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Outpatient Adherence to Beta-Blocker Therapy After Acute Myocardial Infarction

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OBJECTIVES This study was designed to determine adherence to outpatient beta-blocker therapy following acute myocardial infarction (AMI).

BACKGROUND The importance of beta-blocker therapy after AMI is widely recognized. Outpatient adherence with this recommendation, however, is not well described.

METHODS Data on 846 patients surviving AMI were studied. Factors associated with filling a beta-blocker prescription within 30 days postdischarge and the proportion of patients who were or were not discharged on beta-blockers who filled prescriptions for them by 30, 180, and 365 days post-AMI discharge were assessed.

RESULTS Patients with a discharge order for beta-blocker therapy were more likely to fill a prescription in the first 30 days postdischarge (hazard ratio [HR] 15.82, 95% confidence interval [CI], 10.75 to 23.26). Patients older than age 75 years were less likely than those age <65 years to fill a prescription (HR 0.63, 95% CI 0.42 to 0.93). Gender, race, and being an ideal candidate did not affect beta-blocker use. Among patients who were discharged on beta-blockers, 85% of survivors had filled a prescription by 30 days postdischarge, and 63% and 61% were current users at 180 and 365 days, respectively. In contrast, only 8% of those patients with no discharge order for beta-blockers had filled such a prescription by 30 days, and 13% and 12% of patients were current users at 180 and 365 days, respectively.

CONCLUSIONS Patients not discharged on beta-blockers are unlikely to be started on them as outpatients. For patients who are discharged on beta-blockers after AMI, there is a significant decline in use after discharge. Quality improvement efforts need to be focused on improving discharge planning and to continue these efforts after discharge. (J Am Coll Cardiol 2002;40: 1589–95) © 2002 by the American College of Cardiology Foundation

Several clinical trials have convincingly demonstrated the secondary prevention benefits of beta-blocker therapy after acute myocardial infarction (AMI) (1,2). On the basis of these results, the American College of Cardiology (ACC) and American Heart Association (AHA) guidelines for the management of AMI recommend routine beta-blocker therapy for all patients without a contraindication (3). Despite this, use of these drugs after AMI remains suboptimal (4). As a result, patients who are not discharged on beta-blockers have a higher risk of readmissions and mortality (5).

Nearly all studies on this issue have defined beta-blocker use from discharge orders (4,6). However, patients may fail to fill prescriptions for discharge medications (7). Furthermore, patients who initially use these medications may later discontinue their use, either because of intolerance or noncompliance with recommended care, even though indefinite use of beta-blockers post-AMI is recommended (3). Thus, quality improvement efforts restricted to hospitals may not achieve their promised effectiveness.

In this study, we sought to assess the outpatient utilization of beta-blocker therapy during the first year postdischarge after AMI. We also assessed the new use of beta-blockers for eligible patients who were not discharged on them after AMI. We identified a population-based cohort of Medicare beneficiaries, discharged alive after an AMI. The study cohort was that subset of patients who were also enrolled in the Tennessee Medicaid program at discharge and, thus, eligible to receive pharmacy benefits, which enabled us to determine their use of beta-blockers in the year following discharge.

METHODS

Sources of data. MEDICARE DATA. The original Cooperative Cardiovascular Project collected information on all

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Abbreviations and Acronyms

ACC = American College of Cardiology
AHA = American Heart Association
AMI = acute myocardial infarction
CI = confidence intervals
HR = hazard ratio
LVEF = left ventricular ejection fraction
RR = relative risk

nongovernment AMI hospital discharges over eight-month periods between 1994 and 1995 that were billed for Medicare payment. As an extension of this project, the Tennessee Quality Improvement Organization used the same data collection instrument to abstract data on all AMIs in the state in defined time periods after quality improvement interventions were implemented. The time frame for data collection varied, but included at least eight months; because collection was not started until interventions were in place, collection periods were staggered between July 1996 and December 1999.

Medicaid data. The study was conducted among enrollees of the Tennessee Medicaid program. Medicaid computerized files permitted linkage to the Tennessee Quality Improvement Organization data and identification of prescriptions filled for beta-blockers. Medicaid files included the *enrollment file*, a registry of all enrollees linked with death certificates; the *pharmacy file*, consisting of records of prescriptions filled at the pharmacy; the *inpatient file*, with the records of hospitalizations; the *outpatient file*, with encounter records for emergency room, hospital outpatient department, and physician visits for Medicaid enrollees; and the *nursing home file*. Automated pharmacy records are an excellent source of medication data because these records are not subject to information bias and have concordance of better than 90% with patient self-reports of medication use (8,9).

