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Characteristics, Treatment Practices, and In-Hospital Outcomes of Older Patients Hospitalized With Acute Myocardial Infarction

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Abstract

Background/Objectives—The objectives of our study were to examine overall, and decade-long trends (1999–2009), patient characteristics, treatment practices, and hospital outcomes among patients ≥65 years hospitalized for acute myocardial infarction (AMI) and describe how these factors varied in the youngest, middle, and oldest-old patients.

Design—Retrospective cohort study.

Setting—Population-based Worcester Heart Attack Study.

Measurements—We conducted analyses examining the socio-demographic and clinical characteristics, cardiac treatments, and hospital outcomes of older patients in 3 age strata (65–74, 75–84, and ≥85 years).

Participants—The study sample consisted of 3,851 patients aged ≥65 years hospitalized with AMI during 6 biennial years between 1999 and 2009; 32% were aged 65–74 years, 43% were aged 75–84 years, and 25% were ≥85 years.

Results—Advancing age was inversely associated with receipt of evidence-based cardiac therapies. After multivariable adjustment, the odds of dying during hospitalization was 1.46 times higher in patients aged 75–84 years, and 1.78 times higher in those aged ≥85 years, compared with those aged 65–74 years. The oldest-old patients had an approximate 25% decreased odds of a prolonged hospital stay (>3 days) compared with those aged 65–74 years. Decade-long trends in our principal study outcomes were also examined. Although the oldest-old patients hospitalized for

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There are no conflicts of interest to report on behalf of the study authors.

AMI were at the greatest risk for dying among older patients, we observed persistent age-related differences in hospital treatment practices. Similar results were observed after excluding patients with a DNR order in their medical records.

Conclusion—While there are persistent disparities in care and outcomes of older patients hospitalized with AMI, additional studies are needed to delineate the extent to which less aggressive care reflects patient preferences and appropriate implementation of palliative care approaches.

Keywords

acute myocardial infarction; elderly; changing trends

INTRODUCTION

Despite ongoing declines in hospitalizations due to acute myocardial infarction (AMI) in the U.S.,¹ and improvements in survival after AMI,^{2,3} some patient groups have benefited more than others.⁴ Prior studies have suggested that the elderly are at greatest risk for developing, and dying after, an AMI, but they are less likely to be treated with evidence-based cardiac medications or coronary revascularization procedures during hospitalization than younger patients.^{1,5} Limited data exist, however, as to whether trends in the receipt of effective cardiac treatment practices and hospital outcomes have changed in older individuals during recent years.

Data from the 2007 National Hospital Discharge Survey have shown that most hospitalizations for AMI, and the majority of in-hospital deaths associated with AMI, occur among patients 65 years and older.⁶ Studying older individuals is of inherent interest since clinical trials of AMI have traditionally included relatively few elderly patients.⁷ Moreover, few studies have characterized secular trends of in-hospital outcomes and treatment practices among older patients hospitalized with AMI from the more generalizable perspective of a community-wide study.^{1,5}

The objectives of our large observational study were to examine patient characteristics, treatment practices, in-hospital outcomes, and 30-day posthospital admission death rates among patients 65 years and older hospitalized for AMI between 1999 and 2009 and describe how these outcomes varied among older patients in 3 age strata (65-74, 75-84, and 85 years). Data from the population-based Worcester Heart Attack Study were utilized for this investigation.⁸⁻¹¹

METHODS

Described elsewhere in detail,⁸⁻¹¹ the Worcester Heart Attack Study is an ongoing population-based investigation examining long-term trends in the descriptive epidemiology of AMI in residents of the Worcester metropolitan area hospitalized at all 11 medical centers in Central Massachusetts on an approximate biennial basis between 1975 and 2009.⁸⁻¹¹ Computerized printouts of patients discharged from all greater Worcester hospitals with possible AMI [International Classification of Disease (ICD) 9 codes: 410-414, 786.5]

were identified. Cases of possible AMI were independently validated using predefined criteria for AMI.⁸⁻¹¹ These criteria included a suggestive clinical history, elevations in serum enzymes and biomarkers (e.g., creatine kinase (CK), CK-MB, and troponin values), and serial electrocardiographic findings during hospitalization consistent with the presence of AMI. Patients who satisfied at least 2 of these 3 criteria, and were residents of the Worcester metropolitan area since this study is population-based, were included.

