Annals of Internal Medicine | ARTICLE

Insurance Coverage and Care of Patients with Non–ST-Segment Elevation Acute Coronary Syndromes

James E. Calvin, MD; Matthew T. Roe, MD, MHS; Anita Y. Chen, MS; Rajendra H. Mehta, MD, MS; Gerard X. Brogan Jr., MD; Elizabeth R. DeLong, PhD; Dan J. Fintel, MD; W. Brian Gibler, MD; E. Magnus Ohman, MD; Sidney C. Smith Jr., MD; and Eric D. Peterson, MD, MPH

Background: The impact of insurance coverage on the care of patients with non–ST-segment elevation acute coronary syndromes (NSTE ACS) is unclear.

Objective: To compare NSTE ACS care patterns by insurance type.

Design: Comparison of Medicaid patients younger than 65 years of age and Medicare patients 65 years of age or older with patients of similar age who have health maintenance organization (HMO) or private insurance coverage.

Setting: 521 U.S. hospitals participating in the CRUSADE (Can Rapid Risk Stratification of Unstable Angina Patients Suppress ADverse Outcomes with Early Implementation of the ACC [American College of Cardiology]/AHA [American Heart Association] Guidelines) quality improvement initiative from January 2001 through March 2005.

Patients: 37 345 NSTE ACS patients younger than 65 years of age and 59 550 patients 65 years of age or older.

Measurements: Guideline-recommended treatments, and in-hospital outcomes.

Results: Medicaid was the primary payer for 18.7% (6999 of 37 345) of patients younger than age 65 years, whereas Medicare was the primary payer for 67.5% (40 199 of 59 550) of patients age 65 years or older. Medicaid patients were statistically significantly less likely to receive short-term (less than 24 hours) medications and to undergo invasive cardiac procedures than patients covered by HMO and private insurance. They also had higher mortality rates (2.9% vs.1.2%; adjusted odds ratio, 1.33; 95% CI, 1.08 to 1.63). Medications and invasive procedures were used to a similar extent in patients with Medicare and HMO or private insurance, and respective mortality rates were not significantly different (6.2% vs. 5.6%; adjusted odds ratio, 1.08; 95% CI, 0.99 to 1.18).

Limitations: Self-pay patients and patients without insurance were not assessed.

Conclusions: NSTE ACS patients with Medicaid (but not Medicare) as the primary payer were less likely to receive evidence-based therapies and had worse outcomes than patients with HMO or private insurance as the primary payer. The causes of these treatment differences and solutions for narrowing the gaps in quality require further investigation.

Ann Intern Med. 2006;145:739-748. www.annals.org
For author affiliations, see end of text.

For patients with non–ST-segment elevation acute coronary syndromes (NSTE ACS), novel therapeutic approaches, such as low-molecular-weight heparin, glycoprotein (GP) IIb/IIIa inhibitors, and early invasive management strategies, have been shown to have beneficial effects and have been incorporated into practice guidelines of the American College of Cardiology and American Heart Association (ACC/AHA) (1–5). However, the extent to which these and other guideline-recommended therapies are reaching all segments of the U.S. population is unclear. Specifically, although U.S. Medicaid and Medicare programs often provide coverage for patients with limited incomes, reimbursements to health care providers by these programs may differ from those of private insurance plans (6).

Because novel therapies and invasive cardiac procedures for NSTE ACS are costly, differential patterns of reimbursement in Medicaid and Medicare programs may affect treatment patterns and guideline adherence. Thus, we first evaluated patients younger than age 65 years with NSTE ACS from the CRUSADE (Can Rapid risk stratification of Unstable angina patients Suppress ADverse outcomes with Early implementation of the ACC/AHA guidelines) quality improvement initiative to determine the impact of primary Medicaid coverage on the use of guideline-recommended medications, invasive cardiac procedures, and in-hospital clinical outcomes compared with that of patients with primary health maintenance organization (HMO) or private insurance coverage. We then performed a similar comparison between patients 65 years of age or older with primary Medicare coverage and patients of the same age with primary HMO or private insurance coverage. Furthermore, we sought to determine the degree to which any differences in care patterns and outcomes resulted from differences in clinical characteristics or to preferential care of Medicare or Medicaid patients at lower-quality hospitals.

See also:

Print
Editors' Notes 740
Summary for Patients I-47

Web-Only
CME quiz
Conversion of figure and tables into slides

Context

Medicaid and Medicare reimbursement is typically lower than that of private insurance. This might affect access to care for Medicaid and Medicare patients.

Contribution

The authors studied the care received for non–ST-segment elevation acute coronary syndromes by 37 345 patients younger than age 65 years and 59 550 patients age 65 years or older. Compared with privately insured patients, Medicaid patients received fewer guideline-recommended services at admission or discharge and experienced greater delays in receiving invasive procedures. Differences for Medicare patients were fewer and smaller, although delays were common. The in-hospital mortality rate was higher in Medicaid patients but not Medicare patients.

Cautions

The authors could not assess the appropriateness of invasive procedures, socioeconomic status, severity of comorbid conditions, or patient preferences.

—The Editors

METHODS

Patient Inclusion Criteria

Patients with NSTE ACS were included if they had ischemic symptoms at rest within 24 hours of presentation and high-risk features, including ST-segment depression levels of 0.5 mm or more, transient ST-segment elevation levels of 0.5 to 1.0 mm (lasting for less than10 minutes), positive cardiac markers (elevated troponin I or T levels, creatine kinase [CK]-MB levels, or both greater than the upper limit of normal for the local laboratory assay) or both.

Data Collection

CRUSADE is a voluntary quality improvement initiative that began in November 2001 (with retrospective data collection from January 2001), and data collection is ongoing. At the beginning of the project, queries were sent to a geographically diverse sample of hospitals. Participation was voluntary. Because data were collected retrospectively and do not include any patient identifying information, informed consent was waived. The local institutional review board at each hospital approved participation in CRUSADE. No specific quality initiative was implemented in all institutions, although sites were provided with sample order sets and discharge forms to use at their discretion. Data on hospital characteristics were obtained from the American Hospital Association database.

Participating institutions were instructed to submit consecutive eligible patients to the CRUSADE database. Data were abstracted directly from the medical chart by trained data collectors using standardized definitions. Administrative claims data were not abstracted for this study. Abstracted variables included demographics, clinical characteristics, medical therapies and major contraindications, use and timing of cardiac procedures, laboratory results, and in-hospital outcomes.

