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Process of care and outcome after acute myocardial infarction for patients with mental illness in the VA health care system: are there disparities?

[Health Services Research](#), Feb, 2003, by [Laura A. Petersen](#), [Sharon-Lise T. Normand](#), [Benjamin G. Druss](#), [Robert A. Rosenheck](#)

Disparities in health care use and outcome are receiving increasing attention. Of particular concern are findings of lower rates of health care utilization among certain vulnerable groups, such as minorities (Wenneker and Epstein 1989; Hannan et al. 1991; Ayanian et al. 1993; Whittle et al. 1993; Peterson et al. 1997; Peterson et al. 1994; Kressin and Petersen 2001), the elderly (Giugliano et al. 1998; Gatsonis et al. 1995; Rosenthal and Fortinsky 1994), women (Steingart et al. 1991; Ayanian and Epstein 1991), and those with mental illness (Druss, Bradford et al. 2000). Taken together, these findings suggest that vulnerable patients may not be receiving therapies of known benefit.

For patients with mental disorders, the impact of underuse of proven therapies on patient outcome is probably substantial. We know that patients with coexistent depression and acute myocardial infarction suffer from higher mortality after acute myocardial infarction (Ahern et al. 1990). A portion of this excess mortality may be due to poor quality of care, because patients with mental disorders are less likely than those without mental illness to receive some therapies of known benefit (Druss, Bradford et al. 2001).

If patients with mental disorders are vulnerable to underuse of proven therapies, the question is raised whether any systems of care might attenuate or eliminate underuse of care. The literature to date implies that the present health care system may not equitably provide needed care to vulnerable groups. One reason for this may be the lack of integration of the continuum of health care services in most settings (Druss, Rohrbaugh et al. 2001). Studies comparing health care outcomes for racial minorities in integrated health care settings have shown fewer disparities (Jha

et al. 2001; Petersen et al. 2002; Taylor et al. 1997). Thus, we chose to study use of proven therapies after acute myocardial infarction in patients with mental illness in the Veterans Health Administration (VA), the largest vertically integrated health care system in the United States, providing care to nearly 3.5 million veterans annually (Iglehart 1996). The VA is structured such that mental illness is treated in a fully integrated system providing comprehensive mental health and general medical care (Druss and Rosenheck 2000). This integration is achieved by physical proximity, common medical records, shared administrative leadership, and frequent interaction. In the non-VA setting, most people with serious mental illness are treated in state mental health systems that are not connected to any general health care system.

The goals of this study were to compare process of care and outcome after acute myocardial infarction for patients with and without mental illness cared for in the VA. As part of our comparison, we examined subgroups of patients determined by clinical need for coronary angiography and patients who were considered ideal candidates for medical therapies to assess possible underuse.

METHODS

Identifying Patients with Acute Myocardial Infarction

This was a retrospective cohort study using clinical data from chart review. We identified all male patients with a primary diagnosis of acute myocardial infarction (International Classification of Diseases, 9th Revision, Clinical Modification [The International Classification of Diseases 1992] [ICD-9-CM]-410 [excluding a fifth digit of two, indicating acute myocardial infarction in the prior eight weeks]) discharged between January 1, 1994 and September 30, 1995, using the Patient Treatment File, the centralized national discharge database of all VA utilization (Petersen et al. 1999). This yielded an eligible cohort of 13,310 patients discharged from the 139 acute care VA facilities nationwide.

Because procedure utilization varies based upon the on-site availability of cardiac procedures across facilities (Wright et al. 1997; Every, Larson, and Litwin 1993; Blustein 1993), we sampled patients from the 13,310 eligible patients stratified by hospital cardiac service capability. Each of the 139 VA facilities was classified as one of four types: "Noncatheterization" hospitals do not have on-site catheterization, percutaneous transluminal coronary angioplasty (PTCA), or coronary artery bypass graft (CABG) services; noncatheterization hospitals were further divided into "high" and "low" acute myocardial infarction volume. Low volume was defined as the lowest quartile of acute myocardial infarction admissions, and high were the other three quartiles. "Cardiac-catheterization-only" hospitals have on-site catheterization but no revascularization capability. "Cardiac surgery" hospitals have all cardiac procedures available on-site. From the 139 acute care VA facilities in the United States, we randomly chose 81 hospitals stratified within each of the four types of hospitals. Within each of the hospitals, we randomly sampled up to 100 acute myocardial infarction patients if there were more than 100. We thus generated a stratified national random sample of 5,503 VA patients. Of these, 94.4 percent of the records were retrieved for review. After excluding those who did not meet clinical criteria for acute myocardial infarction (Marciniak et al. 1998), patients discharged to an acute care non-VA facility, and those with incomplete information (such as missing discharge date or date of birth), we identified 4,760 veterans discharged from 81 VA facilities. From these, we matched 4,340 (91.2 percent) admission and discharge records to Patient Treatment File records for assessment of mental health diagnostic codes.