Study population. A total of 5,358 confirmed AMI hospital discharges were abstracted by the Tennessee Quality Improvement Organization during the study period. These included 1,412 (26%) discharges on 1,326 patients enrolled in Medicaid at discharge. The first hospitalization in which the patient was discharged to the community was chosen for this analysis. We excluded 193 (14%) patients who died during hospitalization and 151 (11%) who were transferred to another hospital. Although all enrollees in Medicaid have access to prescription drugs through the program, some may choose to use other sources of prescription medications (such as Veterans Administration hospitals); others may be retroactively enrolled in Medicaid and obtain initial post-discharge medications through other means. To ensure that all study subjects were able to fill a prescription through the Medicaid program, the analysis was restricted to 846 of the remaining 982 (86%) patients who filled at least one prescription in the year before discharge or in the first 30 days postdischarge. Of the 846 persons in the study cohort, 788, 681, and 620 subjects were alive and enrolled in Medicaid at 30, 180, and 365 days post-AMI discharge, respectively.

Human subjects. This study was approved by Vanderbilt University and the state of Tennessee Institutional Review Boards, and reviewed and approved by the Centers for Medicare and Medicaid Services and by the Tennessee Medicaid program. Although personal identifiers were used for data linkage, all analysis files were devoid of identifiers and were not able to be linked back to data with identifying information.

Study definitions. We used the same definition of AMI as was used in the Cooperative Cardiovascular Project (10). Patients were classified as ideal candidates for beta-blockers if they had none of the following: heart rate <50 beats/min and not already on beta-blockers, shock, systolic blood pressure <100 mm Hg, high-grade atrioventricular block, asthma, chronic obstructive pulmonary disease, depression, dementia, left ventricular ejection fraction (LVEF) $<35\%$ or not measured, pulmonary edema, and diabetes mellitus with insulin therapy. Because the benefit for beta-blocker therapy post-AMI is limited in patients with very low cardiac risk, the following patients were also excluded from the ideal group: no angina >24 h after arrival with no history of previous AMI, LVEF $\geq 50\%$, no atrial or ventricular arrhythmias, and no ischemia when a stress test was performed. All patients discharged alive and not classified as "ideal" candidates were considered "eligible/not ideal" for beta-blocker therapy.

Clinical data. Clinical data abstracted were the same as the Cooperative Cardiovascular Project and included demographics, clinical evaluation and laboratory values, comorbidities, procedures, medications, complications, and hospital outcomes. Details of the data collection and definitions for the Cooperative Cardiovascular Project have been described previously (10).

For assessing whether beta-blockers were prescribed at discharge or not, the abstractors reviewed the chart comprehensively, including clinical notes (both physician and nursing), physician orders, pharmacy sheets, and discharge summaries. The abstractors were provided with a list of both generic and trade names of all available beta-blockers.

Outcome. The outcomes studied were the proportion of study patients who filled a prescription for a beta-blocker within 30 days after hospital discharge post-AMI, and the proportion who had a current prescription (filled in the prior 30 days) at 180 and 365 days postdischarge. Prescriptions in Medicaid are usually for 30 days and may not exceed this length.

Statistical analysis. Descriptive analyses were performed and the data were tabulated as means or frequencies. Proportional hazards regression was used to estimate adjusted hazard ratios (HR) and 95% confidence intervals (CI) assessing patient characteristics related to the time to filling a beta-blocker prescription within the first 30 days postdischarge. Patient characteristics included age (<65, 65 to 74,

Table 1. Patient Characteristics Associated With Time to First Beta-Blocker Prescription in the First 30 Days Post-Discharge

Patient Characteristic	Overall N = 846 N (%)	Adjusted Hazards Ratio (95% Confidence Interval)*
Age (yrs)		
<65	244 (29)	1.0
65–74	287 (34)	0.86 (0.60–1.23)
≥ 75	315 (37)	0.63 (0.42–0.93)
Race		
White	651 (77)	1.0
Black	113 (13)	0.69 (0.44–1.09)
Other	82 (10)	1.06 (0.65–1.75)
Gender		
Male	367 (43)	1.0
Female	479 (57)	1.35 (0.97–1.52)
Discharge Status		
Eligible/nonideal	699 (83)	1.0
Ideal	147 (17)	1.09 (0.79–1.52)
Discharged on beta-blockers		
No	460 (54)	1.0
Yes	386 (46)	15.82 (10.75–23.26)

*Adjusted for other all other variables presented in the Table.