The present population consisted of adult men and women aged 65 years and older who were hospitalized for AMI in 1999, 2001, 2003, 2005, 2007, and 2009 at any of 11 medical centers in the Worcester metropolitan area (2000 census= 478,000). We restricted our study sample to this period to provide relatively contemporary, and decade-long, insights into the impact of age in this older patient population. This study was approved by the Institutional Review Board at the University of Massachusetts Medical School.

Data Collection

Trained nurses and physicians abstracted information on patient's demographic characteristics, medical history, clinical data, and treatment practices through the review of hospital medical records of patients with confirmed AMI. These factors included patient's socio-demographic characteristics (e.g., age, sex, race), history of previously diagnosed comorbidities (e.g., stroke, diabetes), receipt of do-not-resuscitate (DNR) orders, and AMI order (initial vs. prior) and type [ST-Elevation Myocardial Infarction (STEMI) vs. non-ST-Elevation Myocardial Infarction (NSTEMI)].^{12,13}

In addition, data on new medications, in addition to existing treatment practices at the time of hospitalization for AMI, included the prescribing of 5 effective cardiac medications [angiotensin converting inhibitors (ACE-I)/angiotensin receptor blockers (ARBs), anticoagulants, lipid lowering agents, beta blockers, and aspirin] during hospitalization, and receipt of 3 coronary diagnostic and interventional procedures [cardiac catheterization, percutaneous coronary intervention (PCI), and coronary artery bypass grafting (CABG)] were obtained. The primary short-term outcomes of interest were in-hospital and 30-day post hospital admission case-fatality rates (CFRs) and hospital length of stay (LOS). Overall differences, and age-related trends, in the development of important in-hospital complications, including atrial fibrillation,¹⁴ cardiogenic shock,¹⁵ heart failure,¹⁶ and stroke¹⁷ were also examined.

Data Analysis

As previously mentioned, we categorized older patients into 3 age strata: 65-74 years, 75-84 years, and 85 years and older based on established classifications of older persons into youngest-old, middle-old, and oldest-old. Differences in various patient demographic and clinical characteristics, hospital receipt of cardiac medications and interventional procedures, in-hospital and 30-day post hospital admission CFRs, hospital LOS, and in-hospital clinical complications between the 3 age groups were examined using the ANOVA test for continuous variables and the chi-square test for categorical variables. For cardiac treatment practices, we also repeated the same analyses among patients without a DNR order in their hospital medical records. Decade-long trend analyses in patient's characteristics,

cardiac treatment practices, inhospital and 30-day post hospital admission CFRs, hospital LOS, and in-hospital complications were also conducted within each age group using the ANOVA and/or chi-square test as appropriate.

Multivariable logistic regression analyses were performed to examine the association between the 3 age strata and our principal study outcomes of in-hospital and 30-day post hospital admission CFRs (dead vs. alive) and hospital LOS (> 3 vs. ≤ 3 days), while adjusting for several potentially confounding variables of prognostic importance. These variables included sex, race (white vs. non-white), marital status (single, married, divorced, widowed), year of hospitalization, AMI order and type, comorbid conditions that had been previously diagnosed in this patient population, including atrial fibrillation, diabetes, heart failure, hypertension, peripheral vascular disease, stroke, chronic obstructive pulmonary disease (COPD), chronic kidney disease (CKD) and depression, and in-hospital clinical complications. We also examined changing trends in hospital and 30-day post hospital admission mortality and hospital LOS within each age group using logistic regression modeling with year of hospitalization included as a continuous variable. We did not adjust for the receipt of various cardiac medications and coronary interventional procedures (CABG and PCI) during the patient's index hospitalization in our regression analyses given the nonrandomized nature of the present study and potential for confounding by treatment indication. To examine the potential effects of the receipt of a DNR order, we repeated these analyses but excluded patients who had a DNR order in their hospital medical records.