Identification of Patients with Mental Illness

We used the Patient Treatment File and the Outpatient Care File to identify those with mental illness. In addition to identifying those with an inpatient stay who had a psychiatric diagnosis, we also identified patients who had received services from a VA general psychiatry specialty clinic or from a specialized substance abuse clinic during the year prior to their admission for acute myocardial infarction. Specialty clinic codes available in VA's Outpatient Care File, a comprehensive outpatient workload database, were used to make this determination (Kashner 1998). These utilization data were used as proxies for diagnostic data that were not available from the Outpatient Care File at the time of this study.

Definition of Mental Illness

Those with mental illness or substance abuse problems were patients who had an admission to an inpatient psychiatric or substance abuse unit in the 365 days prior to the index admission for the acute myocardial infarction event; or had a secondary psychiatric diagnosis (ICD-9-CM codes Schizophrenia [295 .xx]; Other Psychoses [297 .xx-299 .xx]; Bipolar [296.0 x, 296.1 x, 296.40-296.89]; Major Depression [296.2-296.39]; or Post Traumatic Stress Disorder [309.81]) or substance use diagnosis (Alcohol 303 .xx or 305.00; Drug 292.0 1-292.99 or 304. xx or 305.2-305.99) on the index admission for acute myocardial infarction; or had received specialized outpatient psychiatric or substance abuse services during the 365 days prior to the index admission for acute myocardial infarction.

Clinical Data Sources

We used the Cooperative Cardiovascular Project (Jencks 1994) structured review instrument to obtain medical

record data. Variables collected from the medical record included patient demographics, symptoms upon presentation, past medical history, laboratory values, test findings, procedure utilization, and hospital course. Medical record data were entered by trained nurses directly into a computer database, using the Cooperative Cardiovascular Project interactive software (Ellerbe et al. 1995). Overall variable agreement was 96 percent for data abstraction (Petersen et al. 2000).

Procedure Utilization

Because a significant percentage of elderly VA patients may undergo procedures under Medicare financing (Wright, Petersen, and Daley 1999), we assessed use of angiography, angioplasty, or bypass surgery both during the index hospitalization as well as in the 90 days after the index admission in either VA or under Medicare financing.

Identification of Patients with Clinical Need for Diagnostic Angiography. We identified patients with clinical need for diagnostic angiography more than 12 hours after symptom onset but prior to hospital discharge using consensus ratings based upon the RAND methodology (Brook et al. 1986). The development of appropriateness ratings for angiography has been described elsewhere (Bernstein et al. 1992; Bernstein et al. 1993) as have the methods used to update 1992 recommendations (Landrum and Normand 1999) and validate such ratings (Hemingway et al. 2001; Normand et al. 2001).

The clinical indications describing the appropriateness of angiography before discharge were defined by the patient's age, the time since symptom onset, the prior use of thrombolytic therapy, the presence of strong contraindications to thrombolytic therapy, and the presence of conditions complicating the acute myocardial infarction. Patients were classified into these indications using information abstracted from medical records. Each clinical indication is associated with one of four mutually exclusive and exhaustive recommendations summarized from the consensus ratings: (1) necessary, the procedure is the best option available to the patient; (2) appropriate but not necessary, the benefits exceed the risks; (3) equivocal, the benefits and risks are equal; and (4) inappropriate, the risks exceed the benefits. We assigned a recommendation to each patient and considered patients with a "necessary" recommendation as those having a clinical need for diagnostic angiography. We focused upon those deemed clinically necessary to best assess underuse of angiography.

Use of Medications

Ideal candidates for thrombolysis, beta-blockers, angiotensin converting enzyme (ACE) inhibitors, and aspirin were identified using recommendations from the American College of Cardiology (ACC)/American Heart Association (AHA) Guidelines for the Treatment of Acute Myocardial Infarction (Ryan et al. 1996). Criteria for medical therapies are given in Table 1. We excluded patients with contraindications to therapy whether they received the therapy or not.

Mortality

All cause mortality was determined using the inpatient discharge status from the Patient Treatment File as well as from the VA Beneficiary Identification and Record Location Subsystem (BIRLS) (Fleming et al. 1992; Fisher et al. 1995).

STATISTICAL ANALYSIS

We calculated the frequency of comorbid conditions, admission characteristics, and other inclusion characteristics (Normand et al. 1996). Chi-square tests and t-tests were used to examine differences between those with and without mental illness for discrete-valued and continuous-valued variables respectively. When appropriate, we

also tabulated the frequency of missing data.