Insurance status was defined as the patient's primary insurance provider. Data abstractors at the participating sites were aware of the patient's primary insurance status and were given specific definitions for categorization of primary insurance status. Health maintenance organization and private insurance were defined as any health insurance provided by a commercial plan, regardless of restrictions or payment arrangements. Medicare coverage was defined as the federal health care plan that reimburses hospitals and physicians for the care of elderly patients 65 years of age or older. Medicaid coverage was defined as state-administered plans jointly funded by state and federal funding mechanisms providing primary coverage to patients younger than 65 years of age who cannot finance their own medical expenses or who have qualifying comorbid conditions. Medicare or Medicaid coverage was recorded on the data collection form as a single, dichotomous variable until November 2003; thus, we could not clearly specify primary Medicaid versus Medicare coverage for patients included in CRUSADE before this time. Self or no insurance coverage was defined as when individuals were the sole payers, regardless of ability to pay. Self or no coverage was recorded on the data collection form as a single, dichotomous variable, and we excluded patients in this category from the analysis because of the inconsistent reporting of this variable. Military or Veterans Affairs Medical Center coverage was used to describe patients with a military or Veterans Administration health plan. This group also was excluded from the primary analysis because of the small number of patients covered by these programs.

Data Accuracy

Routine procedures have been established to maintain and monitor the quality of the CRUSADE database. At data entry and during quarterly quality control procedures, values that exceed expected ranges are flagged and excluded from analysis. In addition, sites receive a quarterly report summarizing any data quality problems observed in their submitted data. In September 2002, CRUSADE formally assessed the reliability of data abstraction. Sites and records were randomly selected. Study coordinators from one fourth of CRUSADE hospitals were contacted and asked to send the CRUSADE Coordinating Center copies of medical records without patient identifiers for audit by CRUSADE project officials. In addition to selected clinical characteristics, audited variables included all medical therapies, procedures, and in-hospital clinical events. The overall accuracy of audited case report forms compared with medical records was 94.8%. The overall degree of missing data averaged approximately 5% across all collected data elements. Of note, such variables as age and sex were missing in fewer than 0.5% of all audited cases. In addition, we

reviewed the degree of missing variables among 119 257 patients included in the overall database through 30 September 2004 and determined that key clinical characteristics, such as age (0.18%), sex (0.29%), race (1.45%), insurance status (1.0%), and such clinical outcomes as death (1.33%) and reinfarction (1.29%) were infrequently missing on data collection forms.

Analysis Cohorts

A total of 138 719 patients was entered into the CRUSADE database from January 2001 through March 2005 at 521 U.S. hospitals. For the Medicaid analysis, we excluded 80 423 patients 65 years of age or older or who had missing age values, 11 438 patients from hospitals without percutaneous and surgical revascularization capabilities, 2587 patients with Medicare listed as the primary payer, 413 patients with insurance status listed as military or Veterans Affairs Medical Center, 6025 patients with insurance status listed as self or none, and 488 patients with missing data on insurance status. The total population for the Medicaid analysis was thus 37 345 patients from 358 hospitals. For the Medicare analysis, we excluded 58 537 patients younger than 65 years of age or who had missing age values, 18 922 patients from hospitals without percutaneous and surgical revascularization capabilities, 214 patients with Medicaid as the primary payer, 275 patients with insurance status listed as military or Veterans Affairs Medical Center, 756 patients with insurance status listed as self or none, and 465 patients with missing data on insurance status. The total population for the Medicare analysis was thus 59 550 patients from 359 hospitals.

Statistical Analysis

We evaluated patient baseline demographics, clinical characteristics, in-hospital care patterns, and in-hospital outcomes for patients younger than 65 years of age with Medicaid as the primary payer compared with those younger than 65 years of age with HMO or private insurance as the primary payer. Likewise, we compared patients 65 years of age or older with Medicare as the primary payer with those 65 years of age or older with HMO and private insurance as the primary payer. "Health maintenance organization" refers to private HMO coverage in our analysis. We were unable to distinguish whether Medicare or Medicaid coverage was received through a managed care program. Also, we could not ascertain whether supplemental insurance coverage was available for Medicare patients older than 65 years of age. We performed these comparisons within separate age categories because we included Medicaid and Medicare as a single, dichotomous variable on the data collection form until November 2003. We reported medians and 25th and 75th percentiles for continuous variables and frequencies for categorical variables. To test for independence of insurance status and in-hospital care patterns and outcomes, Wilcoxon rank-sum tests were used for continuous variables and chi-square tests were used for categorical variables.

To adjust for within-center correlation and among-center variation, we used a generalized estimating equations method for estimating marginal effects of insurance status. The method produces estimates similar to those from ordinary logistic regression, but the estimated variances of the estimates are adjusting for within-hospital clustering of responses. We used an exchangeable correlation structure for this analysis (7, 8).

In examining the association among insurance categories and in-hospital clinical outcomes and care patterns, we accounted for both within-hospital clustering, for which patients at the same hospital are more likely to have similar responses relative to patients in other hospitals (for example, within-center correlation for response), and situations in which hospitals that treat populations that primarily have Medicaid or Medicare tend to have worse (or possibly better) outcomes, regardless of the insurance status of individual patients (among-center variation). The method used for this approach decomposes the insurance status into within-center and among-center components. The among-center component is a covariate representing the proportion of Medicaid (or Medicare) status (for example, p_i) in a given center. Thus, all the patients within that center would have the same proportion for this covariate. The within-center component is a covariate representing the difference between the patient's insurance status (for example, x_{ij}) and the proportion of insurance status for that patient's center. Thus, the overall within-center component may be written as $x_{ij} - p_i$, in which i indexes the centers and j indexes the patients. The model results in 2 odds ratios estimates, but for interpretation, we focused only on the within-center component.

In addition, we displayed figures of fitted probabilities of medications and procedures for both Medicaid and HMO and private insurance across the range of proportion of Medicaid patients among patients younger than 65 years of age. Because the relationship of treatment by proportion of Medicaid patients is nonlinear, we fit the Stone and Koo additive spline transformation for proportion of Medicaid patients (9–11). Furthermore, we explored models testing whether insurance status effects x_{ij} is constant across proportion of Medicaid within center (p_i) by fitting covariates x_{ij}, p_i, and $x_{ij}*p_i$.

