

# Early $\beta$ -Blocker Therapy for Acute Myocardial Infarction in Elderly Patients

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**Background:** Despite the evidence supporting the importance of early  $\beta$ -blocker therapy, this intervention has received little attention as an indicator of quality of care.

**Objectives:** To determine how often  $\beta$ -blockers are administered as early treatment of acute myocardial infarction in patients 65 years of age or older, to identify predictors of the decision to use  $\beta$ -blockers, and to evaluate the association between the early use of  $\beta$ -blockers and in-hospital mortality.

**Design:** Observational study.

**Setting:** Nongovernment, acute care hospitals in the United States.

**Patients:** Medicare beneficiaries who were 65 years of age or older, were hospitalized with an acute myocardial infarction in 1994 and 1995, and did not have a contraindication to  $\beta$ -blocker therapy.

**Measurements:** Medical chart review to obtain information about the use of  $\beta$ -blockers, contraindications to these drugs, patient demographics, and clinical factors.

**Results:** Of the 58 165 patients (from a total of 4414 hospitals), 28 256 (49%) received early  $\beta$ -blocker therapy. Patients with the highest risk for in-hospital death were the least likely to receive therapy. Patients who received  $\beta$ -blockers had a lower in-hospital mortality rate than patients who did not receive  $\beta$ -blockers (odds ratio, 0.81 [95% CI, 0.75 to 0.87]), even after adjustment for baseline differences in demographic, clinical, and treatment characteristics between the two groups.

**Conclusions:** Early  $\beta$ -blocker therapy was not used for 51% of elderly patients who were hospitalized with an acute myocardial infarction and did not have a contraindication to this therapy. Increasing the early use of  $\beta$ -blockers for these patients would provide an excellent opportunity to improve their care and outcomes.

Therapy with  $\beta$ -blockers is an effective and inexpensive early treatment for acute myocardial infarction. Several trials, including the Metoprolol in Acute Myocardial Infarction (MIAMI) Trial and the First International Study of Infarct Survival (ISIS-1) have reported that  $\beta$ -blocker therapy reduces short-term mortality rates in patients with suspected acute myocardial infarction (1–5). On the basis of these studies, the Guidelines for the Management of Patients with Acute Myocardial Infarction, published by the American College of Cardiology and the American Heart Association, strongly endorse the early use of  $\beta$ -blocker therapy for patients without a contraindication (6).

Despite the evidence supporting the importance of early  $\beta$ -blocker therapy, this intervention has received little attention as an indicator of quality of care. The few studies that have assessed the current use of early  $\beta$ -blocker therapy suggest that it is underused, especially in elderly patients (7). Most studies have focused on the use of  $\beta$ -blocker therapy at discharge (8–10), an issue that is distinct from early  $\beta$ -blocker therapy. Moreover, published quality measures for patients with an acute myocardial infarction have focused on the use of  $\beta$ -blocker therapy at discharge (11, 12).

We sought to determine the current pattern of early  $\beta$ -blocker therapy and to assess the effectiveness of this therapy in a large, population-based sample of older patients. Our specific objectives were 1) to determine the current rates of early  $\beta$ -blocker therapy for acute myocardial infarction among elderly patients who did not have contraindications to this therapy, 2) to identify the characteristics of patients who did not receive early  $\beta$ -blocker therapy, and 3) to evaluate the effectiveness of the early use of  $\beta$ -blockers on in-hospital mortality rates by using multivariable methods to adjust for baseline differences between the patients who did and those who did not receive the therapy. We conducted this study as part of the Cooperative Cardiovascular Project (CCP), a Health Care Financing Administration initiative to improve the quality of care for Medicare beneficiaries with acute myocardial infarction (12). The CCP involved medical record abstraction of more than 200 000 Medicare hospitalizations for acute myocardial infarction across the United States from 1994 to 1995.

*Ann Intern Med.* 1999;131:648-654.