>75 years), gender (male/female), race (white/black/other), being an ideal candidate (eligible/not ideal vs. ideal), and discharge status (discharged on beta-blocker, yes/no). Similarly, logistic regression was used to calculate adjusted odds ratios and 95% CI for the relationship of beta blocker status at 30, 180, and 365 days to patient characteristics, stratified by beta-blocker discharge status. Odds ratios were converted to relative risks (RRs) using the method described by Zhang and Yu (11). Regression diagnostics were performed to assess the appropriateness of the proportional hazards and logistic regression models. Data were analyzed using SAS Version 8 (SAS Institute, Cary, North Carolina).

RESULTS

Patient characteristics. The mean age of the study population was 70 ± 13 years. Of the patients, 17% were considered ideal candidates for beta-blocker therapy, and 46% were discharged on beta-blockers (Table 1). There were no significant differences in the demographic characteristics among the cohorts studied at 30, 180, and 365 days post-AMI.

Overall beta-blocker use after discharge. Daily outpatient adherence to beta-blocker therapy post-AMI is depicted in Figure 1. Among patients with a documented discharge prescription for beta-blockers, approximately 80% were using beta-blockers during the first 30 days as measured by prescriptions filled. There was a sharp decline around 30 days, which represents gaps in prescriptions refilled, followed by an increase and then a gradual decrease which remained at around 60% to 65% from approximately 90 through 365 days. Among patients without a discharge prescription for beta-blockers, approximately 7% to 10% were using beta-blockers during the first 30 days; this figure plateaued at around 15% by day 180.

Beta-blocker use according to patient characteristics. Table 1 describes the likelihood of filling a beta-blocker prescription within 30 days after discharge according to patient characteristics. A discharge prescription for beta-blockers was the strongest predictor of filling a prescription

