

Physician Characteristics and the Initiation of β -Adrenergic Blocking Agent Therapy After Acute Myocardial Infarction in a Managed Care Population

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Objective: To determine the association between physician characteristics and the use of β -adrenergic blocking agents after acute myocardial infarction in a national managed care organization.

Study Design: Retrospective administrative data analysis.

Participants and Methods: The study cohort consisted of 473 physicians who prescribed the medications and 578 patients who (1) experienced an acute myocardial infarction between January 1, 1995, and December 31, 1996, with at least 1 cardiac medication claim within 7 days of hospital discharge; (2) were not previously taking β -adrenergic blocking agents; and (3) had none of several defined contraindications to the medication. Using multivariate models, we assessed the relation between physician characteristics and initiation of β -adrenergic blocking agent therapy, controlling for patient characteristics and cardiac treatments.

Results: Sixty-two percent of patients filled a prescription for β -adrenergic blocking agents within 7 days of hospital discharge. Physician characteristics, including specialty and region of hospitalization, were independently associated with the use of β -adrenergic blocking agents. Family practice physicians and other noninternists were much less likely than cardiologists to prescribe β -adrenergic blocking agents. The other most important predictors of the use of β -adrenergic blocking agents were region of hospitalization and patient age.

Conclusions: Physician characteristics are associated with the use of β -adrenergic blocking agents. Although there are opportunities to improve practice for all physicians, family practice physicians and noninternists have the most opportunity to improve.

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use reduces morbidity and mortality.³⁻⁵ Patient factors explain little of the national variation in the use of β -adrenergic blocking agents, and little information is available regarding the importance of other factors such as physician characteristics. Identification of physician factors could facilitate the appropriate targeting of educational efforts and help explain some of the underlying causes for underutilization.

We sought to determine the association of physician characteristics with the initiation of β -adrenergic blocking agent therapy in patients after an AMI who were not previously taking β -adrenergic blocking agents and did not have a defined contraindication to the therapy. To address this issue, we used the database of a large, national managed care organization (MCO) that provided the opportunity to link clinical data from inpatient, outpatient, and pharmacy claims with physician credentialing information.

... METHODS ...

Managed Care Organization

This study was carried out in Prudential Health Care, which consisted of 40 affiliated health plans with point-of-service and health maintenance orga-

Underutilization of recommended therapies for patients hospitalized with acute myocardial infarction (AMI) has drawn national attention. In particular, some studies have documented substantial variation in the use of β -adrenergic blocking agents^{1,2} despite persuasive evidence that their

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nization insurance options located in urban and suburban areas in 26 states. The enrollees included commercial and Medicare populations. The contracted physicians represented solo practices, independent practice associations, and multispecialty provider groups.

Study Cohort

Identification of Patients. We identified patients aged 35 years or older admitted to the hospital for at least 4 days with a principal discharge diagnosis of AMI (*International Classification of Diseases, 9th Revision—Clinical Modification [ICD-9-CM]*,⁶ code 410) and discharged using inpatient claims from January 1, 1995, to December 31, 1996. Using claims data without medical chart review to measure clinical variables required highly specific inclusion criteria to increase confidence in the measurement.^{7,8} Coding using *ICD-9* alone has been reported to have a high sensitivity and predictive value for identification of AMI.⁹ We excluded patients who were hospitalized for a previous AMI (*ICD-9-CM* code 410.x2).¹⁰

Patients had to be continuously eligible for pharmacy benefits from 180 days before hospitalization to 7 days after the event and must have received medical care within the MCO network to enable identification of β -adrenergic blocking agent prescriptions, contraindications to β -adrenergic blocking agents, and comorbid diagnoses. Out-of-network outpatient and pharmacy claims are unable to incorporate key data elements. To confirm pharmacy benefits, patients must have had at least 1 prescription claim for a cardiac medication prescribed or filled within 7 days of hospital discharge to be included in the study cohort. We identified 1159 patients meeting the study inclusion criteria.