A previously published 30-day mortality risk model (12) for patients with NSTE ACS was modified for this analysis. Patient-specific variables in the model included age, male sex, body mass index, white ethnicity, family history of coronary artery disease, hypertension, diabetes, smoking status, hypercholesterolemia, previous myocardial infarction, previous percutaneous coronary intervention, previous coronary artery bypass graft, previous congestive heart failure (CHF), previous stroke, renal insufficiency, ST-segment depression, transient ST-segment elevation, positive cardiac markers, signs of CHF at presentation, heart rate, and systolic blood pressure. Provider and hospital characteristics (physician specialty, total number of hos-

Table 1. **Baseline Characteristics***

Variable	Age < 65 Years		Age ≥ 65 Years	
	Medicaid (*n* = 6999)	HMO or Private Insurance (*n* = 30 346)	Medicare (*n* = 40 199)	HMO or Private Insurance (*n* = 19 351)
Demographic characteristics				
African-American ethnicity, %	25.9	10.4	9.4	6.7
Age, *y*†	55 (48, 60)	55 (49, 59)‡	77 (71, 83)	76 (70, 82)
Female sex, %	39.0	27.5	48.0	43.2
Medical history, %				
Hypertension	72.1	59.7	76.0	74.5
Diabetes mellitus	42.8	26.1	35.7	33.6
Current or recent smoking	51.4	42.8	13.7	13.3
Hyperlipidemia	47.3	53.2	48.0	50.5
Renal insufficiency§	17.9	5.4	18.3	15.9
Previous MI	36.5	22.9	33.9	33.0
Previous CHF	19.4	6.0	24.9	21.7
Previous stroke	11.0	3.8	14.5	13.1
Previous PCI	28.1	21.1	22.2	22.3‡
Previous CABG	21.8	13.7	24.3	24.9‡
Presenting characteristics				
Systolic BP, *mm Hg*†	141 (121, 162)	144 (126, 164)	144 (123, 166)	145 (124, 167)
Heart rate, *beats/min* †	85 (72, 100)	80 (68, 93)	84 (70, 100)	82 (69, 98)
ST depression, %	32.1	34.1	36.9	39.0
Transient ST elevation, %	8.2	9.0	5.9	5.4
Positive cardiac markers, %	89.1	90.2	91.9	91.9
Signs of CHF, %	20.5	10.2	30.1	26.9
Hospital characteristics				
Total beds†	414 (291, 542)	422 (290, 552)	420 (297, 542)	400 (281, 554)
Cardiology inpatient care, %	64.0	70.3	57.4	55.5
Academic center, %‖	39.2	31.9	32.5	28.7

* BP = blood pressure; CABG = coronary artery bypass grafting; CHF = congestive heart failure; HMO = health maintenance organization; MI = myocardial infarction; PCI = percutaneous coronary intervention.
† Presented as median values (25th, 75th percentiles).
‡ $P > 0.05$ for comparisons between insurance types within each age group; all other comparisons $P < 0.05$.
§ Creatinine > 2.0 mg/dL, estimated creatinine clearance <30 μL/min, or need for dialysis.
‖ Member of the Council of Teaching Hospitals in the American Hospital Association database.

pital beds, region of the country, and type of hospital [academic or nonacademic]) were also included. For these analyses, Medicaid or Medicare was compared with the combination of patients with HMO or private insurance coverage.

A *P* value less than 0.05 was established as the level of statistical significance for all tests. All analyses were performed using SAS software, version 8.2 (SAS Institute, Inc., Cary, North Carolina).

Role of the Funding Sources

CRUSADE is funded by unrestricted grants from Schering-Plough Corporation and the Bristol-Myers Squibb-Sanofi partnership. The CRUSADE project and database are owned and independently operated by the academic coordinating center at the Duke Clinical Research Institute in Durham, North Carolina. All analyses on the database are conducted independently by Duke Clinical Research Institute.

RESULTS

Patient Characteristics

Among the analysis cohort of 37 345 patients younger than 65 years of age, Medicaid was the primary payer for 6999 (18.7%) patients, and an HMO or private insurance company was the primary payer for the remaining patients (**Table 1**). Although similar in age, Medicaid patients were more commonly African American and female and more commonly had renal insufficiency, previous stroke, previous myocardial infarction, previous revascularization procedures, and signs of CHF on presentation than did patients with HMO or private insurance coverage (**Table 1**). Although proportionally more Medicaid patients received care in academic centers, Medicaid patients were less likely to be admitted to a cardiology inpatient service.

Among the analysis population of 59 550 patients 65 years of age or older, the primary payer was Medicare in 40 199 (67.5%) patients, and the primary payer in the remaining patients (19 354 [32.5%]) was an HMO or pri-

vate insurance company. Medicare patients were more commonly women and African American and more commonly had diabetes mellitus, previous CHF, renal insufficiency, and signs of CHF at presentation compared with patients with HMO or private insurance coverage. Medicare patients were more likely to be cared for in academic centers and slightly more likely to be admitted to a cardiology inpatient service.

Treatment Patterns

Medicaid versus HMO and Private Insurance Coverage for Patients Younger Than Age 65 Years

Medicaid patients were less likely than patients with HMO or private insurance coverage to receive most guideline-recommended short-term (less than 24 hours) medications and invasive cardiac procedures (**Table 2**). At discharge, Medicaid patients were less likely to receive aspirin, β-blockers, clopidogrel, lipid-lowering agents, dietary counseling, smoking cessation counseling, and referral for cardiac rehabilitation (**Table 2**). Delays were observed for Medicaid patients in the time to first electrocardiogram and in time to cardiac catheterization and revascularization when these procedures were performed (**Table 3**).

Medicare versus HMO and Private Insurance Coverage for Patients Age 65 Years or Older

Medicare patients were slightly less likely to receive short-term (less than 24 hours) clopidogrel and glycoprotein IIb/IIIa inhibitors and catheterization (less than 48 hours) than were patients with HMO or private insurance coverage (**Table 2**). The only statistically significant difference in discharge care was that Medicare patients were less likely to be referred for cardiac rehabilitation (**Table 2**). Time to catheterization, coronary artery bypass graft, and percutaneous coronary intervention was longer in Medicare patients (**Table 3**).