Cardiac Procedure Use and Mortality Differences

Overall cardiac procedure utilization and mortality rates were calculated for those with and without mental illness. We estimated the percentage of patients who underwent PTCA and CABG conditional upon undergoing in-hospital angiography and compared the two groups using chi-square tests. Age-adjusted relative risks and corresponding 95 percent confidence intervals were constructed to compare use between the two groups.

Because underuse of diagnostic angiography cannot be assessed in the absence of judgment of clinical need, we also examined cardiac procedure use and mortality among the subset of patients for whom diagnostic angiography was considered clinically necessary using the procedures described above.

Sensitivity to Choice of Guideline. To ensure that our findings were consistent across different methods for determining clinical need, we also used recommendations for angiography from the American College of Cardiology (ACC)/American Heart Association (AHA) Guidelines for the Treatment of Acute Myocardial Infarction (Ryan et al. 1996). The procedures for development of the guidelines have been previously described. We defined patients with clinical need for angiography as patients falling into "Class I" of the guidelines. According to the guideline, these are "Conditions for which there is evidence and/or general agreement that a given procedure or treatment is beneficial, useful, and effective."

Mortality Differences. Because the two groups differed in some clinical characteristics that might confound mortality comparisons, we controlled for the comorbidity burden of patients (Pilote et al. 1996; Spertus et al. 1995) as well as characteristics of the admitting hospital (teaching affiliation, availability of cardiac services, and number of beds). The adjusted odds ratios (OR) were modeled via a hierarchical logistic regression model (Gatsonis et al. 1993) in order to account for within-hospital clustering of patients, and estimated using the Bayesian inference Using Gibbs Sampling (BUGS) software (Gilks 1994). Estimates of the adjusted ORs and corresponding 95 percent confidence intervals were constructed.

Medication Use

To determine whether there was differential use of specified cardiac medications between the two groups of patients, we calculated the relative risk (RR) of use of a therapy in a patient with mental illness relative to a patient without mental illness. The RRs were estimated with the Cochran-Mantel-Haenszel statistic (Agresti 1990) using the SAS system (SAS Institute, Inc., Cary, NC). Because increasing age has been shown to decrease the likelihood of receipt of medications after acute myocardial infarction (Giugliano et al. 1998; Gatsonis et al. 1995; Rosenthal and Fortinsky 1994) we adjusted each RR by age, using five-year age intervals. We calculated the RRs for all patients discharged alive as well as for those who were known to be ideal candidates for medications, using the criteria in Table 1.

RESULTS

Patient Characteristics

There were 859 (19.8 percent) patients meeting the definition of mental illness. Of those, 284 (33.1 percent) had a history of substance use disorder. Table 2 displays the characteristics of the patients in the cohort. Patients with mental illness were significantly younger than those without mental illness (63.0 versus 66.7 years, respectively; $p < 0.001$). Patients with mental illness had similar rates of diabetes mellitus, cancer, prior myocardial infarction, or prior bypass surgery as those without mental illness. Patients with mental illness were more likely than those without mental illness to suffer from a history of hepatic cirrhosis, and less likely to suffer from a history of

congestive heart failure or hypertension.

There were no differences in severity of acute myocardial infarction at the time of arrival in those with and without mental illness as measured by low systolic blood pressure or ST elevation on electrocardiogram. There were also similar rates of renal disease between the two patient groups.

Patients with mental illness were significantly more likely than those without mental illness to meet modified RAND criteria for clinical necessity of angiography more than 12 hours after admission (55.7 percent versus 50.0 percent respectively; $p = 0.002$). There were no differences in the percentage of those with and without mental illness who were considered Class 1 according to the American College of Cardiology (ACC)/American Heart Association (AHA) Guidelines for the Treatment of Acute Myocardial Infarction (Ryan et al. 1996).

Mortality

The age-adjusted RRs for 30-day and one-year mortality for patients with mental illness versus those without mental illness were 0.98 (95 percent confidence interval 0.79, 1.20) and 1.13 (0.98, 1.29) respectively. However, because those with and without mental illness differed in some of the characteristics displayed in Table 2, we used multivariate adjustment for mortality comparisons. We fitted a logistic regression model adjusting for patient comorbidity, demographic, and other factors known to predict mortality after acute myocardial infarction. (Petersen et al. 2000). The risk-adjusted OR for death within 30 days was 1.00 (0.75,1.32), and for death within one year was 1.25 (1.00,1.53).

