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Acute Myocardial Infarction Quality of Care: The Strong Heart Study

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Abstract

Objectives—Evaluate the quality of care provided patients with acute myocardial infarction and compare with similar national and regional data.

Design—Case series.

Setting—The Strong Heart Study has extensive population-based data related to cardiovascular events among American Indians living in three rural regions of the United States.

Participants—Acute myocardial infarction cases (72) occurring between 1/1/2001 and 12/31/2006 were identified from a cohort of 4549 participants.

Outcome measures—The proportion of cases that were provided standard quality of care therapy, as defined by the Healthcare Financing Administration and other national organizations.

Results—The provision of quality services, such as administration of aspirin on admission and at discharge, reperfusion therapy within 24 hours, prescription of beta blocker medication at discharge, and smoking cessation counseling were found to be 94%, 91%, 92%, 86% and 71%, respectively. The unadjusted, 30 day mortality rate was 17%.

Conclusion—Despite considerable challenges posed by geographic isolation and small facilities, process measures of the quality of acute myocardial infarction care for participants in this American Indian cohort were comparable to that reported for Medicare beneficiaries nationally and within the resident states of this cohort.

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Keywords

Acute Myocardial Infarction; Ethnicity; Guideline Adherence; Outcome and Process Assessment; Quality Indicators

Introduction

Differences in utilization of health care services and the quality of those services between geographic regions of the United States exist.[1,2] Public policy, guidelines, and health care organizations have attempted to address these differences. In 1992 the Healthcare Financing Administration, now the Center for Medicare/Medicaid Services (CMS), initiated the Cooperative Cardiovascular Project with the goal of improving the quality of care for acute myocardial infarction (AMI) nationally.[3] Standards were developed for the evaluation of quality care based on the guidelines of the American College of Cardiology and the American Heart Association.[4] The initial results from this national survey of AMI quality care was presented in 1998[5] and a follow-up survey reported in 2003.[6] National performance since 1999 has been evaluated primarily on the basis of data from voluntary reporting systems, such as the National Registry of Myocardial Infarction,[7] The National Cardiovascular Data Registry,[8] the CMS and Hospital Quality Alliance Program (begun in 2004), and the American Heart Association's *Get With The Guidelines* coronary artery disease program.[9]

There have been efforts to use these programs and quality measures to determine the role they play in the known cardiovascular disease disparities among minority populations.[10,11] Cardiovascular disease accounts for a large proportion of morbidity and mortality among American Indians.[12,13] Yet, studies of cardiovascular disease quality of care among American Indians are limited.[14–16]

The Strong Heart Study is a longitudinal cohort study of cardiovascular disease and its risk factors in American Indians. It is the longest-running population-based cohort study among American Indians with centers in three primarily rural geographic regions in the United States. It has rich demographic and clinical data including physician adjudicated cardiovascular events. In this study, we describe AMI quality care measures from the Strong Heart Study and then compare them to previously published studies from CMS.

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Methods

Strong Heart Study

The American Indian communities participating in the Strong Heart Study (SHS), the study design, survey methods and laboratory techniques have been described previously in detail.[17,18] Briefly it is a population based cohort of 4549 participants aged 45 to 74 years that began in 1989. At baseline and two subsequent follow-up periods approximately 4 and 8 years from baseline, a physical examination, fasting venipuncture, standardized blood pressure measurements, and electrocardiograms were obtained.[17,18]

Cardiovascular Disease Events

Ascertainment of fatal and nonfatal cardiovascular events was accomplished by medical record review and/or yearly participant contact followed by physician adjudication.[17,18] Trained medical record abstractors reviewed medical records for all potential coronary artery disease events or interventions, including procedures diagnostic of coronary artery disease, (eg, treadmill test, coronary angiography). Using information from the medical records, death certificates, and standard criteria, trained physician adjudicators then determined the specific coronary artery disease diagnosis according to standardized criteria.[17,18]

Acute Myocardial Infarction Cases

We included cases if they had sustained a SHS-defined, definite AMI, either fatal or non-fatal, between January 1, 2001 and December 31, 2006.[17,18] The definition did not differentiate between ST segment elevation AMI or non-ST segment elevation AMI cases. We excluded participants with a diagnosis of possible AMI, or an AMI occurring during an acute hospitalization for another medical condition. Additionally, we excluded one case because the time between AMI diagnosis and subsequent, elective referral was an extreme outlier at 23 days.

