Physician Board Certification and the Care and Outcomes of Elderly Patients with Acute Myocardial Infarction

Jersey Chen, MD, MPH,[1] Saif S. Rathore, MPH,[2] Yongfei Wang, MS,[2] Martha J. Radford, MD,[2,3] Harlan M. Krumholz, MD, SM[2,3,4,5]

[1]Beth Israel Deaconess Medical Center, Boston, MA, USA; [2]Section of Cardiovascular Medicine, Department of Medicine, Yale University School of Medicine, New Haven, CT, USA; [3]Center for Outcomes Research and Evaluation, Yale New Haven Health, New Haven, CT, USA; [4]Section of Health Policy and Administration, Department of Epidemiology and Public Health, Yale University School of Medicine, New Haven, CT, USA; [5]Robert Wood Johnson Clinical Scholars Program, Yale University School of Medicine, New Haven, CT, USA.

BACKGROUND: Patients and purchasers prefer board-certified physicians, but whether these physicians provide better quality of care and outcomes for hospitalized patients is unclear.

OBJECTIVE: We evaluated whether care by board-certified physicians after acute myocardial infarction (AMI) was associated with higher use of clinical guideline recommended therapies and lower 30-day mortality.

SUBJECTS AND METHODS: We examined 101,251 Medicare patients hospitalized for AMI in the United States and compared use of aspirin, β-blockers, and 30-day mortality according to the attending physicians' board certification in family practice, internal medicine, or cardiology.

RESULTS: Board-certified family practitioners had slightly higher use of aspirin (admission: 51.1% vs 46.0%; discharge: 72.2% vs 63.9%) and β-blockers (admission: 44.1% vs 37.1%; discharge: 46.2% vs 38.7%) than nonboard-certified family practitioners. There was a similar pattern in board-certified Internists for aspirin (admission: 53.7% vs 49.6%; discharge: 78.2% vs 68.8%) and β-blockers (admission: 48.9% vs 44.1%; discharge: 51.2% vs 47.1). Board-certified cardiologists had higher use of aspirin compared with cardiologists certified in internal medicine only or without any board certification (admission: 61.3% vs 53.1% vs 52.1%; discharge: 82.2% vs 71.8% vs 71.5%) and β-blockers (admission: 52.9% vs 49.6% vs 41.5%; discharge: 54.7% vs 50.6% vs 42.5%). In multivariate regression analyses, board certification was not associated with differences in 30-day mortality.

CONCLUSIONS: Treatment by a board-certified physician was associated with modestly higher quality of care for AMI, but not differences in mortality. Regardless of board certification, all physicians had opportunities to improve quality of care for AMI.

KEY WORDS: board certification; acute myocardial infarction; quality of care; mortality.
DOI: 10.1111/j.1525-1497.2006.00326.x
J GEN INTERN MED 2006; 21:238–244.

In the United States, board certification is a voluntary process whereby private medical organizations ("Boards") evaluate and certify physicians in a particular specialty or subspecialty.[1] Although board certification is not a legal requirement to practice medicine, it has important consequences for physicians.[1] Hospitals and managed care organizations consider board certification as one of the most important factors when hiring physicians.[2–5] Patients also appear to prefer board-certified physicians.[6]

Underlying this preference is an implicit assumption that board-certified physicians practice higher quality medicine than nonboard-certified physicians. The American Board of Internal Medicine, the certifying body for internal medicine and its subspecialties, has stated that board certification "improve(s) the quality of medical care by ensuring that the certified Internists and sub-specialists possess the knowledge, skills and attitudes essential to the provision of excellent care"[7] and the "certification process . . . produce(s) a reliable indicator of physician quality."[8] Given that 30% of all physicians and 27% of Internists in the United States were not board-certified in 2002,[9] differences in quality of care between board-certified and nonboard-certified physicians may potentially affect substantial numbers of patients.

Whether care by board-certified physicians leads to better outcomes is unclear, with some studies showing a benefit and others showing no relationship.[6,10] Furthermore, a systematic review of articles examining board certification and outcomes found only 5% of studies used appropriate research methods.[10] Few studies have evaluated the relationship between board certification and quality of care, particularly with respect to clinical guideline adherence, and those that did have primarily examined outpatient measures[11,12] and not acute illnesses necessitating hospitalization.

Accordingly, we sought to examine the relationship between board certification, quality of care and outcomes using data from the Cooperative Cardiovascular Project (CCP),[13] a national cohort of elderly patients hospitalized with acute myocardial infarction (AMI). Acute myocardial infarction is a condition well suited for assessing quality of care because of its prevalence, potential for serious adverse outcomes, and availability of evidence-based clinical practice guidelines with which to evaluate quality objectively.[14]

METHODS

Study Sample

The CCP was a Centers for Medicare & Medicaid Services (CMS) initiative that identified Medicare beneficiaries hospitalized between January 1994 and February 1996 with a principal discharge diagnosis of AMI.[13] Medical records (n=234,769) were abstracted at central data centers for

The authors have no conflicts of interest to report.