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## Methods

### Sample Selection

The sample included claims from hospital bills (UB-92 claims data) in the Medicare National Claims History File with an International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) principal diagnosis code of 410 (acute myocardial infarction). Codes that were not related to the acute care of an acute myocardial infarction (codes with a fifth digit of 2) were excluded. This file includes all patients treated under fee-for-service plans but does not include all patients treated as part of Medicare managed care risk contracts.

Except for the CCP pilot study states (Alabama, Connecticut, Iowa, and Wisconsin) and Minnesota, the 8-month sample period was different for each state and lasted from February 1994 through July 1995. The pilot states had a 4-month sample period from August through November 1995. Sampling in Minnesota was delayed so that it did not interfere with an ongoing study, the Minnesota Clinical Comparison and Assessment Project (MCCAP). For most non-MCCAP hospitals, the 8-month sample period was April through November 1995. For the MCCAP hospitals and two other hospitals with active quality improvement projects, a random sample of 330 cases was selected.

### Study Sample

The sample was restricted to patients who were 65 years of age or older, had a confirmed acute myocardial infarction, and survived the first hospital day. We excluded first-day deaths to avoid biasing the study in favor of  $\beta$ -blocker therapy. We assumed that some patients who died on the first day may not have had the opportunity to receive  $\beta$ -blockers.

A confirmed acute myocardial infarction was defined as a discharge diagnosis of an acute myocardial infarction and 1) a creatine kinase-MB level of 5% or greater or a lactate dehydrogenase level elevated more than 1.5 times normal and a lactate dehydrogenase-1 level greater than or equal to the lactate dehydrogenase-2 level or 2) a twofold elevation of the creatine kinase level and evidence of myocardial infarction on the official electrocardiogram report. For patients who were hospitalized more than once in the sample period, only the first admission was included. Because of an inability to determine the admission treatments, we excluded patients whose admissions resulted in a transfer from another acute care institution. We also excluded patients who had the following contraindications to  $\beta$ -blocker therapy: bradycardia (heart rate  $\leq$  50 beats/min), low blood pressure (systolic blood pressure  $\leq$  100 mm Hg), high-grade atrioventricular block,

and chart documentation of any of the following: asthma, chronic obstructive pulmonary disease, history of heart failure, shock on admission, heart failure on admission, or intolerance toward  $\beta$ -blockers. All contraindications except asthma were determined by chart review; the presence of asthma was based on a secondary diagnostic code (ICD-9-CM code 493.xx).

### Data Collection

To obtain information from the medical records, the Health Care Financing Administration established two clinical data abstraction centers, which were private organizations with experience in medical abstraction. Trained technicians at the centers abstracted predefined variables from complete copies of the hospital records and entered them directly into a computer database using interactive software. Data reliability was monitored by random reabstractions and calculation of reliability statistics. Problems were identified by determining reasons for the discrepancies and were addressed by improvements in training. The abstraction assessment did not include an assessment of sensitivity and specificity.

### Outcome Variables

The principal outcome for the first phase of the study was the use of  $\beta$ -blockers on the first or second hospital day. We included the first 2 days as the treatment window because some patients may have been admitted late in the day and the  $\beta$ -blocker may not have been administered until the next calendar day. After all medications were reviewed, intravenous and oral  $\beta$ -blockers were identified. Topical  $\beta$ -blockers were excluded.

The principal end point for the second phase of the study was in-hospital mortality. This information was ascertained from the medical records and was cross-checked with Medicare's Enrollment Database (derived from the Master Beneficiary Record of the Social Security Administration). Dates of death in the Medicare Enrollment Database are obtained both from the discharge dates of billing records that indicated a discharge disposition of death and from the Master Beneficiary Record. The Medicare Enrollment Database has accurate records of the vital status of Medicare beneficiaries (13).