We also performed multivariable logistic regression analyses using individual in-hospital clinical complications (atrial fibrillation, cardiogenic shock, heart failure, and stroke) as outcomes, and examined the association between each of these clinical complications and the 3 age categories, while adjusting for several potentially confounding prognostic variables as previously described, among all patients and separately among patients without a DNR order. We also examined potentially changing trends in the development of in-hospital complications within each age strata while controlling for various potentially confounding factors. Multivariable adjusted odds ratios (OR) and 95% confidence intervals (CI) for the risk of inhospital and 30-day post hospital admission mortality, having a prolonged hospital stay, or developing select clinical complications during hospitalization according to age were calculated in a standard manner.

RESULTS

Study population characteristics

The study sample consisted of 3,851 residents of the Worcester metropolitan area aged 65 years and older who were hospitalized with independently validated AMI at all greater Worcester medical centers in 6 study years between 1999 and 2009. The proportion of elderly patients represented 66% of the overall study population, ranging from 55% of the total study population that were hospitalized with AMI in 2009 to 71% in 2001. The average age of this population was 79 years, 51% were men, most were white (95%), and one half were married (50%). More than one-fourth (28%) of patients presented with a STEMI, one-third (33%) had a do-not-resuscitate (DNR) order in their hospital charts, and 13% died

during their acute hospitalization. The average number of comorbid conditions in this population was 2.6.

Among all older patients hospitalized with AMI during the years under study, 31.8% were aged 65-74 years, 43.1% were aged 75-84 years, and 25.1% were 85 years and older. Among these patients, the oldest-old patients were significantly more likely to have been female, unmarried, have a DNR order placed in their charts, and present with a NSTEMI (Table 1). The oldest-old patients were also more likely to have presented with a lower estimated glomerular filtration rate (eGFR) and diastolic blood pressure findings at the time of hospital admission than younger older patients. The youngest-old patients, on the other hand, had a lower average number of comorbid conditions than those who were older.

Changes in patient demographic and clinical characteristics over time

Patient characteristics were compared between the average of the first two periods (1999/2001) and the average of the last two periods (2007/2009) within each age strata (Supplement 1). The average age of hospitalized patients decreased in patients 65-74 years, and in those 85 years and older, but increased in patients 75-84 years. The proportion of patients who were aged 65-74 years, and 75-84 years old, increased from 32% and 43% in 1999/2001 to 36% and 47%, respectively, in 2007/2009; the proportion of patients who were in our oldest age category decreased from approximately 25% to 18% during these periods. The percentage of patients who presented with a STEMI decreased in all age groups between these 2 periods (Supplement 1).

In terms of changing trends in various chronic conditions, the percentage of patients with chronic cardiovascular conditions consistently increased in all age groups over time (Supplement 1).

Receipt of cardiac medications and coronary procedures

Between 1999 and 2009, on average, patients received 3.8 of the 5 cardiac medications [angiotensin converting inhibitors (ACE-I)/angiotensin receptor blockers (ARBs), anticoagulants, lipid lowering agents, beta blockers, and aspirin] examined during their acute hospitalization. During this period, irrespective of age, the hospital use of each of these cardiac medications increased (Figure 1a). The youngest-old patients were more likely to have been prescribed any of the 5 cardiac medications examined than the oldest-old patients (mean=4.0 vs. 3.5 medications, $p<0.001$); similar results were observed when we limited these analyses to patients without a DNR order (mean=4.1 vs. 3.7 medications, $p<0.001$) (Table 2). Three quarters of patients aged 65-74 years received 4 or more of the 5 cardiac medications, while approximately half of the oldest-old patients did (Table 2). Factors positively associated with more aggressive treatment (i.e., received 4 or more of the 5 cardiac medications examined) included a history of prior AMI or hypertension, hospitalization during a more recent time period, and not having a DNR order in their charts, regardless of age group.