Use of Cardiac Procedures

Cardiac procedure rates for those with and without mental illness are displayed in Table 3. Rates of diagnostic angiography during the index admission in those with mental illness were slightly lower than in those without mental illness (41.2 percent versus 43.4 percent respectively; age-adjusted RR 0.90 [0.83,0.98]). When the time window for angiography was expanded to 90 days after the index admission, and angiography in either VA or under fee-for-service Medicare financing was considered, patients with mental illness were again less likely to undergo diagnostic angiography (age-adjusted RR 0.88 [0.81, 0.94]), although the absolute difference in rates was only 4.0 percent.

Of those who underwent in-hospital angiography, the in-hospital PICA rates for those with and without mental illness were 26.3 percent versus 27.6 percent, respectively (age-adjusted RR 0.92 [0.76, 1.11]). Of those who underwent in-hospital angiography, the in-hospital CABG rates were 13.0 percent versus 16.2 percent (age-adjusted RR. 0.80 [0.60, 1.071]). When in hospital PICA and CABG were combined as any revascularization, the rates were 38.7 percent versus 42.4 percent (age-adjusted RR. 0.89 [0.77, 1.02]).

These findings were similar when the time window for PTCA or CABG revascularization procedure use was expanded to 90 days, and procedures in either VA or under Medicare financing were considered.

Table 4 displays findings among only those patients for whom angiography was considered necessary according to the RAND criteria. Patients with mental illness who were eligible for angiography more than 12 hours after arrival were marginally less likely than those without mental illness to undergo angiography (52.6 percent versus 57.5 percent, respectively; age-adjusted RR 0.89 [0.80,0.99]). There were no significant differences between those with and without mental illness in age-adjusted CABG or PTCA rates or age-adjusted 30-day or one-year mortality among patients for whom angiography was necessary. When we repeated our procedure use analyses using the ACC/AHA criteria, the findings did not change.

EFFECTS IN SUBGROUPS OF PATIENTS WITH MENTAL ILLNESS

Analyses in subgroups of patients with mental illness alone, or substance use disorder alone, or both mental illness and substance abuse disorder, resulted in similar findings. There were no significant differences in use of angiography or 30-day or one-year mortality for these subgroups when compared to those without mental illness, though power was limited by small sample sizes.

Use of Medications

Patients with and without mental illness were equally likely to receive medications of known benefit except for the case of beta-blockers in the entire population (Table 5). Patients with mental illness were less likely to receive beta-blockers, possibly because of concern about potential interactions with certain antidepressants. When use of beta-blockers among ideal candidates (excluding those with depression) was assessed, we found no significant difference in use of beta-blockers (63.9 percent versus 68.3 percent; age-adjusted RR 0.92 [0.82, 1.02]).

DISCUSSION

In this study, we assessed care for a vulnerable group of patients in the VA health care system. Examining a variety of process-of-care measures, including guideline-based angiography procedures and medication use, we found that patients with and without mental illness were marginally less likely to receive angiography or revascularization, and equally likely to receive medications of known benefit after acute myocardial infarction. Mortality at one year may have been higher, although in contrast with other studies (e.g., Druss, Bradford et al. 2001), this finding did not reach statistical significance. Advantages of this study include the national sample, the diverse age group, and the availability of both inpatient and outpatient clinical data sources for assessment of mental illness.

In contrast to other studies of those with mental illness, which have reported significantly higher mortality (Druss, Bradford et al. 2001; Frasure-Smith 1991; Frasure-Smith, Lesperance, and Talajic 1993; Felker, Yazel, and Short 1996; Black 1998; Tsuang, Perkins, and Simpson 1983; Penninx et al. 1999; Wulsin, Vaillant, and Wells 1999; Barefoot and Schroll 1996; Barefoot et al. 1996) and lower rates of use of cardiac procedures (Druss, Bradford et al. 2000), we found minimal differences in both process and outcomes of care in this VA sample. Since some of these other studies were carried out among older patients, and older patients are less likely than younger patients to receive therapies for acute myocardial infarction (Giugliano et al. 1998; Gatzonis et al. 1995; Rosenthal and Fortinsky 1994), we wondered whether restricting our analyses to patients aged 65 and older would yield findings similar to those of other authors.

In the subset of patients aged 65 and older, adjusted analyses showed that those with mental illness were significantly less likely to undergo coronary angiography in the 90 days after the index acute myocardial infarction event (RR 0.80 [0.70,0.91]). However, conditional upon undergoing coronary angiography within 90 days, there were no differences in those with and without mental illness in use of revascularization in the 90 days following admission (age-adjusted RR 1.07 [0.90, 1.26]). There were also no differences in risk-adjusted 30-day or one-year mortality in the subset of these older patients, nor in use of medical therapies. Findings from these subset analyses suggest that our results are not merely due to the younger age of the VA patient population.