Acute Myocardial Infarction Quality of Care

The AMI's ascertained for the present study almost invariably included transfer to tertiary care facilities, due to the very rural nature of the populations and the lack of invasive procedure capability of most local facilities. Beyond this, the quality of care criteria we evaluated are similar to those of the previous CMS studies.[5,6,19] Table 1 shows the quality of care standards that were incorporated into an abstraction algorithm used by SHS physician reviewers.

Demographic and Clinical Characteristics

Participants were defined as having diabetes according to 1997 American Diabetes Association criteria.[20] Participants were defined as having hypertension if they were taking anti-hypertensive medications, had a systolic blood pressure ≥140 mm Hg, or a diastolic blood pressure ≥90 mm Hg. The prevalence of hypertension, diabetes or prior cardiovascular event was calculated from those cases with evidence of this morbidity at any point from the baseline exam until the index AMI. Other covariate values, such as tobacco use, body mass index, and serum creatinine, were determined from the Phase I baseline examinations conducted between July 1989 and January 1992, not from primary data collected through the AMI medical records. The reason for this is the lack of data from the subsequent exam in some cases, as well as the fact that most cardiovascular disease (CVD) risk factors require a substantial time period to exert their influence and thus earlier status may be more influential than the most current condition.

Medical facilities, such as outpatient clinics, Indian Health Service (IHS) hospitals, and rural hospitals, providing care at the initial contact are categorized for the purpose of this study as primary care centers (PCC). In contrast, those facilities with cardiac catheterization capability are defined as tertiary care centers (TCC).

Analysis

We calculated the proportion of AMI cases among total cardiovascular events ascertained and the proportion from each SHS center. Then among the AMI cases, descriptive statistics of proportion, range, mean, and median, and where appropriate, of demographic and clinical characteristics, were determined. We calculated the time from onset of symptoms to contact with medical care, time at PCC until transfer to TCC, and travel time from the PCC to TCC and present the range, mean, and median values.

Next we calculated the proportions and 95% confidence intervals, where appropriate, using approximation to the binomial distribution for the AMI quality of care measures and criteria. For each measure or criterion, we present the number eligible, number with contraindications, number for whom it was indicated, and the number who actually received the measure or criterion. Chi-square statistics were used to determine statistical significance for comparison of proportions with a 2-tailed $P<.05$ being considered statistically significant. Statistical analysis was conducted with SPSS, version 10.1.0.

This study was modeled after efforts by CMS and others to improve understanding of and effect change in the geographic and institutional variability of clinical practices and underutilization of known effective treatments. Initial reports[5,19] used the extensive national data collected on Medicare reimbursed services and more limited subsets of the same data set, such as those focused on urban/rural differences.[3] The most recent publication of strictly Medicare data[6] is from the 1998–99 era; but additional analysis was obtained from CMS contractors for 2004 (Dr. D.S. Nilasena, Region VI, CMS, personal communication). Additionally we abstracted 4 state averages for the SHS states of Arizona, North Dakota, Oklahoma and South Dakota. From 1990 until 2006 the National Registry of Myocardial Infarction collected data on 5 cohorts through a voluntary system sponsored by Genentech.[21] We present data from rural Alberta, Canada to lend additional perspective.[22] We present in tabular format our results with the above mentioned studies for the use of aspirin, beta blocker, and ACE inhibitor (ACE-I), and reperfusion done at time of admission or during inpatient therapy. We also looked at aspirin, beta-blocker, and ACE-I treatment and smoking cessation counseling at the time of discharge.

Approval for this study was obtained from relevant institutional review boards and tribes.

Results

Among 4549 Strong Heart Study participants, there were 138 potential AMI events ascertained from 1/1/2001 to 12/31/2006, including 80 definite and 58 possible AMI by SHS criteria. After exclusions, 72 cases remained for analysis. Of these, 29% (*n*=21) were from the Arizona center, 53% (*n*=38) from the Dakota center, and 18% (*n*=13) from the Oklahoma center.