Similarly, the youngest and middle-old patients were more likely to have undergone coronary diagnostic and interventional procedures during hospitalization than the oldest-old patients (Table 2). We further performed a secondary analysis with regards to the use

of invasive coronary procedures in which we excluded patients with a DNR order in their hospital charts; the results of this analysis were consistent with prior study findings in that the oldest-old patients were least likely to have undergone these procedures (Table 2). Between 1999 and 2009, the use of cardiac catheterization and PCI increased in all age groups studied; on the other hand, the use of CABG surgery during hospitalization did not vary much during the period under study (Figure 1b).

In-hospital and 30-day post hospital admission case-fatality rates, length of hospital stay, and clinical complications

The overall in-hospital CFRs during the years under study increased with advancing age: 9.2% in patients aged 65-74 years, 13.8% for those aged 75-84 years, and 17.3% for those 85 years and older. The overall 30-day post hospital admission CFRs during the years under study increased with advancing age: 11.7% in patients aged 65-74 years, 17.7% for those aged 75-84 years, and 26.6% for those 85 years and older. The average hospital LOS during the entire study period was 6.3 days for patients aged 65-74 years, 6.3 days for those aged 75-84, and 5.4 days for those 85 years and older.

In terms of changing trends, a continuing significant decline ($p=0.037$) in hospital death rates was only observed in patients 65-74 years old during the years under study (Figure 2). A similar significant decline ($p=0.015$) in 30-day post hospital admission CFRs was also only observed in patients 65-74 years old during the years under study (Figure 2). A consistent and significant decline ($p<0.001$) of in-hospital LOS was found in patients of all ages over time (Figure 2). We carried out additional analyses of these findings with multivariable adjustment, and our findings of changing trends remained the same.

During hospitalization, important clinical complications, such as atrial fibrillation and heart failure, were most commonly diagnosed in the oldest-old patients while cardiogenic shock was most commonly detected in the youngest-old patients; the frequency of stroke was consistently low in all age groups studied (Table 3). During the years under study, the rates of these cardiac complications were generally stable in all age groups ($p>0.05$), with the exception of atrial fibrillation ($p=0.003$) and heart failure ($p=0.003$), which initially increased and subsequently decreased, in patients aged 75-84 years.

In multivariable logistic regression models adjusting for several variables of prognostic importance, the odds of dying during hospitalization was 1.46 times higher in patients aged 75-84 years, and 1.78 times higher in those aged 85 years and older, compared with those aged 65-74 years; the odds of dying 30 days post hospital admission was 1.52 times higher in patients aged 75-84 years, and was 2.34 times higher in those aged 85 years and older, compared with those aged 65-74 years (Table 4). Patients aged 85 years and older had an approximate 25% decreased odds of a prolonged hospital stay (>3 days) compared with those aged 65-74 years after multivariable adjustment (Table 4). We further performed a secondary analysis in which we excluded patients with a DNR order in their charts, similar results were found among the oldest-old patients in comparison with those aged 65-74 years; the odds of dying during hospitalization was 1.77 times higher in those aged 85 years and older, the odds of dying 30 days after hospital admission was 2.36 times higher in those aged 85 years and older, and patients aged 85 years and older had an approximate 30%

decreased odds of a prolonged hospital stay (>3 days) after multivariable adjustment (Table 4).

We also conducted multivariable-adjusted logistic regression analyses using all 4 hospital clinical complications as outcome variables individually and found that advancing age was significantly associated with an increased odds of developing atrial fibrillation and heart failure during hospitalization. Similar results were observed when we limited our analyses to patients who did not have a DNR order in their medical records (Table 4).