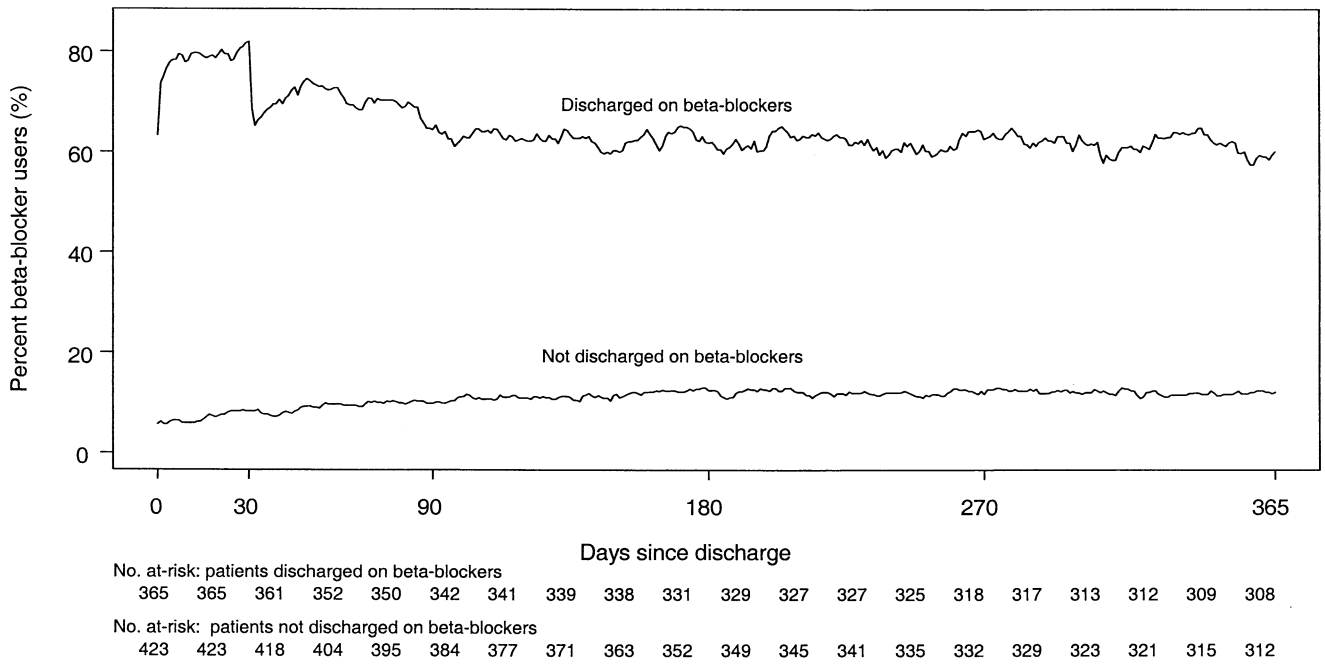

Figure 1. Beta-blocker use after acute myocardial infarction. Use of beta-blockers among patients who were and were not given a prescription for them at discharge. The adherence is shown from discharge to one year postdischarge and includes patients who were alive at any given time period.

Table 2. Patient Characteristics and Beta-Blocker Adherence Among Patients Who Were Discharged on Beta-Blockers

Patient Characteristics	Day 30 N	Day 30 N (%) Beta-Blockers	Day 30 RR (95% CI)*	Day 180 N	Day 180 N (%) Beta-Blockers	Day 180 RR (95% CI)*	Day 365 N	Day 365 N (%) Beta-Blockers	Day 365 RR (95% CI)*
Overall age (yrs)	365	309 (85)		330	209 (63)		308	188 (61)	
<65	126	109 (87)	1.0	119	77 (65)	1.0	114	67 (59)	1.0
65–74	134	114 (85)	0.97 (0.83–1.06)	123	79 (64)	1.02 (0.82–1.19)	116	74 (63)	1.08 (0.84–1.28)
≥ 75	105	86 (82)	0.92 (0.74–1.03)	88	53 (60)	0.96 (0.73–1.17)	78	47 (60)	1.01 (0.74–1.25)
Race									
White	284	241 (85)	1.0	253	167 (66)	1.0	236	149 (63)	1.0
Black	47	39 (78)	0.90 (0.70–1.03)	47	25 (53)	0.81 (0.57–1.04)	44	22 (50)	0.78 (0.52–1.03)
Other	34	29 (88)	1.03 (0.82–1.12)	30	17 (57)	0.87 (0.58–1.13)	28	17 (59)	0.92 (0.60–1.19)
Gender									
Male	158	133 (84)	1.0	149	98 (66)	1.0	139	85 (61)	1.0
Female	207	176 (85)	1.05 (0.94–1.11)	181	111 (61)	0.96 (0.78–1.12)	169	103 (61)	1.00 (0.79–1.18)
Discharge status									
Eligible/nonideal	267	227 (85)	1.0	242	157 (65)	1.0	226	138 (61)	1.0
Ideal	98	82 (83)	0.98 (0.86–1.06)	88	52 (59)	0.93 (0.74–1.10)	82	50 (61)	1.01 (0.80–1.20)

*Adjusted for other all other variables presented in the Table.
CI = confidence interval; RR = relative risk.

within 30 days (HR 15.82, 95% CI 10.75 to 23.26). Patients older than 75 years were significantly less likely to have filled a beta-blocker prescription post-AMI than those <65 years (HR 0.63, 95% CI 0.42 to 0.93). Gender, race, and being an ideal candidate did not affect beta-blocker use.

Beta-blocker use at 30, 180, and 365 days post-AMI according to whether the patients were discharged on beta-blockers is shown in Tables 2 and 3. Patients older than 75 years were significantly less likely to be started on beta-blockers later if they were not discharged on them (RR 0.37, 95% CI 0.16 to 0.87 for 30 days; RR 0.36, 95% CI 0.16 to 0.78 for 180 days; and RR 0.42, 95% CI 0.17 to 0.94 for 365 days). There were no significant differences in the new use of beta-blockers from day 30 to either day 180 or 365 in any of the other subgroups. Regression diagnostics indicated no lack of fit in either the proportional hazards or logistic regression models.