### Independent Variables

The independent variables in this study included age; sex; ethnicity; medical history; preadmission, hospital, and discharge medications; clinical status; hospital complications; hospital procedures; discharge disposition; and length of stay. Age was categorized into three strata: 65 to 74 years, 75 to 84 years, and 85 years or older. Comorbid conditions were a chart-documented history of hypertension, diabetes mellitus, renal dysfunction (defined as a

blood urea nitrogen level  $\geq 14.28$  mmol/L or a creatinine level  $\geq 221$   $\mu\text{mol/L}$  [2.5 mg/dL]), myocardial infarction, anemia (hematocrit  $\leq 30\%$ ), and dementia. Procedure variables were a history of cardiac catheterization, percutaneous coronary revascularization, and coronary artery bypass surgery. Preadmission medications were aspirin,  $\beta$ -blockers, calcium-channel blockers, digoxin, angiotensin-converting enzyme inhibitors, loop diuretics, and warfarin. Presentation characteristics were chest pain and vital signs. Hospital treatment variables on the first day of admission were aspirin, heparin, calcium-channel blockers, and thrombolytic therapy.

On the basis of the admission characteristics, the case mix of the patients was summarized by an expected mortality rate, calculated by using information available on admission and based on a modification of the Medicare Mortality Predictor System (14). This system is a disease-specific model used to predict short-term mortality rates in Medicare patients. Variables for acute myocardial infarction in this system included the Acute Physiology and Chronic Health Evaluation (APACHE) II score (15), age, ability to ambulate, do-not-resuscitate order on admission, blood urea nitrogen level, mean arterial pressure, subendocardial infarction, congestive heart failure on chest radiograph, heart rate, and metastatic cancer. Our version of the Medicare Mortality Predictor System did not include values for serum potassium level in the APACHE II score (which were not abstracted for CCP). Applied to the entire study sample, the model had an area under the receiver-operating characteristic (ROC) curve of 0.78, indicating good discriminant ability. Average predicted values for survivors (0.15) and nonsurvivors (0.35) were similar to those previously reported for Medicare patients with acute myocardial infarction (14).

For the geographic analysis, we classified the patients into subgroups based on the major U.S. Census regions: New England, Mid-Atlantic, South Atlantic, East North Central, East South Central, West North Central, West South Central, Mountain, and Pacific (16).

### Statistical Analysis

For the first phase of the analysis, we sought to determine the frequency with which elderly patients with acute myocardial infarction who were ideal candidates for  $\beta$ -blocker therapy received this therapy on admission or the next day.

We evaluated the bivariate associations of demographic, clinical, physician, and geographic characteristics with the early administration of  $\beta$ -blockers. Then, on the basis of the bivariate analysis and clinical relevance, we developed a multivariable logistic regression model with the administration of

$\beta$ -blockers as the dependent variable. Variables were dropped from the model if the *P* value was 0.05 or more. We calculated an area under the ROC curve for each fitted model to evaluate the discriminating power of the model (17) and used the Hosmer–Lemeshow statistic to assess the calibration of the model (18).

For the second phase of the analysis, we used a logistic regression model to estimate the association between the early use of  $\beta$ -blockers and in-hospital survival in an unadjusted model; after adjustment for demographic factors only (age, sex, ethnicity), after the addition of clinical factors (using the Medicare Mortality Predictor System predicted value as a covariate), after the addition of co-interventions (aspirin, thrombolytic therapy), and after the addition of geographic location. We repeated the analyses after stratifying the patients by age, sex, and previous  $\beta$ -blocker use.

All analyses were repeated after we considered the use of  $\beta$ -blockers only on the first hospital day (first phase) and after we included first-day deaths (second phase). Because these changes in the sample did not alter our conclusions, we present only results of the analyses based on the use of  $\beta$ -blockers within the first 2 days of hospitalization among patients who survived the first hospital day.

The analyses were conducted by using the Stata 5.0 statistical program (Stata Corp., College Station, Texas). To consider patients who were clustered in hospitals, all analyses were performed by using sample survey methods to adjust for clustering by hospital and stratification by state.

