms, or a failure of their healthcare team to recognise and record those symptoms. In an analysis of those patients who had an independent, prospectively acquired interview of their presenting symptoms, the majority of patients without documented ischaemic symptoms actually reported symptoms compatible with ischaemia (Table 5). Among the 37% of undocumented patients who reported chest discomfort, there were no differences in the severity of their presenting pain as compared with those who had documented ischaemic symptoms ($p=0.19$). In addition, roughly half of the patients without documented ischaemic symptoms had either chest discomfort or referred discomfort to the arm, shoulder, neck or jaw. An additional 19% of patients had symptoms including shortness of breath, nausea, or diaphoresis that could have been consistent with ischemia. Thus, a total of three-quarters of the patients without documented

ischaemic symptoms reported symptoms compatible with ischaemia as responsible for their presentation to the hospital.

DISCUSSION

Our analyses of the documentation of ischaemic symptoms in acute MI reveal several important insights. Despite using a broad range of symptoms to capture manifestations of myocardial ischaemia, ischaemic symptoms were not documented in 10% of patients with confirmed acute MI. Such patients typically were older and had more coexisting noncardiac comorbidity. Patients whose symptoms were not documented received lower quality of care throughout their hospitalisation. Moreover, after risk adjustment, patients without documentation of their ischaemic symptoms were more than three times as likely to die during their hospitalisation. An important finding of this study is that almost three-quarters of MI patients without documented ischaemic symptoms reported symptoms during the study interview that were consistent with myocardial ischaemia. In light of these observations, the data suggest that in most cases where ischaemic symptoms were not documented, improved recognition has the potential to be associated with better treatment and outcomes.

Establishing that most patients experienced symptoms consistent with myocardial ischaemia, despite the absence of documentation of these symptoms, is an important extension of previous knowledge. Canto and colleagues [2] examined data from the National Registry of Myocardial Infarction and described lower quality of care and higher subsequent in-hospital mortality in patients presenting without chest pain. Similarly, other investigators [3, 4] have noted higher in-hospital mortality and undertreatment both at admission and at discharge in those who presented without chest pain. These prior studies, however, have relied exclusively upon chart documentation of patients' presenting symptoms. By interviewing a majority of patients, our study demonstrates that in most cases in which ischaemic symptoms were not documented, patients actually experienced ischaemic symptoms that the clinician failed to elicit and/or record in the chart.

Importantly, our study also suggests that the initial failure to recognize myocardial ischaemia influences care well beyond the initial encounter. Despite clear biochemical evidence confirming that patients sustained a recent MI (along with other supporting evidence such as EKG changes), many patients failed to receive important evidence-based therapies at discharge. While early treatment differences arising from underrecognition of ischaemia may be understandable, the failure to initiate aggressive secondary prevention strategies after positive troponin blood tests have established myocardial necrosis warrants further investigation. Numerous publications [12–14] and guidelines [15, 16] have established that elevated troponins herald increased short- and long-term risk, regardless of the presenting symptom complex experienced by the patient. As such, most clinicians would agree that elevated troponins warrant aggressive treatment at discharge. Since undocumented ischaemic symptoms in the medical record was strongly associated with lesser quality of care, as well as higher in-hospital mortality, our study identifies a potentially modifiable target to improve MI care, namely the improved acquisition and documentation of patients' history. Given the annual incidence of myocardial infarction (~865,000 in the United States), a 10% prevalence of unrecognised ischaemic symptoms within this group could represent roughly 86,500 patients.[17] The absolute number of patients likely to have unrecognised ischemic symptoms (and an opportunity to improve their recognition and treatment) is therefore substantial.

Furthermore, with the emergence of public reporting of MI performance measures in the United States (e.g., www.hospitalcompare.hhs.gov),[18–21] failure to recognize presenting

symptoms as ischaemic may underlie some of the observed variability in performance among providers. Thus, physicians and hospitals may need to develop additional strategies to insure better identification of patients' presenting symptoms through education and/or structural changes in the delivery of MI care. Programs such as "Guidelines Applied to Practice" from the American College of Cardiology[22] and "Get with the Guidelines" from the American Heart Association[23, 24] are potential strategies for addressing this current gap in care. Such interventions have the potential to improve both patients' prognosis and providers' publicly reported performance.

Our study has several potential limitations. First, we did not interview 35% of the study patients. While interviewing a subset of the patients may have introduced a bias, great care was taken to ensure that interviewed subjects were randomly sampled when the capacity to interview the caseload of subjects was exceeded. Although previous analyses have suggested small differences between interviewed patients and the total MI population,[8] it is not possible to know how this may have influenced our findings. A second potential limitation is that patients were interviewed 2 days after their admission and their description of symptoms may have changed from that originally presenting to the admitting team. While interviews were designed to avoid leading questions, we can not exclude this possible explanation for our findings. A third concern is that among those without documented ischaemic symptoms, we had limited power to compare differences in the care and outcomes between those who truly did not experience ischaemic symptoms and those who did experience ischaemic symptoms that went undocumented. Yet, given that these patients had unequivocal evidence of infarction including positive troponins, the poorer quality of care at discharge is concerning. A fourth concern is that our study was observational, and our analysis may not have adjusted for potential confounders (e.g., socioeconomic status, education level); nonetheless, risk adjustment was extensive, and we believe that quality of care would be unlikely to vary according to these unmeasured factors. Finally, we did not examine the longer term outcomes related to lesser quality of care at the time of discharge. Further study of unrecognized patients' subsequent care, health status and survival is also needed.