Baseline demographics, clinical characteristics, and timing to care or transfer among the AMI cases are described in Table 2. The high prevalence of adverse comorbidities, such as current smoking (39%), diabetes mellitus (74%), hypertension (72%) and obesity (median BMI of 30.5) is noted. Among ideal candidates (those without contraindications), the utilization rates of inpatient ASA, beta blockers and ACE-I were 94%, 100% and 38.5%, respectively. The proportion of those without contraindications receiving reperfusion therapy was 92%; but there were only 33 of the total that were eligible due to delayed presentation for medical care. Rates of recommended pharmacologic treatment at discharge were all above 80%, except for ACE-I prescriptions, which were provided in only 65% of discharges. Smoking cessation counseling was provided in 71% of cases; but rates of dietary counseling and referral for cardiac rehabilitation (56% and 30%, respectively) were less (Table 3).

Among the AMI cases, 71% (n=51) presented initially to a PCC. Of those presenting to a PCC, 46 (90%) were successfully referred to a TCC. One case died within 1 hour of arrival to a PCC, precluding successful transfer.

There were 12 deaths among the 72 identified AMI cases (16.7%, 95% CI=8.1%–25.3%). Of those deaths, 3 occurred in a PCC facility and 9 in a TCC facility. Of the 12 deaths, 1 occurred among the 37 cases that had reperfusion therapy of any kind (regardless of eligibility criteria); and 11 deaths were among the 35 cases without reperfusion therapy. This represents a significantly decreased rate of death among those who received reperfusion therapy compared to those who did not (chi-square, $P<.001$). Among the 36 cases less than the median age of 67 years there were 5 deaths, and among the other 36 cases, 7 deaths, which was not statistically significant (chi-square, $P=.75$).

Discussion

In spite of considerable challenges posed by geographic isolation and small medical facilities in American Indian communities, we found process measures of the quality of AMI care for participants in this cohort were comparable or slightly above those reported for Medicare beneficiaries nationally and within the resident states of this cohort.

Since much of the original and most comprehensive data on quality of care for AMI was compiled by CMS, our study was designed to allow comparisons with this dataset and subsequent reports to the maximum extent possible. These original CMS investigations defined AMI according to study specific criteria, after ascertaining cases on the basis of hospital discharge ICD-9 codes indicating likely AMI.[5] We chose to define AMI on the basis of the SHS-determined diagnostic code for definite fatal or non-fatal myocardial infarction as adjudicated by physician review panels.[17,18] Specific quality indicators and some cases were excluded from many early evaluations of appropriate care by CMS if patients had been transferred from another facility.[3,5,6] In contrast, we modified our data abstraction tool to include transferred patients, since the initial medical contact for most cases in our study population were primary care facilities that lacked cardiac interventional capabilities.

A notable finding with regard to the demographic characteristics of this series is that the male/female ratio is reversed in comparison with other contemporary studies.[11,15,23,24] This may in part be due to a higher enrollment of females (59%)[12] in the Strong Heart Study and a higher prevalence of diabetes (54 vs 44%)[18] among women vs men in this cohort. The average age at presentation in our study is somewhat older than the mean of 61–62 years reported by studies more focused on procedural interventions,[11,15,24] but similar to the mean age of 66 years from the National Registry of Myocardial Infarction.[23] The prevalence of diabetes in our group (74%) is much higher than the 28%[23] and the 34%[6] reported from large representative samples in the United States whereas the prevalence of hypertension is similar to the 57–68% reported in these studies.[6,23] Although data was not available for all patients on time from onset of symptoms to admission, the median time of 159 minutes is comparable to a National Registry of Myocardial Infarction report for White and non-Black minorities (122 and 135 minutes, respectively).[14] Another report from the National Registry of Myocardial Infarction[11] indicates Medicare insurance coverage for 35%, compared with 60% in our somewhat older age group.

For lipid management, National Registry of Myocardial Infarction reported provision of pharmacologic lipid treatment at discharge of 88% in 2006;[21] we found 80% of patients with AMI in our study were prescribed lipid treatment at discharge. Comparison of reperfusion rates is especially interesting in light of the geographically isolated environment of most SHS participants. Although the metric measuring quality of reperfusion treatment has changed from the initial 24-hour standard to the current goal of less than 90 minutes; the SHS finding of reperfusion therapy in 92% of those eligible and without contraindications is notable. The somewhat increased time from symptoms to medical contact and the significant transportation difficulties involved in the SHS care setting undoubtedly increased the proportion of patients ineligible for reperfusion, nonetheless, 24 (33%) received this therapy out of all 72 patients presenting with acute MI, regardless of eligibility or contraindications (Table 4).