With regards to changing trends in these clinical complications, we found that there were no significant changes in each of the clinical complications examined over time within each individual age group. For example, the odds of developing acute heart failure did not change in a statistically meaningful manner for those aged 65-74 years (OR = 0.89; 95% CI = 0.76, 1.05); 75-84 years (OR = 0.98; 95% CI = 0.86, 1.12), and in those 85 years old (OR = 0.94; 95% CI = 0.78, 1.14).

DISCUSSION

This study provides a relatively contemporary community-based perspective into the socio-demographic and clinical profile, treatment practices, and short-term outcomes among older residents from Central Massachusetts hospitalized with AMI at all greater Worcester medical centers between 1999 and 2009. We observed an adverse association of advancing age with in-hospital and 30-day post hospital admission mortality, hospital LOS, and development of several important clinical complications. On the other hand, the oldest-old patients were significantly less likely to have been prescribed any of the effective cardiac medications examined, or have undergone coronary diagnostic and interventional procedures during their acute hospitalization, than younger old patients. In terms of changing trends, we observed a significant decline in prolonged hospital LOS during the period under study in all 3 age strata. No statistically significant decline was found in hospital and 30-day post hospital admission CFRs, with the exception of those aged 65-74 years old, and in the development of important clinical complications during hospitalization during the period under study in each age strata.

Age-associated differences in patient demographic and clinical characteristics

The cardiac risk factor profile we observed in the oldest-old patients differed in many aspects as compared with younger old patients. Consistent with prior findings,^{5,18} our study showed that the oldest-old patients hospitalized with AMI were more likely to be women, less likely to be married, and had many comorbid conditions more frequently diagnosed than younger old patients. Since the prevalence of several clinically significant comorbidities has increased over time, especially in the oldest-old patients, a lower prevalence of certain comorbid conditions in the oldest-old patients, such as diabetes or peripheral vascular disease, may reflect a healthy survivor effect with earlier mortality among those with the disease, leaving fewer patients with the disease surviving to older age.

Consistent with prior findings from community-based investigations that have shown declines in the incidence rates of STEMI among patients hospitalized with AMI,^{19,20} our

study observed a significant decline in the proportion of patients hospitalized with STEMI during the period under study. It seems likely that the apparent decline in the proportion of patients who were diagnosed with STEMI may be related, at least in part, to the use of increasingly sensitive biomarkers over the period under study. Future studies examining this possible association are warranted, especially since the treatment practices for patients hospitalized with STEMI and NSTEMI may differ as might their long-term outcomes, especially in the elderly.

Hospital treatment practices

The American College of Cardiology/American Heart Association guidelines for the use of cardiac medications in patients hospitalized with AMI have recommended the utilization of β -blockers and aspirin (1990), ACE inhibitors (1996), and lipid lowering medications in the 2002 and 2004 guidelines for the management of patients with NSTEMI and STEMI, respectively.²¹⁻²⁴ Although these guidelines do not differentiate treatment on the basis of age and sex, they do recommend that consideration be given to general health, cognitive status, and life expectancy in older patients. Although a number of studies in different population settings have demonstrated marked increases over time in the use of evidence-based therapies in patients hospitalized with AMI, observed inequalities in management practices still exist in certain groups, including the elderly and women.²⁵

During the period under study, we observed an increased utilization of all newly prescribed and existing cardiac medications, cardiac catheterization, and PCI. However, advancing age was shown to have a negative impact on receiving prescribed medications or undergoing coronary diagnostic and interventional procedures. These results remained even after we excluded patients who had a DNR order in their medical records.