In summary, we found that MI patients whose clinical presentation is not documented as being consistent with myocardial ischaemia tend to receive lower quality care, from admission through discharge, and that these patients are at increased risk for in-hospital mortality. In light of these findings, and the large numbers of patients who might benefit from improved recognition and care, we believe that identifying opportunities to improve the recognition and treatment of myocardial infarction should be a research priority for quality improvement.

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Appendix 1: Participating CORC sites and Investigators

Members of the Cardiovascular Outcomes Research Consortium participating in this study included: *Mid America Heart Institute, Kansas City, MO* – John Spertus MD MPH, Carole Decker RN PHD, Phillip Jones MS, Kimberly Reid MS; *Baptist Health System, Little Rock, AR* –Gary Collins MD; *Barnes Jewish Hospital/Washington University, Saint Louis, MO* – Richard Bach MD; *Beth Israel-Deaconess Medical Center/Harvard University, Boston, MA* – David Cohen MD MSc; *Denver General Health System, Denver, CO* – Frederick Masoudi MD MSPH; *Denver VA Medical Center, Denver, CO* – John Rumsfeld MD PhD; *Duke University, Durham, NC* – Eric Peterson MD MPH; *Emory University, Atlanta, GA* – Susmita Mallik MD, Viola Vaccarino MD PhD, William S. Weintraub MD; *Henry Ford Medical Center, Detroit, MI* – Sanjaya Khanal MD, Jane Jie Cao MD MPH; *Kaiser Permanente, Denver, CO* – David Magid MD MPH; *MeritCare, Fargo ND* Wallace Radke MD, Mohamed Rahman MD; *Sentara Health System (both Sentara and Sentara Lee Hospitals), Norfolk, VA* – John E. Brush Jr. MD; *Stanford University/Palo Alto VA Medical Center* – Paul Heidenreich MD; *Swedish Medical Center, Seattle, WA* – Timothy Dewhurst MD; *Truman Medical Center and the University of Missouri – Kansas City, Kansas City, MO* – Annette Quick MD; *University of Alabama, Birmingham AL* – John Canto MD; *University of Colorado Health System, Denver, CO* – John Messenger MD and *Yale University, New Haven, CT* – Harlan Krumholz MD SM;

Table 1

Characteristics of 2,094 patients with acute myocardial infarction presenting with and without documented ischaemic symptoms.

Variable	Documented ischaemic Symptoms		
	No (N=217)	Yes (N=1,877)	P value
PATIENT CHARACTERISTICS			
Demographic Data			
Mean age (s.d.) yrs	63 (14)	62 (14)	0.060
Female gender, No. (%)	95 (44)	658 (35)	0.011
Race, No. (%)			
White	77 (36)	1,144 (62)	<0.001
Black	132 (61)	604 (33)	
Hispanic	3 (1)	65 (4)	
Other	4 (2)	44 (2)	
Medical History, No. (%)			
Myocardial infarction	47 (22)	513 (27)	0.074
Heart failure	72 (33)	276 (15)	<0.001
Diabetes	102 (47)	600 (32)	<0.001
Renal insufficiency	75 (35)	235 (13)	<0.001
Angina	19 (9)	384 (21)	<0.001
Coronary stenosis >50%	24 (11)	307 (16)	0.043
Prior Percutaneous Coronary Intervention	33 (15)	349 (19)	0.221
Coronary bypass	30 (14)	258 (14)	0.974
Prior Stroke	32 (15)	148 (8)	<0.001
Gastro-oesophageal reflux disease	23 (11)	283 (15)	0.077
Hypercholesterolemia	87 (40)	909 (48)	0.020
Hypertension	174 (80)	1,265 (67)	<0.001
Chronic lung disease	40 (18)	247 (13)	0.032
Alcohol abuse	54 (25)	252 (13)	<0.001
Cancer	30 (14)	181 (10)	0.053
Presentation			
ST Elevation Myocardial Infarction (%)	27 (12)	662 (35)	<0.001
Initial systolic Blood Pressure (mm Hg), mean (s.d.)	140 (46)	139 (39)	0.659
Initial diastolic Blood Pressure (mm Hg), mean (s.d.)	78 (23)	79 (19)	0.500
Initial Heart rate, mean (s.d.)	93 (29)	81 (26)	<0.001
Maximum troponin (ng/dL), median (interquartile range)	11 (0.3–7.1)	54 (1.3–28)	<0.001
Initial creatinine (mg/dL), mean (s.d.)	2.9 (3.7)	1.5 (1.8)	<0.001
Killip Class IV	11 (6)	10 (0.6)	<0.001

Table 2

Factors associated with not having ischaemic symptoms documented in myocardial infarction patients in a multivariable model.