> We found 80% of patients with AMI in our study were prescribed lipid treatment at discharge compared to 88% of patients in the national registry report of 2006.[21]

The 17% in-hospital and 30-day mortality rate experienced in this SHS group is higher than the non-transfer-out hospital mortality of 6.3% (National Registry of Myocardial Infarction[23] in 2006) or the crude rate of 10.2% reported from Canada in 2004.[25] The nominal SHS mortality rate is unadjusted for age, with 24% of the SHS group over the age of 75 and the National Registry of Myocardial Infarction[23] reported mortality rates of 10 and 14% for ST elevation myocardial infarction and non-ST elevation myocardial infarction patients among those over 75 in 2006. Other covariates not considered in unadjusted analyses, such as the presence of diabetes and the need to transfer the majority of the Strong Heart Study patients to facilities able to institute acute reperfusion therapies, may also be factors in the higher inhospital mortality rate.

While our study has many strengths, drawing from a methodologically sound population-based epidemiologic study, there are important limitations. Our chosen diagnostic criterion, the SHS-defined definite MI, may be more stringent than criteria used in other studies. This may lead to an underestimation of the number of AMI cases and therefore possibly less precise estimates of our variables of interest. As in many retrospective studies, the data are limited by variable chart documentation, thus the current results probably represent the minimum rate at which these elements of care were provided. The mortality rate is unadjusted for possibly important covariates, such as age, sex and diabetes.

The AMI quality of care measures in this Strong Heart Study series compares favorably with national data, suggesting that high quality care can be provided in isolated, rural environments. This may be attributable to the development of systematic cooperation between primary care and tertiary care institutions and their staff. Continued public health, public policy, and prevention efforts are needed to prevent development of risk factors for cardiovascular disease. Further studies are needed to elucidate the mechanisms of higher cardiovascular disease mortality and among American Indians.

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Table 1

Acute myocardial infarction quality of care criteria

Criterion	Candidates	Timeliness Standard	Selected Indications, Contraindications or Exceptions
Oral ASA	all AMI	within 24 hours of admission	allergy to ASA, bleeding on admission
Beta blocker	all AMI	within 24 hours of admission	pulse<60, CHF, pulmonary edema, shock, heart block, COPD
Angiotensin converting enzyme inhibitor (ACE-I)	all AMI	within 24 hours of admission	allergy, history of angioedema
Timely reperfusion: thrombolytic therapy OR revascularization (PCI or CABC)	chest pain <12 hours AND ST elevation in 2 contiguous leads	within 24 hours of admission	bleeding diathesis, age>80, previous stroke, surgery in past 2 months, bilirubin>2.0, warfarin therapy, trauma in past month
ASA at discharge	all discharges	at discharge	allergy to ASA, bleeding or platelets<100,000, creatinine>3.0, Hgb<10.0gm/dL
Beta blocker at discharge	all discharges	at discharge	pulse<50 (not previously on beta blocker), heart block, COPD, LVEF<30% SBP< 90mm Hg
ACE-I at discharge	if LVEF <40%	at discharge	creatinine>2.0 mg/dL allergy, aortic stenosis, lastSBP<100 (off ACE-I)
Smoking cessation counseling	all smokers	at discharge	no reported tobacco abuse
Dyslipidemia screening	all discharges	during hospital stay	none
Dietary counseling	cases with dyslipidemia	at discharge	none
Medication treatment for hyperlipidemia	cases with dyslipidemia	at discharge	if LDL-C<100mg/dL and triglycerides <150mg/dL
Cardiac rehab	all discharges	at discharge	none

Note: ASA, aspirin; CHF, congestive heart failure; LVEF, left ventricular ejection fraction; LDL-C, low density lipoprotein, cholesterol; COPD, chronic obstructive pulmonary disease; PCI, percutaneous coronary intervention; CABG, coronary artery bypass graft surgery; Hgb, hemoglobin.