DISCUSSION

Encouraging use of beta-blockers post-AMI has become a major quality improvement goal because of the demonstrated benefit of these drugs in improving survival (1,2). In this regard, there has been some progress made over the past decade (10,12). Most of this research, however, is based on hospital treatment at discharge; issues related to outpatient compliance have been largely unaddressed. It is also not clear whether there is a period after discharge when the chances of decrease in beta-blocker use are substantially higher as compared with other times, or whether there is a continued progressive decline in adherence over time. For patients who are not discharged on beta-blockers after AMI, there is a possibility that these drugs may be started as outpatients. Without knowing the proportion of this group of "new users" of beta-blockers as outpatients, neither

Table 3. Patient Characteristics and Beta-Blocker Adherence Among Patients Who Were Not Discharged on Beta-Blockers

Patient Characteristics	Day 30 N	Day 30 N (%) Beta-Blockers	Day 30 RR (95% CI)*	Day 180 N	Day 180 N (%) Beta-Blockers	Day 180 RR (95% CI)*	Day 365 N	Day 365 N (%) Beta-Blockers	Day 365 RR (95% CI)*
Overall age (yrs)	423	36 (9)		351	46 (13)		312	38 (12)	
<65	105	13 (12)	1.0	96	18 (19)	1.0	93	15 (16)	1.0
65–74	140	14 (10)	0.77 (0.36–1.55)	123	18 (15)	0.73 (0.38–1.33)	107	14 (13)	0.76 (0.36–1.48)
≥ 75	178	9 (5)	0.37 (0.16–0.87)	132	10 (8)	0.36 (0.16–0.78)	112	9 (8)	0.42 (0.17–0.94)
Race									
White	325	29 (9)	1.0	278	39 (14)	1.0	241	29 (12)	1.0
Black	53	4 (8)	0.89 (0.31–2.29)	37	3 (8)	0.54 (0.16–1.56)	36	4 (11)	0.89 (0.32–2.25)
Other	45	3 (7)	0.68 (0.20–2.08)	36	4 (11)	0.69 (0.24–1.75)	35	5 (14)	1.06 (0.41–2.46)
Gender									
Male	175	14 (8)	1.0	151	18 (12)	1.0	130	13 (10)	1.0
Female	248	22 (9)	1.46 (0.75–2.69)	200	28 (14)	1.36 (0.75–2.30)	182	25 (14)	1.62 (0.84–2.90)
Discharge status									
Eligible/nonideal	383	33 (9)	1.0	316	43 (14)	1.0	279	33 (12)	1.0
Ideal	40	3 (8)	0.82 (0.25–2.41)	35	3 (9)	0.59 (0.18–1.69)	33	5 (15)	1.26 (0.49–2.79)

*Adjusted for other all other variables presented in the Table.
CI = confidence interval; RR = relative risk.

the true epidemiologic significance of beta-blocker underutilization can be properly appreciated, nor can appropriate quality improvement strategies be implemented.

Our study demonstrates a significant decline in the use of beta-blockers after AMI discharge from the hospital. Overall, only 46% of the patients were discharged on beta-blockers. During the first 30 days after discharge, another 15% of these patients had not filled a beta-blocker prescription, and by 180 days, a total of 37% of the patients discharged on beta-blockers did not have a current prescription. We did not find a significant further deterioration in adherence to these drugs from 180 days to 1 year post-AMI. Even among those patients classified as ideal for beta-blocker therapy but not discharged on them, the rate of new outpatient prescription was very low. These findings strongly suggest that further quality improvement initiatives need to address drug compliance in the outpatient arena, especially considering that similar results have been shown for lack of adherence with lipid-lowering therapy (13).

Benefit from beta-blocker therapy post-AMI has been demonstrated in multiple subgroups of patients. These include patients at high risk for not receiving beta-blockers (6), those who have undergone coronary revascularization after AMI (14), those who are diabetic (15), and those with a history of chronic obstructive pulmonary disease or asthma (16). Despite this, our data are consistent with earlier reports that beta-blockers at discharge are significantly underused. Further decline in the use of these drugs in the outpatient arena leaves only a minority of patients who actually take these drugs long-term.

Two prior studies have addressed the outpatient use of beta-blockers post AMI, but did not have information on whether these drugs had actually been prescribed at discharge. Soumerai et al. (5) showed that only 21% of the subjects received one or more prescriptions for beta-blockers within 90 days post-AMI discharge. Patients who filled a prescription for beta-blockers as outpatients had a significantly lower risk of mortality and readmission at two years after discharge (5). Another study assessed the proportion of post-AMI patients using beta-blockers within the first 90 days after discharge and reported a significant increase from 39.6% in 1994 to 58.6% in 1997 (12). Although there was a definite trend towards improvement, the absolute numbers may be misleading because active prescription refilling for any medication within the same 90-day period post-AMI was an inclusion criterion for the study. Finally, in patients who have recurrent AMI, the proportion of patients receiving beta-blockers has been shown to be $<50\%$ (17).