The JGIM Conflict of Interest Disclosure Statement was provided on page 2 of the original submission.

Dr. Radford is now with the New York University Medical Center, New York, NY.

Address correspondence and requests for reprints to Dr. Krumholz: Yale University School of Medicine, Room I-456 SHM, 333 Cedar Street, PO Box 208088, New Haven, CT 06520-8088 (e-mail: harlan.krumholz@yale.edu).

Manuscript received January 4, 2005
Initial editorial decision March 18, 2005
Final acceptance October 13, 2005

patient demographics, clinical history, presenting symptoms, and treatments.

We identified patients aged $\geq$65 years with a clinically confirmed AMI as described previously.[13] We excluded patients transferred from another acute care hospital, with a terminal illness or metastatic cancer, subsequent AMI admissions, hospitalizations outside of the 50 United States, and observations that could not be linked with American Hospital Association (AHA) or physician characteristics data. We limited the cohort to patients cared for by allopathic physicians who identified themselves as or were board-certified in cardiology, internal medicine, or family practice. There were 101,251 patients remaining for final analysis.

Physician Characteristics

Physician characteristics were obtained from the American Medical Association (AMA) Physician Masterfile, which includes board certification reported to the American Board of Medical Specialties[15] and contains reliable information on board certification status with $\sim$ 94% accuracy.[16]

The board certification status of the attending physician, the clinician primarily responsible for care during the hospitalization,[17] was obtained by linking the physician's Unique Physician Identification Number (UPIN) to the AMA Masterfile. Self-identified Internists and family practitioners were classified as board-certified or nonboard-certified. Self-identified cardiologists were classified as board-certified in cardiology, board-certified in internal medicine only, or not board-certified in either. Other physician characteristics included type of employment (solo, partnership, etc.), gender, country of medical school, and year of medical school graduation. We estimated the annual number of AMI Medicare admissions for each physician using Medicare Part A data from 1994 to 1996.

Hospital Characteristics

Hospital characteristics were obtained from the 1994 AHA survey of hospitals[18] and included the following: on-site facilities for invasive cardiac procedures, bed size, rural location, ownership type (public, not-for-profit, for-profit), teaching status (affiliation with medical school or resident training program), and U.S. census division. The annual volume of Medicare AMI admissions was estimated from Medicare Part A data from 1994 to 1995 for each hospital.

Quality-of-Care Measures

We determined quality of care for AMI using 4 indicators developed by CMS that assess use of therapies recommended by clinical practice guidelines[14]—aspirin at admission, aspirin prescribed at discharge, β-blockers at admission, β-blockers prescribed at discharge—in patients without chart-documented contraindications in whom treatment was indicated.[19] We defined aspirin or β-blockers at admission as chart-documented administration on the first or second hospital day.

Mortality

We evaluated 30-day mortality after admission for AMI, a time period during which aspirin and β-blockers have been shown to be effective in clinical trials. Secondary analyses were conducted for 1-year mortality, as this time duration would be more strongly affected by potential confounders such as patient comorbidities and less affected by in-hospital and discharge treatments. We obtained patients' vital status from the Medicare Enrollment Database and the Social Security Administration's Master Beneficiary Record File.[20]

Statistical Analysis

We compared patient characteristics, quality of care, and outcomes according to physician board certification status using Pearson's χ^2 tests for categorical variables and analysis of variance for continuous variables. Multivariable logistic regression models were used to assess whether board certification was independently associated with therapies and mortality, controlling for patient, hospital, and physician characteristics. Because clustering of observations about particular providers may lead to biased estimates of standard errors, we employed hierarchical multilevel models using both patient and hospital levels in our analyses.[21] As clustering of observations was more prominent around hospitals rather than individual physicians, the analyses adjusted for clustering around the former.

Multivariable analyses adjusted for mortality risk factors from the GUSTO-I study,[22] noncardiac comorbidities, and functional limitations as in a prior study,[23] and hospital and physician characteristics as described above. Dummy variables were included in the multivariate analyses for variables with more than 5% missing observations. We converted odds ratios into risk ratios, as the latter are more representative of relative risks when outcomes are common.[24]

We conducted statistical analyses using SAS 8.0 (SAS Institute Inc., Cary, NC) and MLwiN 1.10 (Institute of Higher Education, London, UK). The study was approved by the Yale University School of Medicine Human Investigation Committee.