Patients were excluded for 3 additional reasons. First, 145 patients who filled a β -adrenergic blocking agent prescription in the previous 6 months were excluded because the previous use would not allow us to examine initiation of therapy. Second, 240 patients with incomplete data (eg, invalid physician identification numbers and out-of-network physicians) or more than 1 physician identified as prescribing cardiac medications after hospital discharge were excluded because the patient's prescribing physician could not be identified. Finally, 196 patients were excluded for having 1 or more contraindication to β -adrenergic blocking agents using administrative data identification methods from previous studies¹⁰⁻¹² and the Health Plan Employer Data and Information Set (HEDIS)¹³: 51

had insulin-requiring diabetes mellitus, 75 had asthma or chronic obstructive pulmonary disease, 73 had congestive heart failure or left ventricular dysfunction, and 39 had heart block greater than first degree or bradycardia. After these exclusions, 578 patients were defined for the purposes of our study as clinically ideal candidates for β -adrenergic blocking agent therapy and were included in the study population.

Identification of Physicians. We linked the eligible sample of patients to all physicians associated with the patient cohort. Because 1 physician could treat more than 1 patient in the study population, this linkage created a clustered sample. Using patient pharmacy claims for cardiac medications, we selected the physician who prescribed a patient's cardiac medications after hospital discharge. Unique physician identification numbers reported from pharmacy claims were merged with the provider credentialing database to obtain physician characteristics. A total of 473 physicians were linked to the 578 patients with AMI to compose the final cluster sample for analysis.

Data

We collected data from 5 administrative databases. Data from member enrollment, inpatient claims, outpatient claims, and pharmacy databases were merged by unique patient identifiers. Physician information was obtained from the provider credentialing database via unique physician identifiers.

Outcome Variable. The outcome was the filling of a prescription for β -adrenergic blocking agents within 7 days of hospital discharge. β -Adrenergic blocking agent therapy was identified from pharmacy claims by name and generic class code.

Independent Variables. We classified the independent variables into 3 categories: physician characteristics, patient characteristics, and cardiac treatments. Physician characteristics (age, sex, date of medical school graduation, board-certified specialty, and region of practice) were obtained from the physician credentialing database. We coded date of medical school graduation as 1980 or later following evidence from previous research^{14,15} to reflect postgraduate training during or after the large clinical trials demonstrating β -adrenergic blocking agent efficacy. The 5 practice regions—northeast, south Atlantic, north central, south central, and west—were defined by US Census regions.

Patient characteristics (age, sex, Deyo Comorbidity Index score, and length of hospital stay) were obtained from the eligibility and inpatient claims

databases. The Deyo Comorbidity Index¹⁶ is a risk-adjustment tool based on the Charlson Comorbidity Index¹⁷ that uses *ICD-9-CM* codes from claims data to predict short- and long-term mortality. The index score is a composite of assigned weights and represents the burden of comorbid disease.

Cardiac treatment variables were outpatient pharmacological therapies and concurrent procedures during hospitalization. Outpatient pharmacological therapies (calcium channel blockers, digoxin, and angiotensin-converting enzyme inhibitors) were identified from pharmacy claims by name and generic class codes. These therapies were classified as prehospitalization therapies if prescribed within 180 days before the index admission and as postdischarge therapies if received within 7 days after hospitalization. Coronary artery bypass graft surgery, percutaneous transluminal coronary angioplasty, and thrombolytic therapy during the index admission were identified from inpatient claims using *ICD-9-CM* procedure codes and *Current Procedural Terminology* codes.¹⁸

Data Analysis

We examined the distribution of physician and patient characteristics and the distribution of physician characteristics, patient characteristics, and cardiac treatment factors by initiation of β -adrenergic blocking agent therapy. Bivariate analyses were conducted to determine significant differences between selected characteristics and β -adrenergic blocking agent therapy. Then, to adjust for the correlation among providers who treat more than 1 patient, we applied a generalized estimating equations procedure to estimate crude and adjusted odds ratios and 95% confidence intervals.^{19,20} Three adjusted generalized estimating equations models were examined: the first included only physician characteristics, the second added patient characteristics, and the third added cardiac treatment variables. The models were evaluated using the Wald statistic and clinical considerations. We present the full adjusted model in this article, including all variables of interest (physician characteristics, patient characteristics, and cardiac treatment). The SAS System for Windows, release 6.12, was used for all statistical analyses.²¹

... RESULTS ...