## Results

### Patient Characteristics

A total of 166 348 patients in the CCP sample were 65 years of age or older and had a confirmed acute myocardial infarction. After exclusion of patients with repeated hospitalizations (10 358 patients [6.2%]), patients with terminal illness (3422 patients [2.1%]), patients who died during the first day of hospitalization (2555 patients [1.5%]), and patients who were transferred from other acute care facilities (14 175 patients [8.5%]), 140 653 patients remained in the cohort. An ideal cohort of 58 165 patients from 4414 hospitals remained after further exclusion of patients with the following relative contraindications to  $\beta$ -blockers: bradycardia (3963 patients [2.8%]), low blood pressure (9394 patients [6.7%]), high-grade atrioventricular block (6094 patients [4.3%]), shock on admission (2963 patients [2.1%]), history of asthma or chronic obstructive pulmonary disease (28 587 patients [20.3%]), pulmonary edema (16 331 patients [11.6%]), history of heart failure (33 393 patients [23.7%]), heart failure

**Table 1. Bivariate Analysis of Characteristics Associated with Patients Receiving  $\beta$ -Blockers and Those Not Receiving  $\beta$ -Blockers (Adjusted for Clustering)**

Characteristic	Patients	Patients Receiving $\beta$ -Blockers (n = 28 256)	Patients Not Receiving $\beta$ -Blockers (n = 29 909)	P Value
	n	%	%	
Age				
65–74 y	30 306	56.0	48.4	
75–84 y	21 480	35.6	38.3	<0.001
$\geq$ 85 y	6379	8.5	13.3	<0.001
Women	26 602	44.8	46.6	<0.001
White persons	52 675	91.7	89.5	<0.001
Cardiac risk factors				
History of hypertension	34 730	63.1	56.5	<0.001
Diabetes mellitus	14 933	25.1	26.2	0.003
Current smoker	7270	12.3	12.7	0.181
Cardiac history				
Myocardial infarction	13 174	22.8	22.5	>0.2
Percutaneous transluminal coronary angioplasty	4222	7.5	17.0	0.045
Coronary artery bypass grafting	6973	12.2	11.8	0.075
Medical history				
Stroke	6330	9.8	11.9	<0.001
Dementia	2412	2.8	5.4	<0.001
Peptic ulcer disease	7481	12.7	13.0	<0.001
Preadmission medications				
Aspirin	17 645	32.0	28.7	<0.001
Nitrates	16 666	29.3	28.1	0.002
$\beta$ -blockers	10 592	29.4	7.7	<0.001
Calcium-channel blockers	18 631	31.5	32.5	0.014
Angiotensin-converting enzyme inhibitors	8173	13.2	14.9	<0.001
Loop diuretics	12 962	21.6	22.9	<0.001
Warfarin	2708	4.1	5.2	<0.001
Chest pain				
Present	52 799	94.0	87.7	<0.001
Duration > 6 hours	14 162	25.8	23.0	<0.001
Vital signs				
Pulse > 100 beats/min	8176	13.9	14.2	>0.2
Respiratory rate > 25 breaths/min	4058	6.0	7.9	<0.001
Systolic blood pressure < 125 mm Hg*	10 936	16.2	21.3	<0.001
Admission laboratory results				
Blood urea nitrogen level > 14.28 mmol/L or creatinine level > 221 $\mu$ mol/L (>2.5 mg/dL)	2330	2.9	5.1	<0.001
Hematocrit < 30%	1412	1.9	3.0	<0.001
Cardiopulmonary resuscitation within 48 hours	1184	1.5	2.6	<0.001
ST-segment elevation $\geq$ 2 mm	18 684	33.6	30.7	<0.001
Admission treatment				
Reperfusion therapy	16 281	32.0	24.2	<0.001
Aspirin	33 431	64.4	50.9	<0.001
Heparin	4389	81.0	70.2	<0.001
Outcome				
In-hospital death	3860	5.1	8.1	<0.001
Mean length of stay $\pm$ SD, d†	39 891	7.5 $\pm$ 4.3	7.7 $\pm$ 4.2	<0.001
Region				
New England	3120	7.4	3.5	<0.001
Mid-Atlantic	9618	18.7	14.5	
South Atlantic	12 519	21.2	21.8	
West South Central	5663	7.8	11.6	
East North Central	10 048	17.6	16.9	
East South Central	3854	5.4	7.8	
West North Central	4255	6.7	7.9	
Mountain	2887	4.7	5.2	
Pacific	6201	10.5	10.8	

\* Highest systolic blood pressure within 24 hours.