Our results are consistent with prior studies that have shown that older patients hospitalized with AMI are less likely to be treated with evidence-based cardiac medications and coronary diagnostic and interventional procedures compared with their younger counterparts.^{1,5,25} A study of Medicare beneficiaries hospitalized with AMI reported that the utilization rates of aspirin, beta blockers, and coronary reperfusion therapy were lower in older elderly patients.⁵ Data from the National Hospital Discharge Survey examining AMI related hospitalizations in the U.S. between 1979 and 2005 showed that younger patients were more likely to have undergone coronary interventional procedures than were older patients, and those aged 85 years and older were the least likely to have received these interventions.¹

Despite increases in hospital survival rates after AMI that have been observed in a number of clinical/epidemiologic studies over the past several decades, the less than optimal treatment of some older patients may have contributed to their greater risk of dying in the short term. Although physicians need to consider the greater use of these treatment modalities in properly selected older patients to improve their short-term prognosis, they also should take into account the general health, cognitive status, treatment contraindications, and preferences of older individuals. In addition, it is possible that many of the oldest-old patients in our study were already receiving appropriate palliative approaches to their symptoms, which might not necessarily adhere to current practice guidelines.

Short-Term Hospital Outcomes

In our study, patients of advancing age were more likely to have additional comorbidities present at the time of hospitalization for AMI which may have increased their risk of developing clinically significant hospital complications and dying, prolonged their hospital stay, and limited their more effective medical management given the complexity of their disease profile.

Data from the National Hospital Discharge Survey of adults (≥ 25 years old) hospitalized with AMI between 1979 and 2005 showed that the median LOS increased with age: 4 days for patients < 45 years, 5 days for patients aged 55-64 years, and 6 days for patients aged ≥ 65 years. The median hospital stay declined by 67%, and the age-adjusted in-hospital CFRs decreased from 24.2% to 9.4%, between the periods 1979-1981 and 2003-2005.¹

In the present study, the oldest-old patients were more likely to have died during their hospitalization, even after multivariable adjustment. Similar results were observed even after we excluded patients who had a DNR order in their hospital medical records. Our results are consistent with the findings from previous studies which have shown that older patients hospitalized with AMI have a worse short-term prognosis than younger patients.^{1,5,18,26} We found that there was a significant decline in prolonged hospital LOS during the period under study in all 3 age groups. No significant change was, however, found in hospital death rates during the period under study in our 2 oldest age strata after controlling for several variables of prognostic importance whereas an important decline in hospital death rates was observed in those aged 65-74 years.

In our prior analysis of data from the Worcester Heart Attack Study of more than 10,000 patients of all ages hospitalized with AMI between 1986 and 2005,¹⁸ older men and women were more likely to have developed atrial fibrillation and heart failure during their acute hospitalization. The results of the present study showed that advancing age was associated with a higher odds of developing atrial fibrillation and heart failure in older patients hospitalized with AMI. However, no significant declines over time were observed in the frequency of development of each of the in-hospital complications examined in each individual age group.

Although our current analysis showed that increasing age was paradoxically associated with an apparent decrease in the incidence rates of cardiogenic shock, despite an increasing frequency of heart failure, we do not have any clear and specific reasons for these somewhat paradoxical findings. A possible reason is due to patient survivor bias in that the oldest-old patients who may have developed cardiogenic shock never made it to the hospital. Enhanced awareness of the clinical complications that occur in older patients during the peri and post infarction period may help in providing more optimal treatment and monitoring of these high-risk patients.

Study Strengths and Limitations

The strengths of the present study include its community-based design, its large sample of patients hospitalized with AMI, and its relatively contemporary decade-long trends in examining clinically relevant outcomes and hospital treatment practices among older

patients of different age strata. Several limitations need to be acknowledged, however, in the interpretation of the present findings. First, since our study population included only patients who had been hospitalized in the Worcester metropolitan area, one needs to be careful to extrapolate our findings to those who died before hospitalization or to those who reside in other geographic settings. Second, since our study participants were predominantly white, the generalizability of our findings to other race/ethnic groups may be limited. Lastly, there is the potential for unmeasured confounding in our observed associations since we did not have information available on several patient-associated characteristics, such as income, education, psychological factors, cognitive function, prevalent depression, as well as treatment preferences, which may have affected several of the endpoints examined.