Jha et al. (2001) showed lower mortality for African Americans admitted to the VA health care system for six common medical diagnoses (angina, congestive heart failure, pneumonia, chronic obstructive pulmonary disease, diabetes, and chronic renal failure). We also found smaller mortality differentials but also smaller variation in quality-of-care indicators for patients with mental disorders. The relatively uniform quality of the care delivered in the VA health care system may be an important factor underlying the lack of mortality differences seen in the vulnerable populations treated.

Why might disparities in health care use and mortality for vulnerable patients be attenuated in VA health care

settings? In addition to being a system where the delivery of medical care and mental health care is integrated by proximity and leadership structure (Druss, Rohrbaugh et al. 2001), the VA is a national system with a common electronic information system for patient data, and national care and quality monitoring standards (Kizer, Demakis, and Feussner 2000). In the VA, there is dissemination of information on best practices to practitioners (Feussner, Kizer, and Demakis 2000), collection and monitoring of data (Daley et al. 1997), and provision of feedback on performance measures to clinicians (Kizer, Demakis, and Feussner 2000). Furthermore, access to VA health care requires fewer financial resources than non-VA health care. In fact, one criterion for free care in the VA is an income qualification. This feature may be particularly important for the patient group assessed here. All of these may limit variation in the measures we assessed.

Another possible explanation is that the VA health care system treats large numbers of patients with mental illness (Rosenheck and Dilella 2000; Norquist et al. 1990), and mental health care accounts for 14 percent of VA expenditures (Rosenheck and Dilella 2000). Because of the volume of patients with mental illness treated in the VA, there is greater experience and overall quality of medical care for patient groups characterized by social instability, financial barriers, and stigma (Gelberg, Andersen, and Leake 2000). Indeed, for other conditions, hospitals that provide high volume care for particular conditions tend to have better outcomes (Thiemann et al. 1999; Dudley et al. 2000). In this situation, the VA health care system is delivering high-volume medical care to patients with mental disorders.

In general, why might patients with mental illness be less likely to undergo diagnostic angiography or to receive other types of beneficial treatment? Possible explanations for the differential use of health care in patients with mental illness include difficulties with obtaining informed consent (Shander 2000), patient preferences and lack of trust, poor compliance (DiMatteo, Lepper, and Croghan 2000), physicians' inaccurate estimates of disease prevalence (Graber et al. 2000), and physician bias (Schulman et al. 1999).

Our study is limited by the lack of detailed clinical information on patient symptoms of mental illness. Thus, our findings generalize only to patients with well-documented mental illness, those who are likely to have the most serious mental illnesses, and those with the greatest frequency of behavioral comorbidities (Kessler et al. 1999). Also, the acute condition we chose to study may be relatively insensitive to disparities in care for patients with mental illness. Had we chosen a chronic disease, such as diabetes, or a preventive care service requiring multiple steps for completion (Druss et al. 2002), we might have found greater disparities in care.

We had more than 90 percent power to detect an absolute difference of 10 percent or greater for the comparisons presented in Tables 3 and 4, except for the comparison of angioplasty in Table 4, where we had 77 percent power to show such a difference. In terms of medication use, we were sufficiently powered for all comparisons except for beta-blockers, thrombolytic therapy, and ACE inhibitors in ideal candidates. Lastly, because this is a retrospective, observational study, there is always the possibility that unmeasured confounders may have biased our findings.

In summary, we found similar process of care and outcome for patients with and without mental illness treated in an integrated health care system. Our findings are not explained solely by the younger age of patients in our sample. These findings are consistent with studies demonstrating reduced health care disparities for other vulnerable groups, such as racial minorities (Jha et al. 2001; Petersen et al. 2002; Taylor et al. 1997), and suggest that an integrated health care system such as the VA may attenuate such disparities for vulnerable groups of patients. The features that attenuate these disparities could be due to the lack of financial barriers for health care, the integrated nature of health care delivery and the strong systems in place for quality monitoring and improvement, the volume of patients with mental health treated, or other possibilities. Further work should address the mechanism by which various health care systems might foster processes of care that narrow disparities in health care use and outcome for vulnerable patients such as these.

Table 1

Criteria for Ideal Candidates and Subsets of Ideal Candidates Who Would Benefit Most from Medical Therapies (Ryan et al. 1996)

Thrombolytic Therapy:

Presentation Within 12 hours of onset of symptoms AND
 ST elevation in at least two leads or Left Bundle Branch Block (LBBB)
 on ECG AND
 No history of stroke or evidence of stroke on arrival AND
 No cardiopulmonary resuscitation (CPR) AND
 No recent trauma or surgery AND
 No angioplasty procedure in the first 12 hours after arrival AND
 No active bleeding or bleeding diathesis, and no elevation of the
 prothrombin time (PT) or international normalized ratio (INR).