Of the 473 physicians, 93.0% were men and 54.9% had graduated from medical school before 1980 (Table 1). More than half of the physicians (55.2%)

Table 1. Distribution of Physician and Patient Characteristics, Prudential Health Care

	No. (%)
Physician Characteristics (N=473)	
Sex*	
M	436 (93.0)
F	33 (7.0)
Medical school graduation date*	
1990-1996	7 (1.6)
1980-1989	168 (39.4)
1970-1979	170 (39.9)
1969 and earlier	81 (19.1)
Specialty	
Cardiology	261 (55.2)
Internal medicine	114 (24.1)
Family practice	50 (10.6)
Other	48 (10.1)
Region	
Northeast	54 (11.4)
South Atlantic	115 (24.3)
North central	60 (12.7)
South central	128 (27.1)
West	116 (24.5)
No. of patients treated	
1	411 (87.0)
2	34 (7.2)
3	13 (2.7)
4-6	11 (2.3)
≥ 7	4 (0.8)
Patient Characteristics (N=578)	
Age, y	
35-44	72 (12.5)
45-54	205 (35.4)
55-64	211 (36.5)
≥ 65	90 (15.6)
Sex	
M	454 (78.5)
F	124 (21.5)
Length of hospitalization, d	
4-6	380 (65.8)
7-9	125 (21.6)
≥ 10	73 (12.6)
Deyo Comorbidity Index score	
Level 1	440 (76.1)
Level 2	118 (20.4)
Levels 3-4	20 (3.5)
Discharge medications [†]	
β -Adrenergic blocking agent	360 (62.3)
Calcium channel blocker	117 (20.2)
Angiotensin-converting enzyme inhibitor	112 (19.4)

*Numbers in this subsection do not sum to 473 because of missing data.

[†]Some patients might not have received the medications specified and some might have received multiple treatments; therefore, numbers in this subsection do not sum to 578.

were board-certified cardiologists, and another quarter were internists. The practice locations of the physicians were geographically diverse, with larger percentages of physicians corresponding to the market penetration of the MCO in the south Atlantic, south central, and western regions. Most physicians treated only 1 patient in the study. One physician treated 8 patients.

Of the 578 patients in the study cohort, 84.4% were younger than 65 years and 78.5% were men (Table 1). Approximately two thirds of the patients stayed in the hospital for 4 to 6 days after having an AMI, with 76.1% having one or fewer significant comorbidities according to the Deyo Comorbidity Index. β -Adrenergic blocking agent therapy was initiated for 62.3% of patients within 7 days of hospital discharge.

Several physician, patient, and cardiac treatment characteristics were associated with lower β -adrenergic blocking agent prescription initiation rates in the bivariate analysis (Table 2). For example, 52.6% of physicians trained before 1980 prescribed β -adrenergic blocking agents compared with 63.2% trained since 1980 ($P < .05$), and 43.4% of family practice physicians and 40% of other physicians prescribed β -adrenergic blocking agents compared with 67.7% of cardiologists ($P < .001$). Other characteristics that were associated with lower β -adrenergic blocking agent therapy include hospitalization in the western region, patients older than 65 years, and patients with higher comorbidity scores.

The adjusted generalized estimating equations logistic model indicates that physician specialty and region of practice were independently associated with use of β -adrenergic blocking agents after controlling for other physician, patient, and cardiac treatment factors (Table 3). Other physicians (odds ratio, 0.13; 95% confidence interval, 0.04-0.45) and family practitioners (odds ratio, 0.29; 95% confidence interval, 0.12-0.66) were less likely than cardiologists to initiate β -adrenergic blocking agent therapy. Differences in prescription initiation by physicians contracted in internal medicine compared with cardiologists were not statistically significant, but the odds ratios were lower. Physicians who practiced in the northeast were more likely to prescribe β -adrenergic blocking agents than were physicians in any other region, except north central. The adjusted model also indicates that older

Table 2 Factors Associated With Initiation of β -Adrenergic Blocking Agent Therapy in 578 Clinically Eligible Patients With Acute Myocardial Infarction