Our study shows that the best predictor of patients receiving beta-blockers at 30 days post-AMI was discharge prescription of these drugs. This underscores the importance of careful discharge planning. It is possible that the patients discharged on beta-blockers were already on them during the hospital stay and constituted a select group of patients tolerant to these medications. However, both patients and the family members are likely to be responsive to educational opportunity regarding the importance of secondary prevention measures post-AMI, and may be more motivated to comply with the recommendations given during the acute phase. Moreover, physicians may be more likely to continue a prescription on an outpatient basis as compared to remembering and initiating a new treatment.

There has been some improvement in the discharge prescription rate of beta-blockers over time (10,12). However, recent data collected from 1997 to 1999 on Medicare beneficiaries still show substantial opportunities for improvement across states in beta-blocker prescription at discharge (18). Increasing compliance with recommended medicines at hospital discharge has been shown to improve long-term outcomes in patients post-AMI (19). Because of such findings, both the AHA and ACC have recently initiated quality improvement projects to improve compliance with secondary prevention recommendations at discharge after AMI (20,21). These are complementary to the efforts by the Centers for Medicare and Medicaid Services and the Joint Commission on Accreditation of Healthcare Organizations (22,23).

Discharge prescription of medication, however, does not guarantee continued adherence in the outpatient arena. Indeed, our data show that 15% of those patients who were discharged on beta-blockers had not filled a prescription during the first 30 days after discharge. Although theoretically the patient may have been discharged with a 30-day supply, this proportion continued to fall to up to 37% by 180 days. Considering that 54% of the eligible patients were not discharged on beta-blockers, a reduction of another 37% by six months leaves only a small minority of eligible patients who actually were taking these medicines for relatively long periods of time. The estimates we report represent the "best case" scenario. If we assess the data in our "unrestricted cohort," by six months 43% of the patients were not continuing beta-blocker therapy. These trends can have a significant clinical and economic impact on the health care system. It is estimated that if all survivors of first AMI were treated with beta-blockers for 20 years, this could result in a saving of $18 million and a gain of 447,000 life-years (24).

Our findings suggest that attempts to improve quality of care should go beyond discharge planning and include outpatient efforts. In order to efficiently target these outpatient efforts, it is important to know the temporal trends of a decline in adherence. Our data suggest that decline is most likely to occur within the first 180 days. There were no significant changes noted after six months in either the overall use or use in any of the subgroups studied. Considering these results, efforts to improve beta-blocker use after AMI should continue postdischarge for preferably up to six months.

In general, there are multiple patient- and physician-related reasons for lack of compliance with guideline-based recommendations (25,26). In the case of beta-blockers, potential adverse effects are considered to be a major reason. There were multiple potential clinical scenarios in the

eligible/nonideal patients in our study that may have prevented long-term therapy. However, unlike the early use of these drugs during admission, our study focuses on discharge use. Therefore, contraindications such as cardiogenic shock or third-degree heart block are not relevant to our study. For other relative contraindications such as history of pulmonary disease, low ejection fraction, and diabetes, Gottlieb et al. (6) have shown a significant benefit from the use of these drugs post-AMI in patients with these comorbidities. Therefore, to not give beta-blockers to these patients is inconsistent with literature unless the patients are truly intolerant. Moreover, many of these conditions are no longer considered relative contraindications. The recently published Carvedilol Post-Infarction Survival Control In Left Ventricular Dysfunction (CAPRICORN) trial showed that treatment with beta-blockers after an AMI complicated by left ventricular systolic dysfunction results in a significant reduction in all-cause and cardiovascular mortality (27). Restricting the use of these drugs to only ideal patients is estimated to reduce the epidemiologic impact of beta-blocker therapy post-AMI by approximately 60% (24).

To further assess this issue, we defined a group of ideal patients in whom there were no absolute or relative contraindications to the use of beta-blockers and who should have a minimal risk of untoward side effects. Analysis of this group showed similar trends, with a significant reduction in adherence at 30 and 180 days. These data suggest that the root cause for lack of therapy with beta-blockers is likely not restricted to clinical reasons alone.