Table 2. **Short-Term (Less Than 24 Hours) Medications, Invasive Cardiac Procedures, and Discharge Medications and Interventions***

Treatment	Age < 65 Years			Age ≥ 65 Years		
	Medicaid, % (*n* = 6999)	HMO or Private Insurance, % (*n* = 30 346)	Adjusted OR† (95% CI)	Medicare, % (*n* = 40 199)	HMO or Private Insurance, % (*n* = 19 351)	Adjusted OR† (95% CI)
Medications‡						
Aspirin	92.2	95.3	0.79 (0.71–0.88)	92.3	93.1	0.93 (0.86–1.02)
β-blockers	80.3	84.9	0.81 (0.75–0.88)	81.7	83.1	0.94 (0.88–1.01)
Heparin, any§	82.9	88.4	0.81 (0.74–0.88)	83.6	84.7	0.95 (0.89–1.01)
Unfractionated	53.8	57.9	0.93 (0.88–0.99)	49.5	50.2	0.96 (0.93–1.00)
LMWH	35.3	37.9	0.92 (0.87–0.98)	40.2	40.8	1.00 (0.96–1.05)
Clopidogrel	43.2	54.4	0.81 (0.76–0.87)	43.4	44.3	0.94 (0.89–0.99)
GP IIb/IIIa inhibitors	40.4	55.0	0.77 (0.72–0.83)	34.3	36.9	0.93 (0.89–0.99)
Invasive procedures						
Catheterization	74.6	89.9	0.61 (0.57–0.66)	71.2	72.6	0.98 (0.91–1.06)
Catheterization <48 h	51.4	72.0	0.64 (0.60–0.68)	47.6	50.1	0.93 (0.88–0.99)
PCI	41.7	58.0	0.79 (0.74–0.85)	38.7	40.7	0.96 (0.91–1.01)
CABG	11.4	14.7	0.87 (0.79–0.96)	12.7	13.9	0.99 (0.92–1.06)
Discharge medications and interventions						
Aspirin	89.9	94.2	0.75 (0.67–0.85)	91.2	92.1	0.93 (0.86–1.01)
β-blockers	84.2	87.8	0.83 (0.75–0.91)	86.2	87.5	0.95 (0.89–1.03)
ACE inhibitor‖	64.1	62.2	0.97 (0.91–1.04)	61.6	62.4	1.02 (0.97–1.07)
Clopidogrel	56.8	70.3	0.78 (0.73–0.84)	58.4	59.9	0.94 (0.89–1.00)
Lipid-lowering agent¶	82.4	86.8	0.86 (0.77–0.95)	81.3	82.4	1.00 (0.94–1.07)
Dietary counseling	76.1	81.8	0.78 (0.72–0.85)	73.3	75.5	0.93 (0.86–1.01)
Smoking cessation counseling	67.8	78.5	0.84 (0.77–0.92)	62.1	66.4	0.95 (0.84–1.09)
Cardiac rehabilitation	41.2	58.6	0.75 (0.70–0.80)	46.1	52.1	0.91 (0.85–0.98)

* ACE = angiotensin-converting enzyme; CABG = coronary artery bypass grafting; GP = glycoprotein; HMO = health maintenance organization; LMWH = low-molecular-weight heparin; OR = odds ratio; PCI = percutaneous coronary intervention.

† Adjusted odds ratio compares Medicaid or Medicare with HMO or private insurance and adjusts for age, female sex, body mass index, white ethnicity, family history of coronary artery disease, hypertension, diabetes, current or recent smoker, hypercholesterolemia, previous myocardial infarction, previous PCI, previous CABG, previous congestive heart failure, previous stroke, renal insufficiency, ST depression, ST elevation, positive cardiac markers, signs of CHF, heart rate, systolic blood pressure, total number of hospital beds in treating institution, region (West, Northeast, Midwest, or South), teaching or academic institution, and treatment by a cardiologist.

‡ For patients without listed contraindications as detailed in the methods.

§ Both unfractionated and LMWH heparin. The denominator for LMWH includes patients not taking heparin, those taking unfractionated heparin, and those taking LMWH. The numerator is patients taking LMWH. Adjustment also accounted for within-center and across-center correlations.

‖ Only for patients with congestive heart failure, ejection fraction < 40%, diabetes mellitus, or hypertension.

¶ Only for patients with documented hyperlipidemia or those with measured low-density lipoprotein cholesterol levels > 100 mg/dL.

Table 3. **Time-to-Treatment Variables***

Variable	Age < 65 Years			Age ≥ 65 Years		
	Medicaid (*n* = 6999)	HMO or Private Insurance (*n* = 30 346)	Total, *n*	Medicare (*n* = 40 199)	HMO or Private Insurance (*n* = 19 351)	Total, *n*
Time to first ECG, *min*	16 (8, 37)	14 (7, 27)	25 088	16 (8, 35)	15 (7, 33)	43 001
Time to cath, *h*	28 (14, 56)	21 (7, 40)	22 152	32 (16, 62)	28 (15, 55)	27 262
Time to PCI, *h*	26 (11, 53)	20 (5, 39)	13 360	30 (14, 63)	27 (11, 55)	14 471
Time to CABG, *h*	86 (47, 130)	65 (38, 102)	3318	82 (46, 131)	79 (45, 119)	4583

* Variables calculated from time of initial hospital presentation. All values reported as medians with 25th and 75th percentiles for patients receiving the procedure. CABG = coronary artery bypass grafting; cath = catheterization; ECG = electrocardiogram; HMO = health maintenance organization; PCI = percutaneous coronary intervention. Patients who did not undergo these procedures or those with missing data for times to procedures were not included in these calculations.

Hospital Differences

We examined the fitted probabilities of receiving short-term and discharge medications and invasive procedures among patients younger than 65 years of age with Medicaid coverage versus those with HMO or private insurance coverage to further explore how the proportion of Medicaid patients at participating hospitals influenced the treatment differences listed in **Table 2**. We observed that acute and discharge medication and invasive procedure use for Medicaid and HMO or private insurance patients generally decreased as the proportion of Medicaid patients receiving care at hospitals increased (**Figure**). However, the short-term use of aspirin or β-blockers, receipt of angiotensin-converting enzyme inhibitors on discharge, and use of coronary artery bypass graft remained relatively constant in the Medicaid and HMO or private insurance groups as the proportion of Medicaid patients increased at participating hospitals. In addition, we explored whether the effects of Medicaid and HMO or private insurance are constant across the within-center proportion of Medicaid recipients by using models with the interaction term between insurance status and proportion of Medicaid within center for each medication and invasive procedure. We observed that none of the interaction terms is statistically significant.