Conclusions

In this study of nearly 4,000 patients 65 years and older hospitalized with AMI, we observed persistent age-related differences in hospital treatment practices and short-term hospital outcomes. We found that patients of advanced age were at greatest risk for dying and developing clinical complications during their hospitalization. Given the aging U.S. population, the number of older patients who experience an AMI will increase substantially over the coming decades. Our findings highlight the need to improve the evidence base for caring for older patients hospitalized with AMI to improve the quality of care and prognosis for this vulnerable patient population.^{27,28}

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Trends in the receipt of (a) cardiac medications and (b) coronary diagnostic and interventional procedures among older patients hospitalized for acute myocardial infarction according to age.

Figure 2.

Trends of (a) in-hospital case-fatality rates; (b) 30-day post hospital admission case-fatality rates; and (c) mean length of stay among older patients hospitalized for acute myocardial infarction according to age

Table 1

Characteristics of the Study Population According to Age

Characteristics	Age (years)			P
	65-74 (n=1223)	75-84 (n=1661)	85 (n=967)	
Age (mean, years)	69.8	79.7	88.8	<0.001
Female (%)	41.2	50.6	64.8	<0.001
White (%)	90.8	97.2	97.9	<0.001
Married (%)	59.4	54.2	28.9	<0.001
Do-not-resuscitate orders (%)	13.7	30.5	60.7	<0.001
ST-segment myocardial infarction (%)	34.3	27.5	22.9	<0.001
Initial myocardial infarction (%)	61.3	60.0	58.8	0.50
Initial heart rate (Mean, beats/min)	87.0	88.0	89.4	0.06
Serum glucose (Mean, mg/dl)	176.6	178.9	172.3	0.13
Estimated GFR (Mean, ml/min/1.73m ²)	57.8	51.0	45.3	<0.001
Systolic blood pressure (Mean, mmHg)	143.0	141.6	139.6	0.06
Diastolic blood pressure (Mean, mmHg)	77.7	74.5	71.0	<0.001
Medical History (%)				
Atrial fibrillation	12.3	19.7	26.6	<0.001
Heart failure	24.5	30.8	41.3	<0.001
Hypertension	77.1	78.6	79.3	0.43
PVD*	21.4	21.6	17.7	0.037
Stroke	12.3	16.8	14.9	0.004
Diabetes	42.9	39.2	26.4	<0.001
COPD*	22.5	21.9	19.0	0.11
CKD*	19.6	21.3	25.6	0.003
Depression	14.0	16.0	18.0	0.023
Number of conditions (mean)	2.5	2.7	2.7	0.001

* PVD: peripheral vascular disease, COPD: chronic obstructive pulmonary disease, CKD: chronic kidney disease

Table 2

Receipt of Cardiac Medications and Interventional Procedures, During Hospitalization for Acute Myocardial Infarction According to Age

	All patients			Patients without a DNR order*				
	Age (years)			Age (years)				
	65-74 (n=1,223)	75-84 (n=1,661)	85 (n=967)	P	65-74 (n=1,056)	75-84 (n=1,154)	85 (n=380)	P
Medication (%)								
ACE-I/ARBs	68.0	65.4	59.5	<0.001	69.8	69.5	64.5	0.13
Anticoagulants	77.6	74.4	66.7	<0.001	79.7	76.4	71.1	0.002
Aspirin	93.9	90.7	87.9	<0.001	95.9	93.1	89.7	<0.001
Beta Blockers	89.5	87.3	84.3	0.002	91.5	90.5	88.2	0.16
Lipid lowering	74.7	64.5	48.1	<0.001	77.7	69.7	60.0	<0.001
4 Medications	75.3	66.3	52.5	<0.001	78.6	71.2	62.6	<0.001
Mean	4.0	3.8	3.5	<0.001	4.1	4.0	3.7	<0.001
Procedures (%)								
Cardiac catheterization	67.3	48.6	21.8	<0.001	72.6	58.7	34.2	<0.001
CABG surgery	9.9	6.0	0.7	<0.001	10.9	7.7	1.8	<0.001
Percutaneous coronary intervention	43.1	30.2	14.4	<0.001	46.9	37.0	22.1	<0.001