Elderly patients were at particularly high risk for not being discharged on beta-blockers. Existing data suggest significant benefit from beta-blocker therapy in this group of patients, and the decision not to treat these patients is inconsistent with clinical evidence (5,6). Elderly patients are at particularly high risk for not following outpatient medication recommendations (28). This group of patients needs ongoing outpatient efforts to increase compliance with beta-blockers. Although the elderly were particularly susceptible to not taking beta-blockers, our study demonstrates that in every subgroup there was a major gap between the number of patients eligible for treatment and those actually treated. Therefore, although the elderly clearly require special attention, efforts to improve beta-blocker use after AMI should be targeted to all eligible patients.

Multiple new medications are introduced in the care of post-AMI patients. Another possibility for the lack of beta-blocker therapy at discharge may be that physicians chose to start these drugs during a subsequent outpatient visit. Therefore, we studied the new use of beta-blockers in patients who were not discharged on them. Our data show that only a minority of patients were new users of these drugs at all three time frames studied. Again, elderly patients were at the highest risk for not having these medications initiated. In our study, we could not ascertain the reason beta-blockers were initiated in these patients after discharge. Some prescriptions may have been for treatment of other conditions, such as hypertension, in which case treatment with these drugs were not targeted specifically as a secondary preventive measure for AMI, and other drugs could have been used instead of beta-blockers. These results underscore the importance of careful discharge planning.

In order to maximize outcomes after AMI, attempts should be made to improve upon the current trends. Multiple interventions directed at patients have been shown to increase adherence with medications (29). Bradley et al. (30) recently described the hospital-related factors that were associated with increased beta-blocker use after AMI. Prospective studies are needed to assess the effectiveness, safety, and tolerability of these drugs in patients who are at a higher risk for side effects. Finally, dosages less than those used in clinical trials have been associated with substantial beta-blocker benefit after AMI (31). Therefore, patients should at least be tried on smaller doses if larger doses are not tolerated.

Study limitations. Our study has several limitations. Because of the retrospective nature of the study, we do not have data on tolerability of these medications during hospital stay or after discharge. We cannot ascertain the degree to which the lack of adherence is related to physician- or patient-related factors. Our patient population was eligible for both Medicare and Medicaid benefits. This may represent a higher risk population and the results may not be generalizable to other populations. However, patients enrolled in Medicaid were a significant proportion of all Medicare patients with AMI (26%) in our state. In addition, these patients have prescription pharmacy benefits, which remove the financial barrier of obtaining their medications.

In conclusion, our study suggests that a significant proportion of patients who are discharged on beta-blockers after AMI do not fill their prescription as outpatients. Discharge administration of beta-blockers is the strongest predictor of continued use. The use of these drugs is less than optimal in all groups of patients, with elderly patients at the highest risk. New outpatient prescriptions for those not discharged on beta-blockers are infrequent. Quality improvement efforts should focus on improving discharge planning and should continue for at least one month and preferably up to six months post-AMI.

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REFERENCES

1. Beta-Blocker Heart Attack Study Group. The beta-blocker heart attack trial. JAMA 1981;246:2073–4.
2. Hjalmarson A, Elmfeldt D, Herlitz J, et al. Effect on mortality of metoprolol in acute myocardial infarction: a double-blind randomized trial. Lancet 1981;2:823–7.
3. Ryan TJ, Anderson JL, Antman EM, et al. ACC/AHA guidelines for the management of patients with acute myocardial infarction. A report