Variable	O.R.	95% C.I.	p value
Age (per 10 year increase)	1.21	1.07–1.38	0.003
Prior stroke	1.75	1.04–2.94	0.046
Chronic renal insufficiency	1.86	1.27–2.73	0.005
Diabetes	1.68	1.20–2.35	0.007
Lack of prior coronary artery disease*	1.95	1.35 –2.80	0.002
Heart failure	1.45	1.00–2.12	0.065
Non ST-elevation MI	2.71	1.70 – 4.34	<0.001
Non Caucasian race	0.95	0.61–1.50	0.836
Female gender	1.16	0.82–1.64	0.394
Alcohol abuse	1.31	0.87–1.97	0.207
Chronic Lung Disease	0.90	0.87–1.97	0.623

*Defined as lack of prior MI, angina, or coronary revascularization.

Table 3

Core performance measures for eligible myocardial infarction patients according to documentation of ischaemic symptoms.

Core Performance Measures	Documented ischaemic Symptoms		P value
	No	Yes	
	N treated of eligible (%)	N treated of eligible (%)	
Admission Medications and Treatment (%)			
Aspirin in 24 hours	180 of 202 (89%)	1,745 of 1810 (96%)	<0.001
Beta-blockers in 24 hours	127 of 165 (77%)	1,449 of 1,658 (90%)	<0.001
Acute reperfusion in eligible ST Elevation MI patients	4 of 58 (7%)	447 of 773 (58%)	<0.001
In-Hospital Death (%)	32 of 217 (14%)	50 of 1,877 (3%)	<0.001
Discharge Medications and Treatment (%)			
Aspirin at discharge	144 of 165 (87%)	1,618 of 1,742 (93%)	0.009
Beta-blocker	128 of 158 (81%)	1,529 of 1,678 (91%)	<0.001
ACE inhibitor for left ventricular systolic dysfunction	30 of 45 (67%)	314 of 392 (80%)	0.037
Statin drug			
LDL>70 mg/dL (>1.81 mmol/L)	53 of 71 (75%)	1,279 of 1,511 (85%)	<0.001
LDL>100 mg/dL (>2.59 mmol/L)	27 of 38 (71%)	933 of 960 (97%)	<0.001
Smoking Cessation Counseling (in smokers, n=2191)	22 of 48 (46%)	420 of 632 (66%)	0.004

Table 4

Predictors of in-hospital mortality following acute myocardial infarction after adjusting for clinical characteristics and patient clustering.

Variable	O.R.	95% C.I.	p value
Lack of documented ischaemic symptoms	3.21	1.76 – 5.84	<0.001
Age (per 10 year increase)	1.47	1.20 – 1.81	<0.001
Non Caucasian race	1.07	0.59 – 1.96	0.810
Female gender	1.14	0.67– 1.95	0.637
Cancer	1.96	1.01 – 3.81	0.044
Chronic heart failure	1.11	0.60 – 2.06	0.731
Diabetes	1.01	0.58 – 1.73	0.981
Chronic renal insufficiency	1.17	0.55 – 2.51	0.673
Initial heart rate (beats/min, per 10 unit increase)	1.11	1.02 – 1.21	0.015
Initial systolic blood pressure (mm Hg, per 10 unit decrease)	1.18	1.08 – 1.28	<0.001
Confirmed ST elevation MI	3.27	0.28 – 38.1	0.335
Initial creatinine (per 1 mg/dL increase)	1.16	1.05 –1.29	0.003
Killip class 4	2.29	0.77 – 6.78	0.127
No Aspirin (within 24 hrs of admit)	1.22	0.54 – 2.79	0.624
No Beta-blocker (within 24 hrs of admit)	3.27	1.91 – 5.59	<0.001
No Primary reperfusion therapy	1.99	0.78 – 5.08	0.143

Table 5

Symptoms of a subset of 1,356 interviewed patients according to documentation of ischaemic symptoms.

Symptoms reported at interview	Patients reporting symptoms N (%)		p value
	No documented Ischaemic Symptoms (N=122)	Documented Ischaemic Symptoms (N=1,234)	
Chest pain	45 (37%)	898 (73%)	<0.001
Chest pain or referred pain *	60 (49%)	1,064 (86%)	<0.001
Chest pain, referred pain * or dyspnoea	83 (68%)	1,131 (92%)	<0.001
Chest pain, referred pain, * dyspnoea, nausea or Diaphoresis	87 (71%)	1,147 (93%)	<0.001
Chest pain, referred pain, * dyspnoea, nausea, diaphoresis, weakness or lightheadedness or syncope	92 (75%)	1,161 (94%)	<0.001

* Referred pain: discomfort in the neck, shoulder, jaw, arm, back, or epigastrium.