RESULTS

Patient Characteristics

Among 101,251 elderly Medicare patients admitted to 4,361 hospitals for AMI, the mean patient age was 76.5 years, and 51.3% were female and 5.8% were black. Absolute differences between patients treated by board-certified and nonboard-certified physicians were generally small (Table 1). Board-certified physicians were more likely to treat patients who were white and of higher socioeconomic status. Patients treated by board-certified cardiologists were less likely to have diabetes mellitus, prior stroke, or renal dysfunction compared with patients treated by non-certified cardiologists. Board-certified cardiologists were the most likely to treat patients with ST-segment elevation AMI in teaching hospitals and hospitals with facilities for cardiac procedures.

Physician Characteristics

Among the 36,668 physicians in our study, 29,346 (80.0%) were board-certified in any field with 28,125 physicians (76.7%) were board-certified in their self-designated specialty (Table 2). The sample consisted of 11,157 family practitioners with 9,788 board-certified (87.7%), 14,484 Internists with 9,692 board-certified (66.9%), and 11,027 cardiologists with 8,645 (78.4%) board-certified in cardiology and 1,221 (11.1%) board-certified in internal medicine alone. For all 3 specialties,

Table 1. Patient Characteristics According to Physician Specialty and Board Certification Status

	Family Practice		Internal Medicine		Cardiology		
	Noncertified	Certified	Noncertified	Certified	Noncertified	Certified Internist	Certified Cardiologist
N	2,695	18,695	11,384	23,194	3,828	4,162	37,293
Demographics							
Age, y (SD)	77.7 (7.7)	77.5 (7.7)	77.5 (7.6)	77.3 (7.5)	76.2 (7.3)	76.2 (7.3)	75.3 (6.9)*
Women (%)	46.8	47.5	47.7	48.1	54.4	53.8	56.0
Black race (%)	7.4	5.2*	7.6	5.8*	6.4	5.4	5.4
Other race (%)	3.3	2.0*	3.6	2.5*	5.0	2.9	3.2*
Socioeconomic status							
Median household income ($)	26,172	27,299*	29,970	30,206	30,427	31,199	32,408*
High school/college graduate (%)	46.2	47.3*	48.4	49.2*	49.1	49.5	50.6*
History/admission							
Killip class† (%)							
I	50.1	50.3	47.5	48.3	51.6	52.5	54.8*
II	12.1	11.9	11.7	12.2	12.0	12.1	11.9
III or IV	37.8	37.8	40.8	39.5	36.4	35.4	33.2
MI location							
Anterior (%)	46.8	45.4	47.0	45.5	46.8	47.8	46.5
Inferior (%)	44.2	42.8	43.9	44.3	48.3	48.3	50.8*
Other (%)	26.9	29.3	28.3	28.6	25.1	24.1	22.7*
Clinical history and admission laboratory values							
Past MI (%)	26.4	27.1	27.8	29.0	33.1	33.1	32.0
Smoker (%)	14.9	14.4	13.6	13.4	14.7	13.6	15.4
Diabetes mellitus (%)	31.5	31.4	33.4	31.9	30.2	28.4	27.6*
Hypertension (%)	61.0	60.3	64.0	63.9	61.8	61.1	59.9
Stroke (%)	16.0	15.6	15.9	15.5	13.3	13.4	11.6*
CABG (%)	9.5	9.0	10.4	11.2	17.4	15.8	17.2
ST elevation MI (%)	26.3	26.9	27.1	27.3	29.5	30.4	34.4*
Albumin <3 g/dL (%)	31.6	30.9	30.7	31.1	29.5	28.7	30.0
Hematocrit <30%	8.2	7.4	6.9	7.1	5.7	5.9	5.4
BUN >40 mg/dL or Creatinine >2.0 mg/dL (%)	12.4	12.9	14.3	13.1*	11.5	10.7	9.3*
Hospital characteristics							
Cardiac catheterization available (%)	41.3	44.4*	55.2	56.4	67.4	66.2	77.4*
Angioplasty available (%)	23.6	25.3	33.6	36.7*	46.3	42.8	55.4*
Bypass surgery available (%)	19.4	21.4	27.9	31.8*	42.6	36.0	50.8*
Teaching (%)	16.3	22.4*	30.9	30.8	35.1	32.9	41.5*
COTH, major teaching (%)	3.1	3.4	10.1	10.6	13.7	9.9	14.6*
Public (%)	23.4	21.1	11.7	12.7	9.9	10.3	9.7
Private for profit (%)	14.3	9.0*	11.0	9.5*	12.6	12.1	10.0*
Private nonprofit (%)	62.3	69.9*	77.3	77.7	77.6	77.6	80.3*
Without contraindications for guideline-recommended therapies							
During hospitalization							
Aspirin (%)	56.3	54.0	53.4	53.2	53.5	54.3	54.2
β-blockers (%)	34.3	35.2	32.0	33.9*	36.9	37.8	41.4*
At discharge							
Aspirin (%)	31.3	31.7	32.3	32.4	33.9	33.4	34.1
β-blockers (%)	21.4	22.1	21.7	23.2*	27.6	25.7	30.8*
Region							
Northeast (%)	13.5	17.0	30.4	24.3	25.5	28.2	23.7
Midwest (%)	30.0	30.8	23.5	23.3	21.3	19.0	19.3
South (%)	47.4	41.8	35.5	37.0	36.7	39.7	36.9
West (%)	9.2	10.4	10.6	15.5	16.5	13.1	20.0

