

Underuse of Cardioprotective Medications in Patients Prior to Acute Myocardial Infarction

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Secondary prevention in coronary heart disease (CHD) improves survival and reduces recurrent events.¹⁻⁴ National clinical guidelines and organizational performance measures recommend the use of hydroxymethylglutaryl coenzyme A reductase inhibitors (statins), β blockers, angiotensin-converting enzyme (ACE) inhibitors, and aspirin in most patients after acute myocardial infarction (AMI).⁵⁻⁸ However, many high-risk patients do not receive them.^{9,10} We sought to determine whether patients with known CHD admitted for AMI to hospitals in the Veterans Administration (VA) system had indications for pharmacologic secondary prevention before admission and the extent to which these therapies were begun in the period immediately after discharge from the hospital.

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We conducted a before-after study of patients with documented CHD who had an AMI to compare their cardioprotective medications during the 6 months before admission for AMI and during the 3 months after hospital discharge.

We identified established male patients who had a diagnosis of CHD registered from April 1 to June 30, 2000, and were admitted with a primary diagnosis of AMI between July 1, 2000, and June 30, 2001, to any of the 8 VA medical centers in the Veterans Integrated Service Network (VISN) 20. A diagnosis of CHD was defined as an in-patient primary discharge diagnosis or an outpatient diagnosis for any of the following *International Classification of Diseases, 9th revision (ICD-9-CM)* codes: 410 (AMI), 411 (unstable angina pectoris), 412 (past AMI), and 414 (coronary atherosclerosis). We defined an established patient as having visited a VA primary or specialty care clinic (including internal medicine, primary care, geriatric, cardiology, endocrinology, diabetes, hypertension, pulmonary, and mental health) between April 1, 2000, and June 30, 2000, and having made at least 1 visit within

13 to 24 months before April 1, 2000. Only patients who were alive on June 30, 2000, and alive at discharge were included.

Patient, pharmacy, co-morbidity, and laboratory data were extracted from the VISN 20 data warehouse (CHIPS). CHIPS is a relational database that contains data from the clinical information systems of each of the 8 VA medical facilities in VISN 20 of the Veterans Health Administration.

The main variables of interest were prescriptions dispensed for 4 drug classes: statins, β blockers, ACE inhibitors/angiotensin II receptor blockers (ARBs), and aspirin. We included ARBs because a growing body of published reports supports treatment with ARBs in patients intolerant to ACE inhibitors.^{11,12} Drug data were extracted for from January 1, 2000, to September 30, 2001. We compared the proportion of CHD patients with filled prescriptions of each drug class 6 months before the AMI admission date and 3 months after hospital discharge. We also compared the proportion of prescription fills for each of the 4 drug classes based on the history of cardiac risk factors before admission. Risk factors included ICD-9-CM documentation of hypertension, diabetes, and congestive heart failure, and laboratory documentation of elevated low-density lipoprotein (LDL) cholesterol. Data on risk factors were extracted from January 1, 1990, to June 30, 2001. We defined an LDL cholesterol ≥ 120 mg/dl (3.11 mmol/L) as elevated based on the Veterans Health Administration guidelines for management of dyslipidemia. LDL cholesterol data were extracted for 15 months before the admission date. The most recent documented LDL cholesterol before admission was used in our analyses. We used McNemar's test to assess the statistical significance of the changes in the proportion of patients with medication fills before admission and after discharge.

We identified 13,767 male veterans with a history of CHD during April 1 and June 30, 2000. Of these men, 239 were admitted to a VISN 20 facility with a primary diagnosis of AMI from July 1, 2000, to June 30, 2001. Eight patients died in the hospital and were excluded from study. The remaining 231 patients (mean age 69 years) were predominantly white (94%) and married (55%). Cardiac risk factors were common (Table 1). After discharge for AMI, we observed significant ($p < 0.05$) increases in the percentage of patients receiving a prescription for 3 of the 4 drug classes: from 50% to 68% for statins, from 53% to 82% for β blockers, and from 50% to 66% for ACE inhibitors/ARBs (Table 2). The amount of increase

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*The views expressed in this article are those of the investigators and do not necessarily represent the views of the Department of Veteran Affairs.

TABLE 1 Characteristics of Study Patients Before Admission for Acute Myocardial Infarction (AMI) (n = 231)

Characteristics	(%)
Age (yrs)	
<65	31
65–74	33
≥75	36
Race	
White	93
Black	1
Hispanic	1
Unknown	5
Marital status	
Married	55
Divorced	20
Widowed	11
Never married	8
Separated	2
Unknown	4
Systemic hypertension	39
Diabetes mellitus	52
Congestive heart failure	40
Body mass index*	
<25	19
≥25, <30	28
≥30	52
Missing	1
Smoking status	
Nonsmoker	16
Former	41
Current	34
Unknown	9
Hypercholesterolemia [†]	65
LDL cholesterol (mg/dl)	
<100	33
100–119	16
≥120	21
None recorded	30

*Body mass index is the weight in kilograms divided by the square of the height in meters.
[†]Defined as cholesterol level ≥200 mg/dl.