In-Hospital Outcomes

Medicaid versus HMO and Private Insurance in Patients Younger Than Age 65 Years

The frequency of unadjusted adverse in-hospital outcomes was higher in Medicaid patients than in those with HMO or private insurance (**Table 4**). Medicaid patients had higher mortality rates (2.9% vs. 1.2%; adjusted odds ratio, 1.33; 95% CI, 1.08 to 1.63), and after adjustment, the risk for death was significantly higher in Medicaid patients, but there were no statistically significant differences in other outcomes.

Medicare versus HMO and Private Insurance Patients Age 65 Years or Older

The frequency of unadjusted adverse in-hospital outcomes was higher in Medicare patients than patients with HMO or private insurance (**Table 4**). However, after adjustment, no statistically significant differences in outcomes were found.

Discussion

The Institute of Medicine (13) recognizes that health care delivery must be "equitable" (besides being safe, effective, patient-centered, timely, and efficient) to improve the overall quality of patient care. However, much of the resources spent improving health and outcomes in the United States have been directed toward the technology of care (that is, development of drugs, devices, and procedures). In contrast, although there is ample evidence for health care disparities, fewer resources are devoted to improving health care by enhancing "equity" (14–18). This analysis from the CRUSADE quality improvement initiative provides further evidence of contemporary health care disparities and extends this paradigm to Medicaid and Medicare patients with NSTE ACS.

Care Patterns and Outcomes

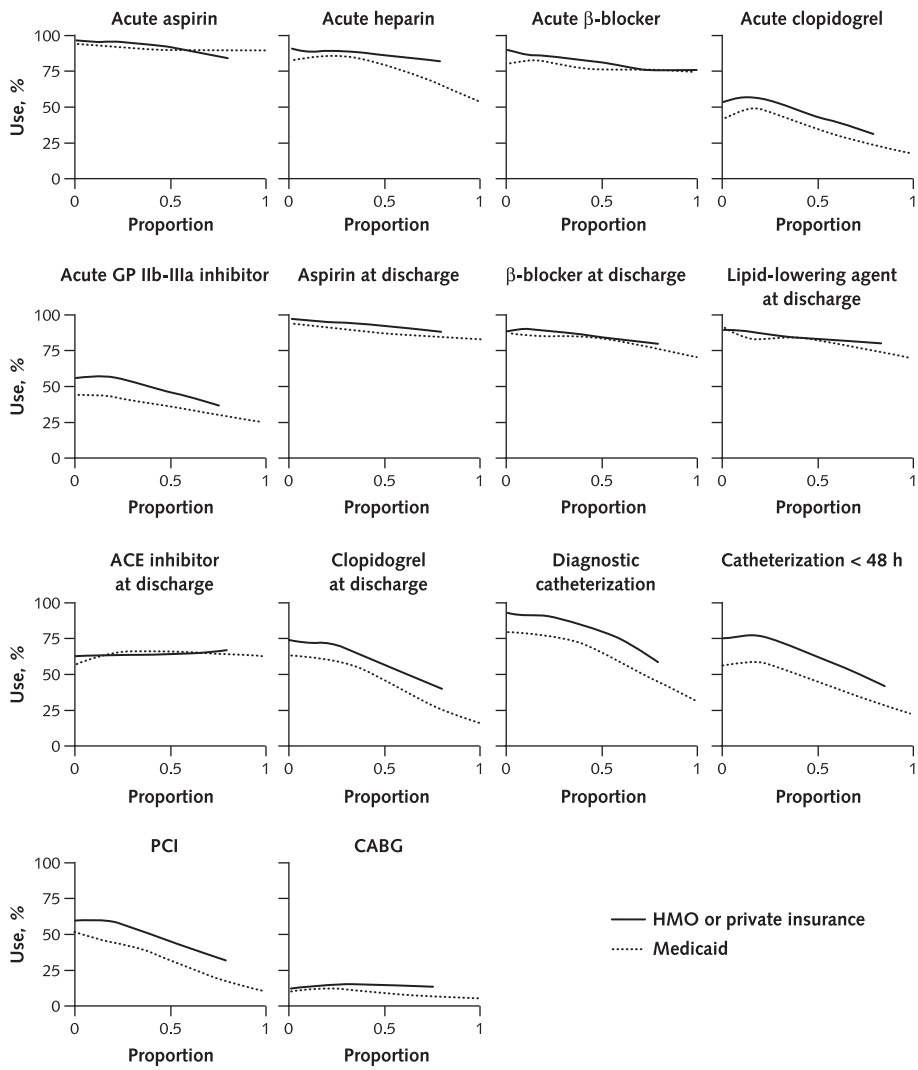
Our analysis provides new evidence supporting the findings of previous studies that insurance status affects access to care, quality of care, and clinical outcomes (14–18). Our results suggest that although adherence to evidence-based guidelines is not optimal for Medicaid patients younger than 65 years of age with NSTE ACS, Medicare patients 65 years of age or older experience only minor gaps in care and have outcomes similar to those of patients with HMO or private insurance. In keeping with the requirements for eligibility for primary Medicaid coverage (poverty and medical disability), it is not surprising that Medicaid patients have a greater frequency of comorbid conditions and previous cardiac events and thus are at higher risk for adverse outcomes (14). However, despite a higher baseline risk profile, Medicaid patients received fewer evidence-based therapies than those patients with primary HMO and private insurance coverage, even after adjustment for differences in clinical characteristics; among-center variation (that is, centers with a large proportion of Medicaid patients); and other confounding variables, such as sex, cardiology care, and teaching hospital

status. Thus, treatment disparities probably accounted for some portion of the higher adjusted mortality rate seen in Medicaid patients, but we could not quantify the relative contributions of comorbid clinical conditions and treatment patterns to risk for death.

Causes of Treatment Disparities

Explanations for the treatment disparities in Medicaid patients are probably multifactorial. First, the burden of comorbid conditions in Medicaid patients (for example, diabetes mellitus, renal insufficiency, and CHF) together with real or perceived financial or cultural barriers to medical care may deter physicians from using guideline-recommended therapies (14). However, differences in care and outcomes persisted after adjustment for clinical characteristics. Second, primary Medicaid coverage is often a marker of other socioeconomic factors, such as education and income, and these may affect Medicaid patients' willingness to receive guideline-based therapies, if given the choice. However, disentangling socioeconomic factors from Medicaid coverage would be difficult for any analysis related to treatment patterns. Although this is theoretically possible, the consistency of our findings across a broad range of low- and high-cost therapies and among invasive and counseling interventions makes it less likely, but patient preferences were not evaluated. Third, Medicaid patients may receive care preferentially at centers that generally provide lower

Figure. **Fitted probabilities of the use of short-term and discharge medications and invasive procedures in patients with Medicaid versus patients with health maintenance organization (*HMO*) and private insurance and those younger than 65 years of age based on the proportion of Medicaid patients at participating hospitals.**



Y-axes denote the percentage use of medications and procedures, and X-axes denote the proportion of Medicaid patients at participating hospitals. The heparin variable includes both unfractionated and low-molecular-weight heparin. ACE = angiotensin-converting enzyme; CABG = coronary artery bypass graft; GP = glycoprotein; PCI = percutaneous coronary intervention.