Beta-blockers: (Krumholz et al. 1998)

Discharge systolic blood pressure greater than or equal to 100 AND
 Discharge pulse greater than or equal to 60 AND
 Absence of pulmonary edema, congestive heart failure, peripheral
 vascular disease, diabetes treated With insulin, shock, second or
 third degree heart block, asthma, chronic obstructive pulmonary
 disease (COPD), absence of depression, and absence of a reaction to
 beta-blocker drugs.

Angiotensin converting enzyme inhibitors: (Rutherford et al. 1994)

Discharge systolic blood pressure [greater than or equal to] 100 mm Hg
 AND
 Serum creatinine less than or equal to 2.0 mg/dL AND
 Absence of aortic stenosis AND
 Absence of a reaction to the medication.

Aspirin:

No bleeding or elevation of the PT or INR
 No treatment With warfarin on discharge
 No aspirin intolerance.

Table 2

Characteristics of Patients with and without Mental Illness Treated for
 Acute Myocardial Infarction in the Veterans Health Administration

COHORT	No Mental Illness
Sample Size	3,481
Patient Sociodemographic Characteristics	
Mean age (years, [+ or -] standard deviation)	66.7 (10.2)
Age categories (yrs)	
<50	271 (7.8)
50-59	507 (14.8)
60-64	621 (17.8)
65-69	665 (19.1)
70-74	705 (20.3)
75-79	437 (12.6)
>79	273 (7.8)
Race	
White	2904 (83.4)
Black	450 (12.9)
Other/unknown	127 (3.7)

Admission Characteristics

Time since chest pain started	
<6 hours	1984 (57.0)
6-12 hours	349 (10.0)
>12 hours	972 (27.9)
No pain	37 (1.1)
Unable to determine	139 (4.0)
Systolic blood pressure on arrival	
<100 mm Hg	276 (7.9)
[greater than or equal to] 100 mm Hg	3197 (91.8)
Not measured/missing	8 (0.2)
Admission Electrocardiogram (ECG)	
Not performed/missing	173 (5.0)
ST Elevation if ECG	1710 (51.7)
Ventricular tachycardia if ECG	23 (0.7)
Atrial fibrillation if ECG	260 (7.7)
Chest pain >60 minutes after arrival	1109 (31.9)
Comorbidities	
Congestive heart failure	562 (16.1)
Prior myocardial infarction	1192 (34.2)
Hypertension	2,146 (61.7)
Diabetes	1157 (33.2)
Diabetes treated with insulin	382 (11.0)
Asthma or chronic obstructive pulmonary disease	878 (25.2)
Chronic liver disease	18 (0.5)
History of stroke or uncontrolled hypertension	551 (15.8)
Test Results	
Creatinine	
< = 2.0 mg/dL	2929 (84.1)
> 2.0 mg/dL	278 (8.0)
Not measured/missing	274 (7.9)
Ejection fraction	
< 35%	367 (10.5)
[greater than or equal to] 35%	1012 (36.7)
Missing	824 (23.7)
Not measured	1278 (36.7)
Hospital Characteristics	
Admitting hospital type:	
Non-catheterization	1652 (46.5)
Catheterization-only	942 (27.1)
Cardiac surgery	887 (25.5)
Bedsize	
< 100 beds	93 (2.7)
100-500 beds	2618 (75.2)
> 500 beds	770 (22.1)
Teaching affiliation	2,775 (79.7)
Mortality	
Death during hospital stay	382 (11.0)
Death 30 days	429 (12.3)
Death one year	772 (22.2)
Length of stay (days, [+ or -] standard deviation)	13.0 (+14.7)
Recommendation for Angiography	
[[n(%)].sup.1]	