of the ACC/AHA Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction). J Am Coll Cardiol 1996;28:1328–428.
4. Krumholz HM, Radford MJ, Wang Y, Chen J, Heiat A, Marciniak TA. National use and effectiveness of beta-blockers for the treatment of elderly patients after acute myocardial infarction: National Cooperative Cardiovascular Project. JAMA 1998;280:623–9.
5. Soumerai SB, McLaughlin TJ, Spiegelman D, Hertzmark E, Thinault G, Goldman L. Adverse outcomes of underuse of beta-blockers in elderly survivors of acute myocardial infarction. JAMA 1997;277:115–21.
6. Gottlieb SS, McCarter RJ, Vogel RA. Effect of beta-blockade on mortality among high-risk and low-risk patients after myocardial infarction. N Engl J Med 1998;339:489–97.
7. Andrade SE, Walker AM, Gottlieb LK, et al. Discontinuation of antihyperlipidemic drugs—do rates reported in clinical trials reflect rates in primary care settings? N Engl J Med 1995;332:1125–31.
8. Storm BL, Carson JL. Use of automated databases for pharmacoepidemiology research. In: Epidemiologic Reviews. 12th edition. Baltimore, MD: The Johns Hopkins University of Hygiene and Public Health, 1990:87–107.
9. Johnson RE, Vollmer WM. Comparing sources of drug data about the elderly. J Am Geriatr Soc 1991;39:1079–84.
10. Marciniak TA, Ellerbeck EF, Radford MJ, et al. Improving the quality of care for Medicare patients with acute myocardial infarction: results from the Cooperative Cardiovascular Project. JAMA 1998;279: 1351–7.
11. Zhang J, Yu KF. What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes. JAMA 1998;280: 1690–1.
12. Heller DA, Ahern FM, Kozak M. Changes in rates of beta-blocker use between 1994 and 1997 among elderly survivors of acute myocardial infarction. Am Heart J 2000;140:663–71.
13. Avorn J, Monette J, Lacour A, et al. Persistence of use of lipid-lowering medications: a cross-national study. JAMA 1998;279:1458–62.
14. Chen J, Radford MJ, Wang Y, Marciniak TA, Krumholz HM. Are beta-blockers effective in elderly patients who undergo coronary revascularization after acute myocardial infarction? Arch Intern Med 2000;160:947–52.
15. Chen J, Marciniak TA, Radford MJ, Wang Y, Krumholz HM. Beta-blocker therapy for secondary prevention of myocardial infarction in elderly diabetic patients: results from the National Cooperative Cardiovascular Project. J Am Coll Cardiol 1999;34:1388–94.
16. Chen J, Radford MJ, Wang Y, Marciniak TA, Krumholz HM. Effectiveness of beta-blocker therapy after acute myocardial infarction in elderly patients with chronic obstructive pulmonary disease or asthma. J Am Coll Cardiol 2001;37:1950–6.
17. McCormick D, Gurwitz JH, Lessard D, Yarzebski J, Gore JM, Goldberg RJ. Use of aspirin, beta-blockers, and lipid-lowering medications before recurrent acute myocardial infarction. Missed opportunities for prevention. Arch Intern Med 1999;159:561–7.
18. Jencks SF, Cuerdon T, Burwen DR, et al. Quality of medical care delivered to Medicare beneficiaries. A profile at state and national levels. JAMA 2000;284:1670–6.
19. Fonarow GC, Gawlinski A, Moughrabi S, Tillisch JH. Improved treatment of coronary heart disease by implementation of a Cardiac Hospitalization Atherosclerosis Management Program. Am J Cardiol 2001;87:819–22.
20. Guidelines Applied in Practice. ACC. Available at: http://www.acc.org/gap/gap.htm. Accessed: January 6, 2002.
21. Get With the Guidelines. AHA. Available at: http://www.americanheart.org. Accessed: January 6, 2002.
22. Quality of Care—Peer Review Organization Priorities. Available at: http://www.hcfa.gov/quality/11a1-b.htm. Accessed: January 6, 2002.
23. Joint Commission Information on Final Specifications for National Implementation of Hospital Core Measure. Available at: http://www.jcaho.org/perfmeas/coremeas/AMI_5. Accessed: .
24. Phillips KA, Shlipak MG, Coxson P, et al. Health and economic benefits of increased beta-blocker use following myocardial infarction. JAMA 2000;284:2748–54.
25. Balkrishnan R. Predictors of medication adherence in the elderly. Clin Ther 1998;20:764–71.
26. Cabana MD, Rand CS, Powe NP, et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. JAMA 1999;282:1458–65.
27. Dargie HJ. Effect of carvedilol on outcome after myocardial infarction in patients with left-ventricular dysfunction: the CAPRICORN randomized trial. Lancet 2001;357:1385–90.
28. Ryan AA. Medication compliance and older people: a review of literature. Int J Nursing Stud 1999;36:153–62.
29. Haynes RB, Montague P, Oliver T, McKibbon KA, Brouwers MC, Kanani R. Interventions for helping patients to follow prescription medications. Cochrane Database Syst Rev 2001;3:1–34.
30. Bradley EH, Holmboe ES, Mattera JA, Roumanis SA, Radford MJ, Krumholz HM. A qualitative study of increasing beta-blocker use after myocardial infarction. Why do some hospitals succeed? JAMA 2001; 285:2604–11.
31. Barron HV, Viskin S, Lundstrom RJ, et al. Beta-blocker dosages and mortality after myocardial infarction data from a large health maintenance organization. Arch Intern Med 1998;158:449–53.