Table 4. **In-Hospital Outcomes***

Outcome (%)	Age < 65 Years			Age ≥ 65 Years		
	Medicaid (*n* = 6999)	HMO or Private Insurance (*n* = 30 346)	Adjusted OR (95% CI)	Medicare (*n* = 40 199)	HMO or Private Insurance (*n* = 19 351)	Adjusted OR (95% CI)
Death	2.9	1.2	1.33 (1.08–1.63)	6.2	5.6	1.08 (0.99–1.18)
Reinfarction	2.7	2.1	1.07 (0.87–1.32)	3.0	3.1	1.05 (0.92–1.19)
Cardiogenic shock	2.4	1.7	0.99 (0.77–1.28)	3.5	3.1	1.10 (0.97–1.24)
CHF	7.5	4.0	1.13 (0.99–1.30)	11.6	12.0	1.07 (1.00–1.15)

* CHF = congestive heart failure; HMO = health maintenance organization; OR = odds ratio.

levels of guideline-based care (19, 20). Although our results partially support this, the effect was slight, and Medicaid patients remained substantially less likely to receive evidence-based care after hierarchical modeling was used to control for hospital characteristics. Thus, within a given center, insurance status still remained a strong predictor of care patterns. Finally, it has been shown that cardiologists are more likely to use evidence-based therapies to treat acute myocardial infarction than noncardiologists (21), and in our study, Medicaid patients were less likely to be cared for by cardiologists. However, differences in care persisted after adjustment for cardiology inpatient care. Therefore, the care of patients with NSTE ACS appears to be influenced by type of patient insurance.

Quality Implications

Our findings and those of previous studies indicate that restructuring the Medicaid infrastructure and financing may be needed to promote better quality of care (22). These points are quite relevant in the contemporary setting when federal and state governments are challenged to make Medicaid programs affordable, and proposals for cutbacks in coverage have been suggested (23). Although federal demonstration projects, such as "pay-for-performance," have made efforts to monitor and improve the care of Medicare patients, Medicaid services are administered by individual states and thus operate under a decentralized system of quality assurance (24–28). Novel approaches to quality improvement within the Medicaid system, such as statewide rapid-cycle quality initiatives, public reporting and benchmarking quality of care, or tying reimbursement to the quality of care provided to Medicaid beneficiaries, should be considered as potential methods to reverse treatment disparities in the Medicaid population (29–32).

It also should not be forgotten that quality initiatives require financing by each hospital. Although CRUSADE provided prototypes of admission orders and reminder systems throughout the course of the study, implementation depended on the resources available at each hospital. This may be very challenging for academic and other hospitals that at the present time have higher proportions of patients with government-issued insurance programs and reduced contribution margins as a result of reduced government funding. Whereas other studies of Medicare patients have examined the use of revascularization procedures in acute myocardial infarction, this study looked at medical therapies, invasive cardiac procedures, and discharge secondary prevention interventions. Disparities in medical therapies and lifestyle modification interventions are harder to explain than large-ticket items, such as cardiac catheterization or revascularization procedures. Thus, failure to institute simple cost-effective measures, such as smoking cessation and dietary modification counseling before discharge, in Medicaid patients suggests that system improvements need further analysis and refinement.

Limitations

There are several limitations to this retrospective, observational analysis. First, we were unable to determine whether invasive cardiac procedures in Medicaid and Medicare patients were appropriately used or whether they were inappropriately overused for the HMO or private insurance group for financial gains. Second, we could not determine patient preferences and recognize that these may play a role in the use of invasive procedures. Third, health status, race and ethnic identity, socioeconomic status, and education are all closely related to health insurance status. Although we adjusted for race and to some extent health status, information on socioeconomic status and education were not collected within CRUSADE, which precluded us from providing any insights about the potential contribution from these factors to treatment disparities. This would be important in evaluating variability in care of self-pay patients who were excluded from this study. Fourth, we could not account for the severity of coexisting medical illnesses, such as diabetes mellitus, renal insufficiency, and previous CHF, before hospitalization, which may have contributed to treatment differences. Fifth, we collected HMO and private insurance as 1 category during our data collection process, but differences may exist in the coverage of guideline-recommended medications and invasive procedures between these insurance categories. In a similar manner, coverage for medications and procedures may differ among Medicare and Medicaid plans, but we could not account for variations in coverage for these programs in our analysis. Sixth, we collected self-pay and no insurance as 1 category in our data collection form and excluded patients in this category from our analysis. Thus, we could

not compare the impact of primary Medicaid coverage with no insurance coverage in patients younger than 65 years of age. Seventh, CRUSADE hospitals were more likely to be academic and were larger than nonparticipating hospitals, and this may affect the generalizability of results. Eighth, we were unable to account for implementation of specific quality initiatives within participating hospitals. Finally, although we show an association between lower use of medical therapies and invasive procedures among Medicaid patients and worse in-hospital outcomes, we cannot prove a causal link.

Conclusions

Adherence to clinical practice guidelines among patients younger than 65 years of age with NSTE ACS primarily covered by Medicaid needs improvement, and treatment disparities in this population appear to contribute to a higher risk for death. Conversely, patients 65 years of age or older primarily covered by Medicare experienced fewer and smaller gaps in care. Because improved use of evidence-based therapies for patients with NSTE ACS is associated with lower mortality rates, further investigation is needed to understand the root causes for these findings and to determine novel strategies to ameliorate health care disparities and reduce mortality rates for Medicaid patients (33).

From Rush University Medical Center, Chicago, Illinois; Duke Clinical Research Institute and Duke University Medical Center, Durham, North Carolina; North Shore University Hospital, Long Island, New York; Northwestern University Hospital, Chicago, Illinois; University of Cincinnati School of Medicine, Cincinnati, Ohio; and the University of North Carolina School of Medicine, Chapel Hill, North Carolina.