† Excludes in-hospital mortality rate, percentage of patients who transferred out, and 99th percentiles.

on admission (51 897 patients [36.9%]), or chart-documented intolerance toward  $\beta$ -blockers (1276 patients [0.9%]).

The mean age of the ideal cohort was 75.1 years; 45.7% of patients were women, and 90.6% were white. The prevalence of a history of an acute myocardial infarction was 22.7%. The in-hospital mortality rate in the sample, a group that survived at least the first hospital day, was 6.6%. The average

length of stay among those who were discharged alive and were not transferred to another hospital was 7.6 days.

Of the 58 165 ideal patients, 48.6% received  $\beta$ -blockers on the day of admission or the next day. Of the 47 573 ideal patients (81.8%) who were not receiving  $\beta$ -blocker therapy before admission, 19 957 (42.0%) received it on the day of admission or the next day.

## Predictors of the Use of $\beta$ -Blockers

Demographic and clinical characteristics and geographic information are presented in **Tables 1** and **2** according to whether the patient received  $\beta$ -blockers. Compared with patients who received  $\beta$ -blockers, patients who did not receive  $\beta$ -blockers were older, more likely to be women, and less likely to be white. The use of  $\beta$ -blockers was also associated with use of co-interventions. Patients who received  $\beta$ -blockers were more likely to also receive aspirin and reperfusion therapy, which are known to reduce mortality rates.

The **Figure** shows the use of  $\beta$ -blockers on admission across the United States. Use significantly varied by state and region. The states with the highest early use of  $\beta$ -blocker therapy were Connecticut (71.9%), Vermont (68.7%), Massachusetts (68.2%), and Rhode Island (65.1%). The lowest use was seen in Puerto Rico (24.2%), Mississippi (27.2%), Oklahoma (31.7%), and Kansas (33.4%). All other census regions had significantly lower rates than New England.

In the multivariable model, we first evaluated the demographic variables. Age, sex, and ethnicity were statistically significant correlates of the use of  $\beta$ -blockers, but the model did not have good discriminant value; the area under the ROC curve was 0.68 and the Hosmer–Lemeshow *P* value was 0.15. Adding clinical variables and co-interventions increased the area under the ROC curve to 0.80, with a Hosmer–Lemeshow *P* value of 0.10. The census regions provided a final model that had an area under the ROC curve of 0.80 and a Hosmer–Lemeshow *P* value of 0.06.

## In-Hospital Mortality

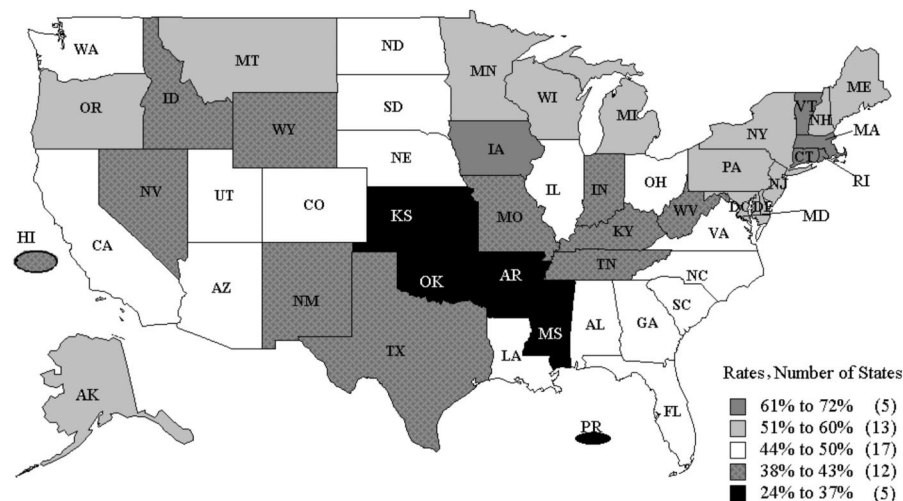
Patients who received early  $\beta$ -blocker therapy had significantly lower in-hospital mortality rates than