*P<*0.001 for comparison of board-certified versus non-board-certified physicians within physician speciality.*

†*Killip class measures severity of heart failure with MI.*

BUN, blood urea nitrogen; CABG, coronary artery bypass graft surgery; COTH, Council of Teaching Hospitals; MI, myocardial infarction.

nonboard-certified physicians were more likely to be in solo practice, to have graduated from medical schools outside of the United States or Canada, or to be in practice longer compared with board-certified physicians.

Quality Measures

Board-certified physicians had significantly higher use of quality indicator therapies than nonboard-certified physicians in each of the specialties we evaluated (Table 3). Patients treated by board-certified family practitioners had higher use of aspirin at admission (51.1% vs 46.0%, $P<.001$), aspirin at discharge (72.2% vs 63.9%, $P<.001$), β-blockers at admission (44.1% vs 37.1%; $P<.001$), and β-blockers at discharge (46.2% vs 38.7%, $P=.001$) compared with patients treated by nonboard-certified family practitioners.

Patients treated by board-certified Internists had higher use of aspirin at admission (53.7% vs 49.6%, $P<.001$) and at

Table 2. Physician Characteristics According to Specialty and Board Certification Status

	Family Practice		Internal Medicine		Cardiology		
	Noncertified	Certified	Noncertified	Certified	Noncertified	Certified Internist	Certified Cardiologist
Total	1,369	9,788	4,792	9,692	1,161	1,221	8,645
Male (%)	93.9	88.7*	88.7	86.6*	96	95.7	96.2
Medical school location							
U.S./Canada	69.7	89.5*	56.3	81.9*	51	68.3	75.9*
OECD member, major industrialized country (%)	5.0	1.6*	7.5	2.1*	8.8	5.9	2.8*
Other (%)	25.3	8.9*	36.3	16.0*	40.2	25.8	21.4*
Employment type							
Solo (%)	54.4	27.9*	43.9	28.3*	50.2	45.5	18.8*
Partnership (%)	9.8	10.8	8.0	8.5	8.8	7.6	7.7
Group (%)	22.4	41.0*	24.4	39.9*	25.7	32.6	46.6*
Medical school (%)	0.5	1.4	0.7	0.9	3.1	1.4	4.0*
Other/missing (%)	12.9	19.0*	23.1	22.4	12.2	12.9	22.9*
Year in which MD degree was obtained							
Before 1965 (%)	40.3	9.7*	21.5	8.4*	49.8	46.5	9.7*
1965 to 1974 (%)	31.3	18.4*	26.6	19.9*	33.3	28.7	31.7*
1975 to 1984 (%)	24.5	49.5*	39.8	48.2*	15.8	20.4	48.3*
1985 or later (%)	4.0	22.4*	12.2	23.6*	1.2	4.3	10.3*
Estimated mean annual Medicare AMI volume	3.9	3.7	4.6	4.7	7.5	7.6	12.3*

*P<0.001 for comparison of board-certified versus nonboard-certified physicians within physician speciality.
AMI, acute myocardial infarction; OECD, Organization for Economic Cooperation and Development.

discharge (78.2% vs 68.8%, $P<.001$), and higher use of β-blockers at admission (48.9% vs 44.1%; $P<.001$) and at discharge (51.2% vs 47.1%, $P=.001$) compared with patients treated by nonboard-certified Internists.

Cardiologists with board certification in cardiology had higher quality indicators than cardiologists with no board certification (aspirin at admission: 61.3% vs 52.1%, $P<.001$; aspirin at discharge: 82.2% vs 71.5%, $P<.001$; β-blockers at admission: 52.9% vs 41.5%, $P<.001$; β-blockers at discharge: 54.7% vs 42.5%, $P<.001$).

Cardiologists with board certification in cardiology had higher quality indicators than cardiologists with board certification in internal medicine only (aspirin at admission: 61.3% vs 53.1%, $P<.001$; aspirin at discharge: 82.2% vs 71.8%, $P<.001$; β-blockers at admission: 52.9% vs 49.6%, $P=.01$; β-blockers at discharge: 54.7% vs 50.6%, $P=.01$).

Cardiologists with board certification in internal medicine only had higher quality indicators than cardiologists with no board certification for use of β-blockers (at admission: 49.6% vs 41.5%, $P<.001$; at discharge: 50.6% vs 42.5%, $P<.001$), but had comparable use of aspirin (at admission: 53.1% vs 52.1%, $P=.48$; at discharge: 71.8% vs 71.5%, $P=.87$).