	β -Adrenergic Blocking Agent Prescriptions, No. (%)	
	Yes	No
Physician Characteristics		
Medical school graduation date*		
1980 or later	127 (63.2)	74 (36.8)
Before 1980	170 (52.6)	153 (47.4)
Physician specialty†		
Cardiology	220 (67.7)	105 (32.3)
Internal medicine	97 (64.7)	53 (35.3)
Family practice	23 (43.4)	30 (56.6)
Other	20 (40.0)	30 (60.0)
Region*		
Northeast	45 (78.9)	12 (21.1)
South Atlantic	93 (65.5)	49 (34.5)
North central	40 (65.6)	21 (34.4)
South central	114 (59.1)	79 (40.9)
West	68 (54.4)	57 (45.6)
Patient Characteristics		
Age, y*		
35-44	50 (69.4)	22 (30.6)
45-54	137 (66.9)	68 (33.1)
55-64	126 (59.7)	85 (40.3)
≥65	47 (52.2)	43 (47.8)
Length of hospitalization, d		
4-6	251 (66.1)	129 (33.9)
7-9	74 (59.2)	51 (40.8)
≥10	35 (47.9)	38 (52.1)
Deyo Comorbidity Index score*		
Level 1	280 (63.6)	160 (36.4)
Level 2	73 (61.9)	45 (38.1)
Levels 3-4	7 (35.0)	13 (65.0)
Cardiac Treatments		
Preadmission medications		
Digoxin†	40 (62.5)	24 (37.5)
Calcium channel blocker*	53 (52.4)	48 (47.6)
Therapy at 7 d		
Calcium channel blocker†	42 (35.9)	75 (64.1)

* $P < .05$.

† $P < .01$.

age (55-64 years), digoxin administration before hospital admission, and calcium channel blocker prescription within 7 days of hospital discharge were significantly associated with use of β -adrenergic blocking agents.

... DISCUSSION ...

This study expands our understanding of the factors associated with use of β -adrenergic blocking agents. The results of this study suggest that physician characteristics might be responsible for some of the variation in care, with other physicians and family practitioners having the most opportunity to improve practice. To isolate these factors, we specifically examined initiation of therapy in a cohort of patients free from 1 of several defined contraindications to the therapy. By linking with a pharmacy database we identified patients who were not taking β -adrenergic blocking agents before their AMI and who filled a prescription for cardiac medications within 7 days of hospital discharge. We also identified the physicians who wrote those prescriptions and who were presumably responsible for the patient's immediate postdischarge cardiac care. Although the opportunity to improve practice was evident for all types of physicians, the specific groups with the lowest utilization might derive the most benefit from improvement efforts.

Our findings with regard to specialty are consistent with previously published information. Ayanian et al¹⁴ reported a physician survey that indicated that noncardiologists were much less likely to believe that β -adrenergic blocking agents for the treatment of patients with an AMI are associated with a mortality benefit. Others have reported that patients treated by cardiologists have better outcomes and greater use of guideline-based medications.^{22,23}

Our study results also show that few patient characteristics were associated with the initiation of β -adrenergic blocking agent therapy, although region of hospitalization was associated. In addition to some physician characteristics, region of hospitalization was a strong predictor of the use of β -adrenergic blocking agents. The observation of regional variation, reported by others,²⁴ defies easy explanation but seems to suggest that approaches to the use of β -adrenergic blocking agents are ingrained in the practice patterns in specific areas of the country. The only important patient characteristic was age, another observation that has been reported previously.^{2,10,11,25} Similar to previous studies,^{11,24,25} we

also found that the prescription of calcium channel blockers on hospital discharge was negatively associated with β -adrenergic blocking agent prescription.

This study was conducted entirely with administrative claims data. Although this approach has its limitations, these data are inexpensive and provide opportunities that are not available in retrospective medical chart review studies. With the strong incentive for patients to use the MCO's pharmacy benefit, it is likely that the approach used in this study led to a reasonably accurate estimate of prescriptions filled. Also, from a medical record review it can be difficult

Table 3. Adjusted Generalized Estimating Equations Logistic Model of Factors Associated With the Initiation of β -Adrenergic Blocking Agent Therapy in 578 Clinically Eligible Patients With Acute Myocardial Infarction