Table 2

Baseline demographic, clinical, and selected characteristics of acute myocardial infarction cases from the Strong Heart Study (*N*=72)

Characteristic	*n*	Proportion	Range	Mean	Median
Sex (female)	38	53%			
Age at time of AMI	72		56 to 87 years	69 years	67 years
Medicare insurance	43	60%			
Medicare or Medicaid insurance	48	67%			
Private insurance	13	18%			
Indian Health Service only	7	12%			
Current smoker*	28	39%			
Body mass index (kg/m^2)*	71		21.3–45.6	31.1	30.5
Serum creatinine (mg/dl)*	71		.60–1.6	.91	.87
Hypertension†	52	72%			
Diabetes†	53	74%			
Previous AMI‡	17	24%			
Previous cardiovascular diseases§	24	33%			
Time from onset of symptoms to first recorded medical care (minutes)	45		10–2918	410	159
Time to transfer from PCC to TCC// (minutes)	50		20–4121	504	249
Travel time from PCC to TCC¶ (minutes)	46		10–314	94	77

*Derived from SHS data collected from 1989–1992.

†Any instance of hypertension or diabetes in SHS data collected from 1989–1999.

‡Any instance of definite MI occurring between 1989 and MI ascertained for this study.

§Any instance of definite MI, coronary heart disease or stroke occurring between 1989 and MI ascertained for this study.

//Time from admission at first facility to admission at second facility; PCC, primary care centers; TCC, tertiary care centers.

¶Transit time enroute between first facility and second facility.

Table 3

Acute myocardial infarction quality of care measures or criteria

Measures or Criteria	Eligible	Contra-indications present	Indicated	Received	Proportion Received Among Those Indicated (%)	95% CI*
ASA<24 hrs	72	7	65	63	94%	88–99
Beta blocker<24 hrs	72	15	57	57	100%	
ACE inhibitor in hospital	72	None†	72	27	38.5%	26–49
Thrombolysis	33	8	25	8	32%	14–50
PCI or CABC	33	8	25	22	88%	75–100
Reperfusion by any Rx	33	8	25	23	92%	81–100
ASA at discharge	60	2	58	53	91%	84–99
Beta blocker at discharge	60	8	52	45	86%	77–96
ACE-I at discharge‡	22	5	17	11	65%	42–87
Smoking cessation	14	0	14	10	71%	48–95
Lipid panel obtained	60	0	60	47	77%	67–88
LDL>100 or TG<150	47	0	47	25§	53%	39–68
Dietary counseling	25	0	25	14	56%	37–76
Medication treatment for hyperlipidemia	25	0	25//	20	80%	64–97
Cardiac rehab	60	0	60	18	30%	18–42

*95% CI = 95% confidence intervals.

†There were no contraindication criteria established for in hospital treatment with ACE-I, therefore all of the cases were assumed to be eligible for treatment (likely overestimated).

‡Indications for ACE-I at discharge were LVEF<40%.

§Number with abnormal lipid values.

//No data were available regarding contraindications to medical management, thus all those meeting criteria for hyperlipidemia were considered candidates.

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Table 4

Comparison of prior acute myocardial infarction quality of care studies with findings from the Strong Heart Study

	Admission or In-patient therapy (%)				Discharge Therapy (%)			
	ASA	β-Block	Reper-fusion	ACE-I	ASA	β-Block	ACE-I	Smoking Cessation
CMS, (national)[6] 1998–99	83	68	61*	NA	83	71	71	37
CMS, (4-states)[6] 1998–99	84	68	65*	NA	85	72	72	36
CMS, (national)† 2004	88	82	42‡	NA	91	89	68	68
CMS, 4-statest 2004	89	83	43‡	NA	91	89	69	73
NRMI§, 2006[22]	90	82	73//	NA	94	92	74	NA
Hosp. Compare¶ 2005–6, (national)	90	81	51‡	NA	85	82	78	72
Hosp. Compare¶ 2005–6, 4-states	90	82	53‡	NA	85	83	79	75
Alberta, Canada[23] 2001–2	86	87	75	64	86	87	87	13
Strong Heart Study	94	100	92*	38	91	87	65	71

*Procedure provided within 24 hours of admission.

†CMS, personal communication.

‡PCI within 90 minutes, a new standard.

§NMRI (National Registry of Myocardial Infarction), data presented are for ST segment elevation myocardial infarction.

//Procedures provided at any time during hospitalization.

¶Hosp. Compare refers to the CMS sponsored website, http://www.hospitalcompare.hhs.gov/Hospital/Search/Welcome.asp.