In multivariable analyses adjusting for patient, hospital, and physician characteristics, patients treated by board-certified family practitioners did not have significantly higher use of aspirin (risk ratio [RR] = 1.06, confidence intervel [CI] 0.99 to 1.12) and β-blockers (RR = 1.00, CI 0.92 to 1.08) at admission, or use of aspirin (RR = 1.05, CI 0.99 to 1.10) and β-blockers (RR = 1.05, CI 0.93 to 1.17) at discharge compared with nonboard-certified family practitioners (Table 3).

Patients treated by board-certified Internists continued to be more likely to receive aspirin at admission (RR = 1.04, CI 1.01 to 1.07), aspirin at discharge (RR = 1.08, 1.06 to 1.11), and β-blockers at admission (RR = 1.06, CI 1.02 to 1.10) after adjustment, but had a likelihood of receiving β-blockers at discharge not significantly different from that of patients treated by nonboard-certified Internists (RR = 1.04, CI 0.98 to 1.09).

Among cardiologists, board certification in cardiology was associated with higher adjusted likelihood of aspirin at admission (RR = 1.10, CI 1.05 to 1.15), aspirin at discharge (RR = 1.07, CI 1.03 to 1.10), β-blockers at admission (RR = 1.20, CI 1.13 to 1.26), and β-blockers at discharge (RR = 1.20, CI 1.12 to 1.29) compared with those who were not board-certified. Patients treated by cardiologists with board certification in internal medicine only had a higher adjusted likelihood of receiving β-blockers at admission (RR = 1.13, CI 1.05 to 1.21) and at discharge (RR = 1.14, CI 1.03 to 1.25), but not for aspirin at admission (RR = 1.00, CI 0.94 to 1.06) and discharge (RR = 0.98, CI 0.93 to 1.03) compared with patients treated by cardiologists without any board certification.

Mortality

Patients treated by board-certified family practitioners had lower 30-day mortality (19.9% vs 21.8%, $P=.02$) compared with those treated by non-board-certified family practitioners (Table 4). Patients treated by board-certified Internists and nonboard-certified Internists had similar 30-day mortality rates (19.4% vs 19.8%, $P=.46$). Patients treated by board-certified cardiologists had better outcomes than patients treated by cardiologists with no board certification at 30 days (16.2% vs 17.9%, $P=.001$). Patients treated by board-certified cardiologists also had better outcomes at 30 days than patients treated by cardiologists with board certification in internal medicine only (16.2% vs 18.6%, $P<.001$). Patients treated by cardiologists with internal medicine board certification only had similar outcomes at 30 days compared with those treated by cardiologists with no board certification (18.6% vs 17.9%, $P=.42$). Receiving treatment from board-certified physicians regardless of specialty was significantly associated with lower

Table 3. Unadjusted* and Adjusted† Use of AMI Therapies in Patients Without Contraindications, Stratified by Physician Board Certification Status

	Aspirin at Admission		Aspirin at Discharge		β-blockers at Admission		β-blockers at Discharge	
	Proportion Achieving Quality Indicator (%)	Adjusted RR (95% CI)	Proportion Achieving Quality Indicator (%)	Adjusted RR (95% CI)	Proportion Achieving Quality Indicator (%)	Adjusted RR (95% CI)	Proportion Achieving Quality Indicator (%)	Adjusted RR (95% CI)
Family Practice								
Noncertified	46.0	1.00 (referent)	63.9	1.00 (referent)	37.1	1.00 (referent)	38.7	1.00 (referent)
Certified Family Practice	51.1	1.06 (0.99 to 1.12)	72.2	1.05 (0.99 to 1.10)	44.1	1.00 (0.92 to 1.08)	46.2	1.05 (0.93 to 1.17)
Internal medicine								
Noncertified	49.6	1.00 (referent)	68.8	1.00 (referent)	44.1	1.00 (referent)	47.1	1.00 (referent)
Certified internist	53.7	1.04 (1.01 to 1.07)	78.2	1.08 (1.06 to 1.11)	48.9	1.06 (1.02 to 1.10)	51.2	1.04 (0.98 to 1.09)
Cardiology								
Noncertified	52.1	1.00 (referent)	71.5	1.00 (referent)	41.5	1.00 (referent)	42.5	1.00 (referent)
Certified Internist	53.1	1.00 (0.94 to 1.06)	71.8	0.98 (0.93 to 1.03)	49.6	1.13 (1.05 to 1.21)	50.6	1.14 (1.03 to 1.25)
Certified cardiologist	61.3	1.10 (1.05 to 1.15)	82.2	1.07 (1.03 to 1.10)	52.9	1.20 (1.13 to 1.26)	54.7	1.20 (1.12 to 1.29)

*P =*0.001 or lower for all unadjusted comparisons of board-certified versus nonboard-certified physicians within physician speciality.*
†*Relative risk adjusted for patient, physician, and hospital characteristics in 2-level (patient and hospital) hierarchical analysis.*
AMI, acute myocardial infarction; CI, confidence interval; RR, relative risk.