those who did not receive this therapy (5.1% compared with 8.1%;  $P \leq 0.001$ ). The association between  $\beta$ -blockers and better in-hospital mortality rates was attenuated with adjustment for potential confounders but persisted in the fully adjusted model (odds ratio, 0.81 [95% CI, 0.75 to 0.87]) (**Table 3**).

In stratified analyses, the adjusted odds ratio of death associated with the use of  $\beta$ -blockers was 0.84 (CI, 0.73 to 0.96) for patients 65 to 74 years of age, 0.79 (CI, 0.71 to 0.89) for patients 75 to 84 years of age, and 0.87 (CI, 0.73 to 1.03) for patients 85 years of age or older. The adjusted odds ratio of death associated with the use of  $\beta$ -blockers was 0.78 (CI, 0.69 to 0.87) for men and 0.82 (CI, 0.74 to 0.91) for women. The adjusted odds ratio of death associated with the use of  $\beta$ -blockers was 0.69 (CI, 0.57 to 0.83) for patients who previously received  $\beta$ -blockers and 0.82 (CI, 0.76 to 0.90) for patients who did not. The benefit of  $\beta$ -blockers is similar among patients who did and those who did not receive reperfusion therapy. The adjusted odds ratio of death associated with the use of  $\beta$ -blockers was 0.86 (CI, 0.73 to 0.99) for patients who received reperfusion therapy and 0.87 (CI, 0.80 to 0.94) for those who did not.

## Discussion

Our principal finding is that a substantial proportion of elderly patients who were hospitalized with an acute myocardial infarction and were ideal candidates for early  $\beta$ -blocker therapy did not receive this therapy. Several factors unrelated to absolute or relative contraindications to  $\beta$ -blockers appeared to be associated with the decision not to treat patients, including geographic region and advanced age. Nevertheless, a substantial proportion of the variation in the decision to use  $\beta$ -blockers remained unex-