TABLE 2 Changes in the Percentage of Prescribed Cardioprotective Medications Before and After Hospitalization for Acute Myocardial Infarction (AMI) (n = 231)

Drug Type	Pre-admit (%)	Discharge (%)	p Value*
Statins	50	68	<0.001*
β blockers	53	82	<0.001*
ACE inhibitor /ARB	50	66	<0.001*
Aspirin	65	71	0.085

*Statistically significant at <0.05.
admit = admittance.

varied according to the presence of cardiac risk factors (Table 3).

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We studied a group of patients who had documented CHD and had had an AMI. Many of the patients had ≥1 cardiovascular risk factor that would have been an indication for a cardioprotective medication in and of itself before the occurrence of an AMI. For example, patients with hypercholesterolemia and CHD should generally receive treatment with a statin. Those with hypertension and CHD

should typically receive a β blocker or an ACE inhibitor/ARB, or both, and patients with diabetes or heart failure and CHD should typically receive an ACE inhibitor/ARB. All patients with CHD should receive aspirin. Thus, these data suggest that a significant proportion of patients with CHD who are at high risk for an acute coronary event and who have indications for cardioprotective medications do not receive them until after they have experienced an AMI. However, we did find that a greater percentage of the VA population received cardioprotective medications than the general Medicare population.¹³

We did observe heterogeneity among subgroups with respect to their receipt of cardioprotective drugs. For example, 61% of diabetics and 61% of those with heart failure were already receiving an ACE inhibitor/ARB before hospitalization. These moderate proportions may reflect systematic efforts in the outpatient setting to improve treatment of diabetes and heart failure.^{14,15} There are specific performance standards in the VA that address use of these drugs for these indications.¹⁶ Despite systematic efforts to improve care of patients with heart failure, we found a statistically significant increase in ACE inhibitor/ARB prescriptions after hospitalization for diabetes, but not for heart failure. In contrast, the relatively low proportion of patients with hypertension receiving β blockers or ACE inhibitors/ARBs may reflect the lack of consistent guidelines for specific treatment with these medications. Moreover, much of the focus of AMI prevention has targeted patients who have had an AMI. Thus, the existing performance standards for CHD include prescription of statins, aspirin, ACE inhibitors/ARBs, and β blockers in the post-AMI period, but there are no standards applicable to patients with CHD before they have had an AMI. Our results suggest that clinicians have been paying heed to some performance standards. However, they often seem to neglect potentially beneficial interventions when there is no directly applicable performance measure. In the case of CHD, it can be argued that focusing on the post-AMI period has inadvertently directed attention to preventing a second or third infarction rather than emphasizing prevention of a first event.

The investigation had limitations. First, we were unable to investigate reasons why patients may not have been receiving apparently indicated medications before AMI. Variations in medication use after AMI have been observed in different regions of the country.¹⁷ Different patterns of use by physician specialties have been reported.¹⁸ Clinicians cite absolute or relative contraindications to ≥1 of the drug classes as 1 reason they are not prescribed.¹⁹ However, it is unlikely that contraindications were a major reason for not prescribing medications before admission, given the sizable increases in prescriptions for these same drugs after hospitalization. A second limitation is that our sample size was relatively small. However, this was sufficient to prove statistical significance of the differences. Third, our reliance solely on administrative data may have led to misclassification. We used ICD-9-CM codes to identify CHD and cardiovascular

TABLE 3 Changes in Percentage of Prescription Fills Before and After Admission for Acute Myocardial Infarction (AMI) According to Drug Class and Presence of Cardiac Risk Factors (n = 231)[†]

	Hypertension (n = 94)	Diabetes (n = 120)	LDL ≥ 120 (n = 48)	CHF (n = 93)
Drug type				
Statins				
Before [‡]	49	53	40	57
After [§]	76	64	75	65
p value	<0.0001*	0.02*	0.0004*	0.16
β blockers				
Before	52	53	44	61
After	86	84	88	75
p value	<0.0001*	<0.0001*	<0.0001*	0.02*
ACE /ARB				
Before	51	61	48	61
After	72	73	69	63
p value	0.0012*	0.03*	0.03*	0.73
ASA				
Before	68	60	63	72
After	77	67	81	62
p value	0.14	0.24	0.05	0.11

*Statistically significant at <0.05.
[†]Risk factors present before admission for AMI.
[‡]Percentage of prescription fills before admission for AMI.
[§]Percentage of prescription fills after admission for AMI.
 ASA = aspirin.

risk factors. Patients with chest pain suspicious for angina may be coded as angina, yet subsequently prove to have noncardiac chest pain. We attempted to minimize misclassification of our study population by excluding the ICD-9-CM code for angina. In addition, we believe that coding for diagnoses such as AMI and unstable angina pectoris is reasonably specific and sensitive.²⁰ Third, the existing evidence for use of β blockers and aspirin in patients with CHD is strongest for those who have had an AMI.

In summary, we observed sizable improvements in the proportion of patients receiving cardioprotective medications after hospitalization for AMI. A significant number of patients with CHD who were at high risk for an AMI and had indications for cardioprotective medications did not receive them until after AMI. These data suggest that instituting systematic measures to improve prescriptions for cardioprotective medications in high-risk outpatients who have CHD may help prevent adverse outcomes.

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