Table 4. Unadjusted* and Adjusted† Mortality After Acute Myocardial Infarction, Stratified by Physician Board Certification Status

	30-D Mortality		1-Y Mortality	
	Unadjusted (%)	Adjusted RR (95% CI)	Unadjusted (%)	Adjusted RR (95% CI)
Family Practice				
Noncertified	21.8	1.00 (referent)	36.6	1.00 (referent)
Certified Family Practice	19.9	0.95 (0.87 to 1.04)	34.4	0.98 (0.92 to 1.04)
Internal Medicine				
Noncertified	19.8	1.00 (referent)	35.8	1.00 (referent)
Certified internist	19.4	1.02 (0.97 to 1.07)	33.8	0.98 (0.94 to 1.01)
Cardiology				
Noncertified	17.9	1.00 (referent)	31.1	1.00 (referent)
Certified internal medicine	18.6	1.07 (0.97 to 1.19)	30.6	1.01 (0.94 to 1.09)
Certified cardiology	16.2	1.03 (0.95 to 1.12)	26.8	0.98 (0.92 to 1.04)

*P< *0.05 for all unadjusted comparisons of board-certified versus nonboard-certified physicians within physician speciality, except 30-day mortality in internal medicine.*
†*Adjusted for patient, physician, and hospital characteristics in 2-level (patient and hospital) hierarchical analysis.*
CI, confidence interval; RR, relative risk.

1-year mortality compared with receiving treatment from physicians without board certification ($P<.05$).

In multivariate analyses adjusting for patient, physician, and hospital characteristics, board certification was not significantly associated with differences in 30-day mortality among patients treated by family practitioners (RR 0.95, 95% CI 0.87 to 1.04), Internists (RR 1.02, 95% CI 0.97 to 1.07), and cardiologists (certified in cardiology RR 1.03, 95% CI 0.95 to 1.12; certified in internal medicine only RR 1.07, 95% CI 0.97 to 1.19) compared with those treated by nonboard-certified physicians; there were no statistically significant differences in mortality up to 1 year (Table 4).

DISCUSSION

In a nationwide cohort of elderly patients with AMI, our study found that physicians who were board-certified in family practice, internal medicine, or cardiology were modestly more likely than nonboard-certified physicians to prescribe aspirin and β-blockers. The higher use of aspirin or β-blockers persisted in multivariate analysis for board-certified Internists and cardiologists. These findings suggest that board-certified physicians provided slightly higher quality of care as assessed by these guideline-recommended treatments for AMI.

The reasons for why board-certified physicians treated a higher proportion of patients with guideline-recommended therapies are unknown but likely multi-factorial. Cabana et al.[25] have identified several mechanisms thought to affect physician adherence to clinical guidelines: knowledge, attitudes, and external barriers. For example board-certified physicians may be more aware of or more familiar with practice guideline recommendations as, on average, they complete more hours of continuing medical education and report more time reading journals.[26] With respect to attitudes, it is possible that board-certified physicians may agree with clinical guidelines more often than nonboard-certified physicians, leading to higher treatment adherence. Whether differences in attitudes exist is unclear, but some studies correlate board certification examination scores with higher subjective ratings of clinical practices during and after residency, suggesting that board-certified physicians adhere more consistently with consensus-defined practices.[27–29] Lastly, board certification may serve as a marker for hospital environments that support the use of clinical guidelines and reduce barriers to their use.

Why was board certification only associated with modest differences in aspirin and β-blocker use? One possibility may be that the board certification exam may be a sensitive assessment of a physician's knowledge base, but less effective for identifying behavioral qualities such as ability to translate evidence from clinical trials into practice, or comfort level or attitudes toward rapidly initiating therapies based on clinical guidelines. Because differences between board-certified and non-board-certified physicians were modest, and even board-certified physicians had room for quality improvement, caution should be exercised when attempting to use board certification as a marker of quality—treatment by a board-certified physician does not necessarily imply optimal adherence to guideline-recommended therapies.

Given the differences in aspirin and β-blocker use, it seems paradoxical that board certification was not associated with improved survival after AMI. One explanation is that the absolute survival benefit was too small for our analysis to detect. Assuming that untreated 30-day mortality was 25% and that aspirin and β-blockers each independently reduce mortality by a relative 25%,[30,31] and that there was an absolute 5% difference in the use of these therapies between board-certified and nonboard-certified physicians, this would imply an $\sim$ 0.5% absolute mortality difference. Finding a statistically significant difference in mortality of this magnitude is difficult; for example, a clinical trial would require over 180,000 patients to detect a mortality difference of 18.0% and 18.5% at 80% power with an α of 0.05.