**Figure.** Use of  $\beta$ -blocker therapy in the United States, by state or territory.

**Table 2. Predictors of Early  $\beta$ -Blocker Use (Adjusted for Clustering)\***

Characteristic	Odds Ratio (95% CI)	P Value
<b>Demographic</b>		
Age > 65 y	0.98 (0.98–0.99)	<0.001
White ethnicity	1.14 (1.06–1.23)	<0.001
<b>Medical and cardiac history</b>		
History of hypertension	1.24 (1.18–1.30)	<0.001
Diabetes mellitus	0.91 (0.87–0.95)	<0.001
Current smoker	0.90 (0.85–0.95)	0.001
Dementia	0.84 (0.75–0.93)	0.002
Inability to ambulate	0.86 (0.81–0.92)	<0.001
History of bleeding	1.09 (1.01–1.18)	0.025
Previous myocardial infarction	0.86 (0.82–0.91)	<0.001
Previous percutaneous transluminal coronary angioplasty	0.88 (0.80–0.96)	0.003
Previous coronary artery bypass grafting	0.89 (0.83–0.96)	<0.001
<b>Source of admission</b>		
Skilled nursing facility	0.75 (0.65–0.87)	<0.001
<b>Preadmission medications</b>		
Angiotensin-converting enzyme inhibitors	0.84 (0.80–0.89)	<0.001
Calcium-channel blockers	0.87 (0.83–0.91)	<0.001
Loop diuretics	0.88 (0.84–0.93)	<0.001
Nitrates	0.91 (0.87–0.96)	<0.001
Warfarin	0.81 (0.73–0.90)	<0.001
<b>Clinical presentation</b>		
Chest pain < 48 h before admission	1.71 (1.58–1.84)	<0.001
Chest pain > 6 h after admission	1.14 (1.09–1.19)	<0.001
Do-not-resuscitate order on arrival	0.89 (0.81–0.98)	0.021
<b>Vital signs and laboratory findings</b>		
Pulse > 100 beats/min	1.37 (1.29–1.45)	<0.001
Respiratory rate > 25 breaths/min	0.87 (0.80–0.94)	<0.001
Systolic blood pressure > 150 mm Hg	1.27 (1.22–1.32)	<0.001
Blood urea nitrogen level > 14.28 mmol/L or creatinine level > 221 $\mu$ mol/L (> 2.5 mg/dL)	0.73 (0.65–0.81)	<0.001
Hematocrit < 30%	0.86 (0.75–0.99)	0.034
<b>Electrocardiographic findings</b>		
Left bundle-branch block	0.79 (0.70–0.88)	<0.001
Right bundle-branch block	0.88 (0.82–0.95)	<0.001
New Q waves	1.14 (1.08–1.20)	<0.001
ST-segment elevation > 2 mm	1.08 (1.03–1.13)	<0.001
Atrial fibrillation	0.69 (0.63–0.75)	<0.001
Ventricular tachycardia	0.70 (0.51–0.97)	0.032
<b>Hospital treatments and course</b>		
Aspirin	1.61 (1.55–1.68)	<0.001
Reperfusion	1.30 (1.24–1.37)	<0.001
Left ventricular ejection fraction measured	1.27 (1.21–1.33)	<0.001
Peak creatine kinase level > 4 times normal	1.15 (1.10–1.20)	<0.001
<b>Census region (baseline is New England)</b>		
Mountain	0.43 (0.35–0.53)	<0.001
South Atlantic	0.47 (0.40–0.55)	<0.001
Pacific	0.48 (0.40–0.57)	<0.001
East North Central	0.52 (0.43–0.61)	<0.001
West South Central	0.34 (0.28–0.40)	<0.001
West North Central	0.42 (0.35–0.51)	<0.001
East South Central	0.35 (0.29–0.43)	<0.001
Mid-Atlantic	0.63 (0.53–0.74)	<0.001

\* Area under receiver-operating characteristic curve = 0.67; goodness of fit = 0.51 (Hosmer–Lemeshow statistic).

plained. The ideal candidates who did not receive  $\beta$ -blockers had significantly higher mortality rates. After we accounted for imbalances in patient characteristics between the treatment groups, the early use of  $\beta$ -blockers was associated with a 19% odds reduction in rates of in-hospital death. Given that  $\beta$ -blockers are inexpensive, this intervention is also economically attractive, as suggested in previous studies (19).

It is important to note that the absolute risk reduction associated with  $\beta$ -blockers is related to a patient's baseline risk for death. The clinical trials have generally shown small benefits associated with  $\beta$ -blockers in low-risk patients (1).  $\beta$ -Blockers would have a smaller absolute benefit for patients with the lowest baseline risk. In contrast, patients with the highest risk would be expected to receive the most substantial benefit (20).