* Excluded patients who had a DNR order in their hospital medical records

Table 3

Hospital and 30 day Post Hospital Admission Case-Fatality Rates (CFRs), Length of Stay, and Clinical Complications According to Age

	Age (years)			P
	65-74 (n=1223)	75-84 (n=1661)	85 (n=967)	
Hospital CFRs (%)	9.2	13.8	17.3	<0.001
30 Day CFRs (%)	11.7	17.7	26.6	<0.001
Length of Stay				
Mean	6.3	6.3	5.4	0.001
>3 days (%)	65.1	69.2	63.8	0.009
Clinical Complications				
Atrial fibrillation	20.4	27.3	31.5	<0.001
Cardiogenic shock	7.0	6.3	4.8	0.08
Heart failure	38.1	46.1	56.4	<0.001
Stroke	2.4	2.0	2.3	0.76

Table 4

Multivariable Adjusted Association between Age and Hospital Case-Fatality Rates(CFR), 30 day Post Hospital Admission CFRs, Length of Stay (LOS), and Clinical Complications

Outcomes		Model 1	Model 2	Model 3
	Age (years)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Hospital CFR	65-74	1.00	1.00	1.00
	75-84	1.57 (1.24, 1.99)	1.46 (1.13, 1.89)	1.05 (0.66, 1.66)
	85	2.05 (1.59, 2.65)	1.78 (1.33, 2.37)	1.77 (1.01, 3.12)
30 Day Post	65-74	1.00	1.00	1.00
Hospital Admission CFR	75-84	1.62 (1.31, 2.01)	1.52 (1.21, 1.92)	1.12 (0.77, 1.64)
	85	2.74 (2.18, 3.43)	2.34 (1.81, 3.03)	2.36 (1.51, 3.70)
LOS (>3 days)	65-74	1.00	1.00	1.00
	75-84	1.21 (1.03, 1.41)	1.11 (0.93, 1.31)	1.20 (0.98, 1.46)
	85	0.95 (0.79, 1.13)	0.73 (0.60, 0.90)	0.69 (0.53, 0.92)
Atrial fibrillation *	65-74	1.00	1.00	1.00
	75-84	1.47 (1.23, 1.75)	1.37 (1.14, 1.65)	1.37 (1.11, 1.71)
	85	1.80 (1.48, 2.19)	1.77 (1.42, 2.20)	1.91 (1.42, 2.56)
Cardiogenic shock *	65-74	1.00	1.00	1.00
	75-84	0.89 (0.66, 1.20)	0.94 (0.68, 1.29)	0.71 (0.46, 1.09)
	85	0.66 (0.46, 0.96)	0.70 (0.46, 1.07)	0.81 (0.42, 1.57)
Heart failure *	65-74	1.00	1.00	1.00
	75-84	1.39 (1.20, 1.62)	1.28 (1.08, 1.50)	1.15 (0.96, 1.40)
	85	2.10 (1.77, 2.49)	1.84 (1.51, 2.24)	1.47 (1.13, 1.93)
Stroke *	65-74	1.00	1.00	1.00
	75-84	0.84 (0.50, 1.38)	0.69 (0.40, 1.18)	0.72 (0.34, 1.56)
	85	0.96 (0.55, 1.68)	0.79 (0.43, 1.46)	0.75 (0.26, 2.19)

Model 1: unadjusted Model 2: adjusted for socio-demographic characteristics, medical history, year of hospital admission (1999/2001, 2003/2005, 2007/2009), AMI order and type, and clinical complications during hospitalization Model 3: same as Model 2, but excluded patients who had a DNR order in their hospital medical records

* Models did not adjust for clinical complications during hospitalization