Our study adds to the existing literature by demonstrating a modest correlation between board certification and quality for the treatment of a life-threatening illness in an acute care hospital setting. Previous studies that examined clinical guideline-based measures of quality were limited to examining care in the ambulatory setting for preventative care activities[11] or for screening mammography.[12]

One study on board certification and AMI by Norcini et al.[32] examined mortality, but not quality-of-care measures. This study found that care by a board-certified physician was associated with a 15% lower in-hospital mortality after hospitalization for AMI.[32] However, the explanation for the dissimilar results may be that the Norcini study examined AMI hospitalizations in a single state, and used different clinical risk-adjustment methods.

The absolute differences in these quality measures between board-certified and non-board-certified physicians are probably smaller today as their use has increased over time, in particular, for β-blockers.[33] However, even the existence of a difference between board-certified and non-board-certified physicians in 1993 to 1994 is an important finding, given that major clinical trials that proved the efficacy of aspirin and β-blockers after AMI were published at least 5 to 10 years before the study period,[30,31] and suggests the potential for analogous differences from newer therapies in current clinical practice.

Our study has some limitations. Board certification status depended on accurate reporting in the AMA Physician Masterfile; however, misclassification of board certification status would make the physician groups appear more similar, biasing results toward the null and underestimating the relationship between certification and outcomes. We could not differentiate between nonboard-certified physicians who failed the board examination (a true board certification attributable difference) and nonboard-certified physicians who did not attempt certification (a difference attributable to physician self-selection). However, distinguishing reasons for lack of board certification is arguably a moot issue for patients or health care organizations. Board certification may also be associated with differences in documentation of contraindications or comorbidities. Although we considered characteristics of the attending physician, we were unable to determine whether this physician was solely responsible for the majority of decisions made during the patient's hospitalization, or whether care was directed by subspecialty consultants.

Although we found that board certification, on average, was modestly correlated with several guideline recommended treatments for AMI, our study illustrates the challenges of using board certification as a marker of quality. Board certification was not a strong measure of quality, as treatment by a board-certified physician did not guarantee use of aspirin or β-blockers in all patients for whom treatment was indicated.

Indeed, for each of the quality indicators, the differences between the use of guideline recommended treatments by board-certified physicians and maximal adherence were larger than the difference between board-certified and nonboard-certified physicians. Although there is a correlation with markers of higher quality AMI care overall, even board-certified physicians have considerable room for improvement.

The analyses upon which this publication is based were performed under Contract Number 500-99-CTO1, entitled, ''Utilization and Quality Control Peer Review Organization for the State of Connecticut,'' sponsored by the CMS, U.S. Department of Health and Human Services. The content of this publication does not necessarily reflect the views or policies of the U.S. Department of Health and Human Services, nor does mention of trade names, commercial products, or organization imply endorsement by the U.S. Government. The author assumes full responsibility for the accuracy and completeness of the ideas presented. This article is a direct result of the Health Care Quality Improvement Program initiated by the Health Care Financing Administration, which has encouraged identification of quality improvement projects derived from analysis of patterns of care, and therefore required no special funding on the part of this Contractor. Ideas and contributions to the author concerning experience in engaging with issues presented are welcomed.

Mr. Rathore is supported by NIH/National Institute of General Medical Sciences Medical Scientist Training Grant GM07205.