Few studies have focused on the current early use of  $\beta$ -blockers for the treatment of acute myocardial infarction. Most observational studies focus on the use of  $\beta$ -blocker therapy as secondary prevention after discharge (8–10). For example, we have reported that  $\beta$ -blocker therapy is underused as a treatment for secondary prevention and, in that setting, is associated with better outcomes in the year after discharge (9). In the current study, we specifically examined the early use of  $\beta$ -blocker therapy and its association with an early survival benefit. Because we focused on in-hospital mortality rates, this analysis does not overlap with our study of long-term  $\beta$ -blocker therapy. The benefit of early  $\beta$ -blocker use may be even more important than their use at discharge because patients who do not get these medications early may not survive until discharge. A recent study suggested that the early use of  $\beta$ -blockers importantly contributes to the better risk-adjusted outcomes seen at top hospitals (21). Our findings of the underuse of early  $\beta$ -blocker therapy are consistent with the results of McLaughlin and colleagues, who reported on the practice patterns for patients admitted to 37 Minnesota hospitals from 1992 to 1993 with an acute myocardial infarction (7). Among the 447 patients who were ideal candidates for  $\beta$ -blockers, 53% received this treatment. The treatment rate in our larger sample, which was studied about 2 years later, is remarkably similar at 49%.

Our study focused on ideal candidates for  $\beta$ -blockers. As a result, only 41% of the eligible cohort were included in the ideal group. We do not, however, suggest that other patients should not receive  $\beta$ -blocker therapy. Many patients with acute myocardial infarction and relative contraindications

**Table 3. Association of  $\beta$ -Blockers with In-Hospital Death (Adjusted for Clustering)**

Models	Odds Ratio for Death (95% CI)
Unadjusted	0.61 (0.57–0.66)
Adjusted for age, sex, and ethnicity	0.69 (0.64–0.74)
Adjusted for demographic and clinical variables	0.76 (0.70–0.82)
Adjusted for demographic and clinical variables and co-interventions	0.80 (0.74–0.86)
Adjusted for demographic and clinical variables, co-interventions, and census region	0.81 (0.75–0.87)

may be candidates for early  $\beta$ -blocker therapy because the relative reduction in acute risk may outweigh the increased risk during short-term therapy. Because the group of older patients with relative contraindications is large, future studies need to illuminate the best clinical strategies for these patients with respect to  $\beta$ -blockers.

Our study has several limitations. First, it depended on retrospective medical record review. We cannot exclude the possibility that some patients classified as ideal had undocumented reasons not to receive  $\beta$ -blockers. In addition, despite efforts to maintain the highest data abstraction standards, some bias could have been caused by misclassification in the abstraction process; we could not assess this possibility because we lack information about the sensitivity and specificity of the abstraction. Moreover, despite our attempts to control for confounding, we cannot exclude unmeasured factors that contribute to the better outcomes of patients who received  $\beta$ -blockers compared with those who did not. The similarity of our estimates of the effects of  $\beta$ -blocker treatment on short-term survival with the randomized trials does provide some assurance. Finally, we did not address  $\beta$ -blocker dosing. In the group that received  $\beta$ -blocker therapy, dosing effects may be important. Inadequate dosing of some patients, however, would have biased the study toward the null and away from the benefit that we found.

In conclusion, despite evidence from randomized trials demonstrating that early  $\beta$ -blockers treatment of acute myocardial infarction decreases short-term mortality rates, many elderly patients do not receive this inexpensive intervention. This national study provides strong evidence to support augmented efforts to increase the use of early  $\beta$ -blocker therapy for appropriate older patients with an acute myocardial infarction.

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**Grant Support:** Dr. Krumholz is a Paul Beeson Faculty Scholar. The analyses on which this report is based were performed under contract 500-96-P549, titled “Utilization and Quality Control Peer Review Organization for the State of Connecticut,” sponsored by the Health Care Financing Administration, Department of Health and Human Services. The content of this publication does not necessarily reflect the views or policies of the Department of Health and Human Services, and the mention of trade names, commercial products, or organizations does not imply endorsement by the U.S. Government. The authors assume full responsibility for the accuracy and completeness of the ideas presented. This article is a direct result of the Health Care Quality Improvement Program initiated by the Health Care Financing Administration, which has encouraged identification of quality improvement projects derived from analysis of patterns of care and therefore required no special funding on the part of this Contractor. Ideas and contributions to the authors concerning experience in engaging with issues presented are welcomed.

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