	Odds Ratio (95% Confidence Interval)
Physician Characteristics	
Medical school graduation date	
1980 or later	1.0 (Referent)
Before 1980	0.66 (0.40-1.03)
Physician specialty	
Cardiology	1.0 (Referent)
Internal medicine	0.65 (0.38-1.11)
Family practice	0.29 (0.12-0.66)
Other	0.13 (0.04-0.45)
Region	
Northeast	1.0 (Referent)
South Atlantic	0.34 (0.12-0.93)
North central	0.40 (0.14-1.15)
South central	0.28 (0.10-0.73)
West	0.17 (0.06-0.47)
Patient Characteristics	
Age, y	
35-44	1.0 (Referent)
45-54	0.58 (0.29-1.20)
55-64	0.44 (0.21-0.91)
≥ 65	0.44 (0.18-1.07)
Length of hospitalization, d	
4-6	1.0 (Referent)
7-9	0.79 (0.44-1.40)
≥ 10	0.75 (0.35-1.63)
Deyo Comorbidity Index score	
Level 1	1.0 (Referent)
Level 2	1.47 (0.83-2.61)
Levels 3-4	0.89 (0.20-3.83)
Cardiac Treatments	
Preadmission medications	
Digoxin	0.36 (0.16-0.81)
Calcium channel blocker	1.07 (0.59-1.96)
Therapy at 7 d	
Calcium channel blocker	0.18 (0.10-0.33)

to determine who is responsible for the patient's medications. The innovative use of pharmacy records can provide this information. Although this is a nonrandom sample, the study cohort is a reasonable reflection of the physician market available to the MCO. The study cohort is geographically diverse and represents several general practice arrangements, including large networks of physicians linked through independent practice associations, solo practices, and multispecialty offices.

This study has several limitations. First, there are inherent problems with relying on administrative data to identify patients who are ideal candidates for β -adrenergic blocking agent therapy. The diagnostic codes do not always agree with information that is documented in the chart.²⁶ Consequently, our approach might have led to the inclusion of patients who had clinical reasons for not receiving a β -adrenergic blocking agent. Overall, however, our estimate of the use of β -adrenergic blocking agents is similar to that found in other studies based on medical record review.^{10,12,15,22} Second, we captured information about prescriptions that were filled by the patients. We do not know how often physicians wrote prescriptions for β -adrenergic blocking agents that were not filled by their patients.

Third, we cannot be certain that we correctly identified the physician who was responsible for the patient's ongoing cardiac care on an outpatient basis in every case. Our approach was to identify the physician who prescribed cardiac medications within 1 week of hospital discharge. We chose a time frame of 7 days because the American Heart Association and the American College of Cardiology recommend prescription of β -adrenergic blocking agents be continued indefinitely after the first day in the hospital and the HEDIS 3.0 measurement allows 7 days for the receipt of a β -adrenergic blocking agent prescription.^{4,13} In addition, although many physicians might collaborate on postdischarge planning of the care of patients with AMI, 1 physician must ultimately have responsibility for ensuring appropriate outpatient therapy. We made the assumption that the physician who prescribed the patient's cardiac medications filled within 7 days of hospital discharge would be that physician.

Fourth, despite the use of a national MCO database, our sample size was sufficient only for the detection of relatively large effects. Given this sample size, we might have missed small or moderate-sized effects that could be important. We presented 95% confidence intervals to describe the precision of our estimates. Even with the small sample size, we

detected physician characteristics that were significant and substantial. Some comparisons, however, that might be important (cardiologists vs internists) could not be adequately studied with our sample size. Also, our study raises an important issue associated with the selection of physicians by patients. Given the acute nature of an AMI, it is unlikely for patients to be able to actively select a particular physician, although a hospital choice might be made. A larger study would be required to further explore this relation.

Finally, we only studied patients cared for by network physicians. Patients discharged from the hospital are eligible to receive follow-up care from a nonnetwork physician to maintain continuity of care. The MCO receives a claim and basic clinical data for out-of-network medical care, but physician characteristics are not available. This gap in information presents a challenge to MCOs and other organizations seeking to measure quality of care within a healthcare delivery system with a variety of coverage options. In addition, the specialty of excluded physicians is not known if the provider could not be linked to the MCO's provider file. Therefore, we cannot determine whether a particular provider type is more likely to be excluded from the analysis than providers within the MCO network provider file.

Understanding the utilization of oral β -adrenergic antagonists after an AMI in the community setting is a complex but important task. Illuminating factors associated with possible underuse has implications for guideline implementation, medical education, and quality improvement programs.

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