Grant Support: CRUSADE is funded by Schering-Plough Corporation. Bristol-Myers Squibb/Sanofi-Aventis Pharmaceuticals Partnership provides additional funding support. Millennium Pharmaceuticals, Inc., Cambridge, Massachusetts, also provided funding for this research.

Potential Financial Conflicts of Interest: *Consultancies:* M.T. Roe (Schering-Plough, Bristol-Myers Squibb, Sanofi), E.M. Ohman (Savacor, Liposcience, Responsible Biomedical, The Medicines Company, Inovise): *Honoraria:* J.E. Calvin (Millenium Speaker's Bureau), M.T. Roe (Sanofi, Bristol-Myers Squibb, Schering-Plough); *Stock ownership or options (other than mutual funds):* E.M. Ohman (Inovise, Savacor, Medtronics Inc.); *Grants received:* M.T. Roe (Schering-Plough, Bristol-Myers Squibb), W.B. Gibler (Schering-Plough, Bristol-Myers Squibb, Sanofi-Aventis), E.M. Ohman (Bristol-Myers Squibb, Sanofi-Aventis, Schering-Plough, Millenium Pharmaceuticals, Eli Lilly Inc., Berlex).

Requests for Single Reprints: James E. Calvin, MD, Section of Cardiology, Rush University Medical Center, 1653 West Congress Parkway, Room 1021-Jelke SC, Chicago, IL 60612; e-mail, James_Calvin@rush.edu.

Current author addresses and author contributions are available at www.annals.org.

References

1. **Braunwald E, Antman EM, Beasley JW, Califf RM, Cheitlin MD, Hochman JS, et al.** ACC/AHA guidelines for the management of patients with unstable angina and non-ST-segment elevation myocardial infarction: executive summary and recommendations. A report of the American College of Cardiology/American Heart Association task force on practice guidelines (committee on the management of patients with unstable angina). Circulation. 2000;102:1193-209. [PMID: 10973852]

2. **Braunwald E, Antman EM, Beasley JW, Califf RM, Cheitlin MD, Hochman JS, et al.** ACC/AHA 2002 guideline update for the management of patients with unstable angina and non-ST-segment elevation myocardial infarction—summary article: a report of the American College of Cardiology/American Heart Association task force on practice guidelines (Committee on the Management of Patients With Unstable Angina). J Am Coll Cardiol. 2002;40:1366-74. [PMID: 12383588]

3. Inhibition of platelet glycoprotein IIb/IIIa with eptifibatide in patients with acute coronary syndromes. The PURSUIT Trial Investigators. Platelet Glycoprotein IIb/IIIa in Unstable Angina: Receptor Suppression Using Integrilin Therapy. N Engl J Med. 1998;339:436-43. [PMID: 9705684]

4. **Cannon CP, Weintraub WS, Demopoulos LA, Vicari R, Frey MJ, Lakkis N, et al.** Comparison of early invasive and conservative strategies in patients with unstable coronary syndromes treated with the glycoprotein IIb/IIIa inhibitor tirofiban. N Engl J Med. 2001;344:1879-87. [PMID: 11419424]

5. **Eikelboom JW, Anand SS, Malmberg K, Weitz JI, Ginsberg JS, Yusuf S.** Unfractionated heparin and low-molecular-weight heparin in acute coronary syndrome without ST elevation: a meta-analysis. Lancet. 2000;355:1936-42. [PMID: 10859038]

6. **Kreindel S, Rosetti R, Goldberg R, Savageau J, Yarzebski J, Gore J, et al.** Health insurance coverage and outcome following acute myocardial infarction. A community-wide perspective. Arch Intern Med. 1997;157:758-62. [PMID: 9125007]

7. **Berlin JA, Kimmel SE, Ten Have TR, Sammel MD.** An empirical comparison of several clustered data approaches under confounding due to cluster effects in the analysis of complications of coronary angioplasty. Biometrics. 1999;55:470-6. [PMID: 11318202]

8. **Liang HZ, Chen KJ.** [Clinical effects of ginseng injection and a ginseng combination injection on the aged patients with heart failure as evaluated by a computerized nuclear stethoscope]. Zhong Xi Yi Jie He Za Zhi. 1986;6:13-6, 2. [PMID: 2942271]

9. **Stone CJ, Koo CY.** Additive splines in statistics. In: Proceedings of the Statistical Computing Section of the American Statistical Assocation. 1985; 45-8.

10. **Devlin TF, Weeks BJ.** Spline functions for logistic regression modeling. Proceedings of the 11th Annual SAS Users Group International Conference. Cary, NC: SAS Institute; 1986:646-51.

11. **Stone CJ.** Comment: generalized additive models. Statist Sciences. 1986;1:312-314.

12. **Boersma E, Pieper KS, Steyerberg EW, Wilcox RG, Chang WC, Lee KL, et al.** Predictors of outcome in patients with acute coronary syndromes without persistent ST-segment elevation. Results from an international trial of 9461 patients. The PURSUIT Investigators. Circulation. 2000;101:2557-67. [PMID: 10840005]

13. Institute of Medicine, Committee on Quality of Health Care in America. Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, DC: National Academy Pr; 2001:1-22.

14. **Philbin EF, McCullough PA, DiSalvo TG, Dec GW, Jenkins PL, Weaver WD.** Underuse of invasive procedures among Medicaid patients with acute myocardial infarction. Am J Public Health. 2001;91:1082-8. [PMID: 11441735]

15. **Carlisle DM, Leake BD, Shapiro MF.** Racial and ethnic disparities in the use of cardiovascular procedures: associations with type of health insurance. Am J Public Health. 1997;87:263-7. [PMID: 9103107]

16. **Canto JG, Rogers WJ, French WJ, Gore JM, Chandra NC, Barron HV.** Payer status and the utilization of hospital resources in acute myocardial infarction: a report from the National Registry of Myocardial Infarction 2. Arch Intern Med. 2000;160:817-23. [PMID: 10737281]

17. **Seddon ME, Ayanian JZ, Landrum MB, Cleary PD, Peterson EA, Gahart MT, et al.** Quality of ambulatory care after myocardial infarction among Medicare patients by type of insurance and region. Am J Med. 2001;111:24-32. [PMID: 11448657]