American College of Cardiology/ American Heart Association Guideline		
Class I	1,710 (66.4)	
Class IIa	477 (18.5)	
Class IIb	388 (15.1)	
RAND-based criteria for angiography		
Necessary	1,254 (50.0)	
Appropriate, not necessary	673 (26.8)	
Equivocal	583 (23.2)	
COHORT	Mental Illness	P-Value
Sample Size	859	
Patient Sociodemographic Characteristics		
Mean age (years, [+ or -] standard deviation)	63.0 (12.0)	<0.001
Age categories (yrs)		<0.001
<50	171 (19.9)	
50-59	135 (15.7)	
60-64	124 (14.4)	
65-69	139 (16.2)	
70-74	158 (18.4)	
75-79	84 (9.8)	
>79	47 (5.5)	
Race		0.52
White	722 (84.0)	
Black	113 (13.2)	
Other/unknown	24 (2.9)	
Admission Characteristics		
Time since chest pain started		0.07
<6 hours	472 (55.0)	
6-12 hours	74 (8.6)	
>12 hours	252 (29.3)	
No pain	16 (1.9)	
Unable to detennine	45 (5.2)	
Systolic blood pressure on arrival		0.74
<100 mm Hg	75(8.7)	
[greater than or equal to] 100 mm Hg	782 (91.0)	
Not measured/missing	2 (0.2)	
Admission Electrocardiogram (ECG)		0.92
Not performed/ missing	42 (4.9)	
ST Elevation if ECG	433 (53.0)	0.51
Ventricular tachycardia if ECG	5 (0.6)	0.78
Atrial fibrillation if ECG	50 (6.0)	0.08
Chest pain >60 minutes after arrival	281 (32.7)	0.63
Comorbidities		
Congestive heart failure	113 (2.6)	0.03
Prior myocardial infarction	287 (33.4)	0.64
Hypertension	498 (58.0)	0.05
Diabetes	259 (30.2)	0.08
Diabetes treated with insulin	94 (10.9)	0.98
Asthma or chronic obstructive pulmonary disease	220 (25.6)	0.82
Chronic liver disease	15 (1.8)	0.001
History of stroke or uncontrolled hypertension	129 (15.0)	0.56

Test Results		
Creatinine		0.21
< = 2.0 mg/dL	728 (84.8)	
> 2.0 mg/dL	55 (6.4)	
Not measured/ missing	76 (8.8)	
Ejection fraction		0.24
< 35%	74 (8.6)	
[greater than or equal to] 35%	260 (30.3)	
Missing	220 (25.6)	
Not measured	305 (35.5)	
Hospital Characteristics		
Admitting hospital type:		0.75
Non-catheterization	415 (48.3)	
Catheterization-only	236 (27.5)	
Cardiac surgery	208 (24.2)	
Bedsizes		0.02
< 100 beds	17 (2.0)	
100-500 beds	617 (71.8)	
> 500 beds	225 (26.2)	
Teaching affiliation	692 (80.6)	0.58
Mortality		
Death during hospital stay	80 (9.3)	0.16
Death 30 days	94 (10.9)	0.26
Death one year	195 (22.7)	0.74
Length of stay (days, [+ or -] standard deviation)	13.6 (+16.6)	0.34
Recommendation for Angiography [[n(%)].sup.1]		
American College of Cardiology/ American Heart Association Guideline		0.51
Class I	423 (66.5)	
Class IIa	108 (17.0)	
Class IIb	105 (16.5)	
RAND-based criteria for angiography		0.002
Necessary	346 (55.7)	
Appropriate, not necessary	125 (20.1)	
Equivocal	150 (24.2)	

(1)Denominator for these analyses are patients eligible for angiography more than 12 hours after admission under the criteria. For the RAND analysis, the denominator was 3,131. For the ACC analysis, the denominator was 3,211 patients.

Table 3

Age-Adjusted Cardiac Procedure Use in VA Patients with and without Mental Illness after Acute Myocardial Infarction

COHORT	No Mental Illness
Sample Size	3,481
During Index Hospital Stay n (%)	
Diagnostic angiography	1,510 (43.4)
Percutaneous transluminal coronary angioplast angioplasty, conditional upon angiography	416 (27.6)
Coronary artery bypass graft surgery, condition upon angiography	244 (16.2)
Any revascularization, condition upon	640 (42.4)

angiography	
In 90 Days after Index Admission n (%)	
Diagnostic angiography	1,784 (51.2)
Percutaneous transluminal coronary angioplastt, conditional upon angiography within 90 days	557 (31.2)
Coronary artery bypass graft Surgery, conditional upon angiography within 90 days	429 (24.0)
Any revascularization, conditional upon angiography within 90 days	941 (52.8)

COHORT	Mental Illness
Sample Size	859

During Index Hospital Stay n (%)	
Diagnostic angiography	354 (41.2)
Percutaneous transluminal coronary angioplast angioplasty, conditional upon angiography	93 (26.3)
Coronary artery bypass graft surgery, condition upon angiography	46 (13.0)
Any revascularization, condition upon angiography	137 (38.7)

In 90 Days after Index Admission n (%)	
Diagnostic angiography	405 (47.2)
Percutaneous transluminal coronary angioplastt, conditional upon angiography within 90 days	115 (28.4)
Coronary artery bypass graft Surgery, conditional upon angiography within 90 days	82 (20.2)
Any revascularization, conditional upon angiography within 90 days	191 (47.2)

COHORT	RR (95% CI) (2)
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Sample Size

During Index Hospital Stay n (%)	
Diagnostic angiography	0.90 (0.83, 0.98)
Percutaneous transluminal coronary angioplast angioplasty, conditional upon angiography	0.92 (0.76, 1.11)
Coronary artery bypass graft surgery, condition upon angiography	0.80 (0.60, 1.07)
Any revascularization, condition upon angiography	0.89 (0.77, 1.02)

In 90 Days after Index Admission n (%)	
Diagnostic angiography	0.88 (0.81, 0.94)
Percutaneous transluminal coronary angioplastt, conditional upon angiography within 90 days	0.89 (0.76, 1.05)
Coronary artery bypass graft Surgery, conditional upon angiography within 90 days	0.85 (0.69, 1.05)
Any revascularization, conditional upon angiography within 90 days	0.88 (0.79, 0.98)

(2)RR (95% CI) = Age-adjusted relative risk and 95 percent confidence interval for the relative risk.