REFERENCES

1. **Smith JJ.** Legal implications of specialty board certification. J Leg Med. 1996;17:73–111.
2. **Gold MR, Hurley R, Lake T, Ensor T, Berenson R.** A national survey of the arrangements managed-care plans make with physicians. N Engl J Med. 1995;333:1678–83.
3. **Jacobs MO, Mott PD.** Physician characteristics and training emphasis considered desirable by leaders of HMOs. J Med Educ. 1987;62:725–31.
4. **McIlrath S.** Board-certified only need apply. American Medical News. 1994:1, 47–9.
5. **Gramling A.** Health plans want to know: are you certified? Manag Care. 1994;3:39–41.
6. **Brennan TA, Horwitz RI, Duffy FD, Cassel CK, Goode LD, Lipner RS.** The role of physician specialty board certification status in the quality movement. JAMA. 2004;292:1038–43.
7. **Benson JA Jr.** Certification and recertification: one approach to professional accountability. Ann Intern Med. 1991;114:238–42.
8. **Cassel CK.** The quality crescendo. Perspectives. American Board of Internal Medicine Newsletter for Diplomates. 1999: 1, 4, 5, 12.
9. **American Medical Association.** Physician Characteristics and Distribution in the US. 2004 Edn. Chicago, IL: AMA Press; 2004.
10. **Sharp LK, Bashook PG, Lipsky MS, Horowitz SD, Miller SH.** Specialty board certification and clinical outcomes: the missing link. Acad Med. 2002;77:534–42.
11. **Ramsey PG, Carline JD, Inui TS, Larson EB, LoGerfo JP, Wenrich MD.** Predictive validity of certification by the American Board of Internal Medicine. Ann Intern Med. 1989;110:719–26.
12. **Tamblyn R, Abrahamowicz M, Dauphinee WD, et al.** Association between licensure examination scores and practice in primary care. JAMA. 2002;288:3019–26.
13. **Marciniak TA, Ellerbeck EF, Radford MJ, et al.** Improving the quality of care for Medicare patients with acute myocardial infarction: results from the Cooperative Cardiovascular Project. JAMA. 1998;279:1351–7.
14. **Ryan TJ, Anderson JK, Antman EM, et al.** ACC/AHA guidelines for the management of patients with acute myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction). J Am Coll Cardiol. 1996;28:1328–428.
15. **Baldwin LM, Adamache W, Klabunde CN, Kenward K, Dahlman C, Warren JL.** Linking physician characteristics and Medicare claims data: issues in data availability, quality, and measurement. Med Care. 2002;40:82–95.
16. **Cherkin D, Lawrence D.** An evaluation of the American Medical Association's Physician Masterfile as a data source—one state's experience. Med Care. 1977;15:767–9.
17. **Iezzoni LI.** Data sources and implications: administrative data bases. In: Iezzoni LI, ed. Risk Adjustment for Measuring Health Outcomes. Ann Arbor: Health Administration Press; 1994:122–75.
18. **American Hospital Association.** The Annual Survey of Hospitals Database: Documentation for 1994 Data. Chicago, IL: American Hospital Association; 1994.
19. **Ellerbeck EF, Jencks SF, Radford MJ, et al.** Quality of care for Medicare patients with acute myocardial infarction: a four-state pilot study from the Cooperative Cardiovascular Project. JAMA. 1995; 273:1509–14.
20. **Wentworth DN, Neaton JD, Rasmussen WL.** An evaluation of the Social Security Administration master beneficiary record file and the National Death Index in the ascertainment of vital status. Am J Public Health. 1983;73:1270–4.
21. **DeLong E.** Hierarchical modeling: its time has come. Am Heart J. 2003; 145:16–8.
22. **Lee KL, Woodlief LH, Topol EJ, et al.** Predictors of 30-day mortality in the era of reperfusion for acute myocardial infarction. Results from an international trial of 41,021 patients. GUSTO-I investigators. Circulation. 1995;91:1659–68.
23. **Chen J, Radford MJ, Wang Y, Krumholz HM.** Care and outcomes of elderly patients with acute myocardial infarction by physician specialty: the effects of comorbidity and functional limitations. Am J Med. 2000; 108:460–9.
24. **Zhang J, Yu KF.** What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes. JAMA. 1998; 280:1690–1.
25. **Cabana MD, Rand CS, Powe NR, et al.** Why don't physicians follow clinical practice guidelines? A framework for improvement. JAMA. 1999;282:1458–65.
26. **Gemson DH, Elinson J.** Prevention in primary care: variability in physician practice patterns in New York City. Am J Prev Med. 1986; 2:226–34.
27. **Norcini JJ, Webster GD, Grosso LJ, Blank LL, Benson JA Jr.** Ratings of residents' clinical competence and performance on certification examination. J Med Educ. 1987;62:457–62.
28. **Haber RJ, Avins AL.** Do ratings on the American Board of Internal Medicine Resident Evaluation Form detect differences in clinical competence? J Gen Intern Med. 1994;9:140–5.
29. **Shea JA, Norcini JJ, Kimball HR.** Relationships of ratings of clinical competence and ABIM scores to certification status. Acad Med. 1993;68:S22–S24.
30. **ISIS-2 (Second International Study of Infarct Survival) Collaborative Group.** Randomised trial of intravenous streptokinase, oral aspirin, both, or neither among 17,187 cases of suspected acute myocardial infarction: ISIS-2. Lancet. 1988;2:349–60.
31. **Beta-Blocker Heart Attack Trial (BHAT).** A randomized trial of propranolol in patients with acute myocardial infarction. I. Mortality results. JAMA. 1982;247:1707–14.
32. **Norcini JJ, Kimball HR, Lipner RS.** Certification and specialization: do they matter in the outcome of acute myocardial infarction? Acad Med. 2000;75:1193–8.
33. **Jencks SF, Huff ED, Cuerdon T.** Change in the quality of care delivered to Medicare beneficiaries, 1998–1999 to 2000–2001. JAMA. 2003; 289:305–12.