18. **Leape LL, Hilborne LH, Bell R, Kamberg C, Brook RH.** Underuse of cardiac procedures: do women, ethnic minorities, and the uninsured fail to re-

ceive needed revascularization? Ann Intern Med. 1999;130:183-92. [PMID: 10049196]
19. **Siu AL, Leibowitz A, Brook RH, Goldman NS, Lurie N, Newhouse JP.** Use of the hospital in a randomized trial of prepaid care. JAMA. 1988;259: 1343-6. [PMID: 3339839]
20. **Rapoport J, Gehlbach S, Lemeshow S, Teres D.** Resource utilization among intensive care patients. Managed care vs traditional insurance. Arch Intern Med. 1992;152:2207-12. [PMID: 1444680]
21. **Jollis JG, DeLong ER, Peterson ED, Muhlbaier LH, Fortin DF, Califf RM, et al.** Outcome of acute myocardial infarction according to the specialty of the admitting physician. N Engl J Med. 1996;335:1880-7. [PMID: 8948564]
22. **Nelson AR.** Unequal treatment: report of the Institute of Medicine on racial and ethnic disparities in healthcare. Ann Thorac Surg. 2003;76:S1377-81. [PMID: 14530068]
23. **Pear R.** Health costs will keep rising, U.S. says, along with government share. The New York Times. 24 February 2005:A20.
24. Improving care for acute myocardial infarction: experience from the Cooperative Cardiovascular Project. The Cooperative Cardiovascular Project Best Practices Working Group. Jt Comm J Qual Improv. 1998;24:480-90. [PMID: 9770638]
25. **Burwen DR, Galusha DH, Lewis JM, Bedinger MR, Radford MJ, Krumholz HM, et al.** National and state trends in quality of care for acute myocardial infarction between 1994-1995 and 1998-1999: the medicare health care quality improvement program. Arch Intern Med. 2003;163:1430-9. [PMID: 12824092]
26. **Jencks SF, Cuerdon T, Burwen DR, Fleming B, Houck PM, Kussmaul AE, et al.** Quality of medical care delivered to Medicare beneficiaries: A profile at state and national levels. JAMA. 2000;284:1670-6. [PMID: 11015797]
27. **Sloan FA, Rankin PJ, Whellan DJ, Conover CJ.** Medicaid, managed care, and the care of patients hospitalized for acute myocardial infarction. Am Heart J. 2000;139:567-76. [PMID: 10740136]
28. **Gold MR, Mittler J, Aizer A, Lyons B, Schoen C.** Health insurance expansion through states in a pluralistic system. J Health Polit Policy Law. 2001;26: 581-615. [PMID: 11430253]
29. **Boden WE, McKay RG, Cabin HS, Radford MJ, Krumholz HM, Zaret BL, et al.** The Connecticut Cardiovascular Consortium: a unique, state-wide research collaboration to advance clinical outcomes in patients with heart disease. Conn Med. 2001;65:597-604. [PMID: 11702518]
30. **Levknecht L, Schriefer J, Schriefer J, Maconis B.** Combining case management, pathways, and report cards for secondary cardiac prevention. Jt Comm J Qual Improv. 1997;23:162-74. [PMID: 9103970]
31. **Iliadis EA, Klein LW, Vandenberg BJ, Spokas D, Hursey T, Parrillo JE, et al.** Clinical practice guidelines in unstable angina improve clinical outcomes by assuring early intensive medical treatment. J Am Coll Cardiol. 1999;34:1689-95. [PMID: 10577558]
32. **Mehta RH, Montoye CK, Gallogly M, Baker P, Blount A, Faul J, et al.** Improving quality of care for acute myocardial infarction: The Guidelines Applied in Practice (GAP) Initiative. JAMA. 2002;287:1269-76. [PMID: 11886318]
33. **Peterson ED, Roe MT, Mulgund J, DeLong ER, Lytle BL, Brindis RG, et al.** Association between hospital process performance and outcomes among patients with acute coronary syndromes. JAMA. 2006;295:1912-20. [PMID: 16639050]

Current Author Addresses: Dr. Calvin: Section of Cardiology, Rush University Medical Center, 1653 West Congress Parkway, Room 1021-Jelke SC, Chicago, IL 60612.
Drs. Roe and Peterson: Division of Cardiology, Duke Clinical Research Institute, 2400 Pratt Street, Durham, NC 27705.
Ms. Chen and Drs. Mehta and DeLong: Duke Clinical Research Institute, 2400 Pratt Street, Durham, NC 27705.
Dr. Brogan: Department of Emergency Medicine, New York University School of Medicine, North Shore Long Island Jewish Health System, Plainview, NY 11803.
Dr. Fintel: Coronary Care Unit, Northwestern University School of Medicine, Wesley Suite 726, 250 East Superior Street, Chicago, IL 60611.
Dr. Gibler: Department of Emergency Medicine, University of Cincinnati College of Medicine, Mail Location 0769, 231 Albert Sabin Way, Cincinnati, OH 45267-0769.
Dr. Ohman: Division of Cardiology, Duke University Medical Center, Room 7403 Duke Hospital North, Box 3126 DUMC, Durham, NC 27705.
Dr. Smith: Center for Cardiovascular Science and Medicine, The University of North Carolina at Chapel Hill, CB #7075, 6th Floor, Burnett-Womack Building, 99 Manning Drive, Chapel Hill, NC 27599-7075.

Author Contributions: Conception and design: S.C. Smith, J.E. Calvin, M.T. Roe, W.B. Gibler, E.D. Peterson, E.M. Ohman.
Analysis and interpretation of the data: M.T. Roe, A.Y. Chen, E.D. Peterson, E.M. Ohman.
Drafting of the article: J.E. Calvin, R.H. Mehta, E.D. Peterson.
Critical revision of the article for important intellectual content: S.C. Smith, J.E. Calvin, M.T. Roe, R.H. Mehta, G.X. Brogan, E.R. DeLong, D.J. Fintel, W.B. Gibler, E.D. Peterson, E.M. Ohman.
Final approval of the article: S.C. Smith, J.E. Calvin, M.T. Roe, R.H. Mehta, G.X. Brogan, E.R. DeLong, D.J. Fintel, W.B. Gibler, E.D. Peterson, E.M. Ohman.
Provision of study materials or patients: E.D. Peterson.
Statistical expertise: M.T. Roe, A.Y. Chen, E.R. DeLong, E.D. Peterson.
Obtaining of funding: E.D. Peterson, E.M. Ohman.
Administrative, technical, or logistic support: E.D. Peterson, E.M. Ohman.
Collection and assembly of data: E.D. Peterson.