Table 4

Age-Adjusted Cardiac Procedure Use and Mortality in VA Patients with and

without Mental Illness for Whom Angiography Was Clinically Necessary (3)
after Acute Myocardial Infarction

COHORT	No Mental Illness	Mental Illness
Sample	1,254	346
RAND "Necessary" for angiography		
Angiography, in hospital	721 (57.5)	182 (52.6)
Percutaneous transluminal coronary angioplasty, conditional upon angiography in hospital	223 (30.9)	56 (30.8)
Coronary artery bypass graft surgery, conditional upon angiography	142 (19.7)	29 (15.9)
Any revascularization, conditional upon angiography	349 (48.4)	84 (46.2)
30-day mortality	78 (6.2)	16 (4.6)
One-year mortality	165 (13.2)	53 (15.3)

COHORT RP (95% CI) (4)

Sample

RAND "Necessary" for angiography	
Angiography, in hospital	0.89 (0.80, 0.99)
Percutaneous transluminal coronary angioplasty, conditional upon angiography in hospital	0.95 (0.75, 1.21)
Coronary artery bypass graft surgery, conditional upon angiography	0.80 (0.56, 1.15)
Any revascularization, conditional upon angiography	0.93 (0.78, 1.10)
30-day mortality	0.80 (0.47, 1.35)
One-year mortality	1.26 (0.94, 1.68)

(3)The denominator is patients who are eligible for angiography more than 12 hours after arrival under the RAND criteria (n = 3,131). Definition of RAND "Necessary": the procedure is the best option available to the patient.

(4)RR (95% CI) = Age-adjusted relative risk and 95 percent confidence interval for the relative risk.

Table 5

Age-Adjusted Use of Medications in VA Patients with and without Mental Illness Treated for Acute Myocardial Infarction.

Group	No Mental Illness	Mental Illness
Thrombolytic therapy at arrival		
Sample size, all patients	3,481	859
Use in all patients	739 (21.2)	185 (21.5)
Sample size, ideal candidates only (6)	469	132
Use in ideal candidates only	286 (61.0)	84 (63.6)
Use of beta-blockers at discharge		
Sample size, all patients (7)	3,099	779
Use in all patients	1,715 (55.3)	394 (50.6)
Sample size, ideal candidates only (6)	813	191
Use in ideal only	555 (68.3)	122 (63.9)

Use of angiotensin converting enzyme inhibitors at discharge		
Sample size, all patients (7)	3,099	779
Use in all patients	1,248 (40.3)	293 (37.6)
Sample size, ideal candidates only (6)	229	40
Use in ideal candidates only	153 (66.8)	29 (72.5)
Use of aspirin at discharge		
Sample size, all patients (7)	3,099	779
Use in all patients	2,391 (77.2)	597 (76.6)
Sample size, ideal candidates only (6)	1,200	297
Use in ideal candidates only	1,016 (84.7)	254 (85.5)
	RR (95%	
Group	CI) (5)	
Thrombolytic therapy at arrival		
Sample size, all patients		
Use in all patients	0.96 (0.83,1.10)	
Sample size, ideal candidates only (6)		
Use in ideal candidates only	1.01 (0.88,1.18)	
Use of beta-blockers at discharge		
Sample size, all patients (7)		
Use in all patients	0.89 (0.83,0.96)	
Sample size, ideal candidates only (6)		
Use in ideal only	0.92 (0.82,1.02)	
Use of angiotensin converting enzyme inhibitors at discharge		
Sample size, all patients (7)		
Use in all patients	0.95 (0.86,1.05)	
Sample size, ideal candidates only (6)		
Use in ideal candidates only	1.09 (0.89,1.38)	
Use of aspirin at discharge		
Sample size, all patients (7)		
Use in all patients	0.99 (0.95,1.03)	
Sample size, ideal candidates only (6)		
Use in ideal candidates only	1.01 (0.96,1.07)	

(5)RR(95% CI) = Age-adjusted relative risk and 95 percent confidence interval for the relative risk.

(6)Definitions of ideal candidates for each therapy are given in Table 1.

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