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Medical Education

State-Mandated Continuing Medical Education and the Use of Proven Therapies in Patients With an Acute Myocardial Infarction

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OBJECTIVES The purpose of this study was to determine whether state-mandated continuing medical education (CME) requirements affect the use of evidence-based therapies and outcomes in patients with acute myocardial infarction (AMI).

BACKGROUND The Institute of Medicine recommends that educational programs demonstrate their effect through process and outcome measures.

METHODS We analyzed 134,609 patients according to whether or not CME was mandated in the state of physician practice. A hierarchical multivariable model was developed that controlled for state, hospital, physician, and patient level characteristics to determine the association between state CME requirements and the use of evidence-based therapies. Primary outcome measures were admission aspirin use and reperfusion therapy, and discharge aspirin and beta-blocker prescription. Thirty-day and one-year mortality were secondary outcome measures.

RESULTS States with and without CME requirements had similar rates of aspirin use at admission and discharge (79.9% vs. 79.4% and 72.5% vs. 72.5%, respectively) and beta-blocker prescription at discharge (53.6% vs. 55.3%). The rate of reperfusion therapy at admission was significantly higher in states requiring CME (53.1%) compared with states without CME (47.9%) ($p < 0.0001$). After adjustment, patients admitted in CME-requiring states were significantly more likely to receive reperfusion therapy, mainly owing to "patented" thrombolytic therapy (odds ratio 1.15; $p = 0.016$). There was no association between CME requirements and one-year mortality.

CONCLUSIONS State-mandated CME had little association with AMI care or outcome, other than an increased use of patented thrombolytic therapy. Further research is needed to maximize the measurable effect of CME on the use of proven therapies irrespective of whether patented or generic medications are involved. (J Am Coll Cardiol 2004;44:192–8) © 2004 by the American College of Cardiology Foundation

The Institute of Medicine (IOM), in the recent report entitled "Health Professions Education, A Bridge to Quality-2003" (1), makes specific recommendations on the continuing education of health professionals. Specifically, they recommend that "accreditation bodies move forward expeditiously to revise their standards so programs are required to demonstrate—through process and outcome measures—that they educate students in both academic and continuing education programs." The IOM also goes on to recommend that "boards should require licensed health professionals to demonstrate periodically their ability to deliver patient care" through "direct measures of technical competence, patient assessment, patient outcomes, and other evidence-based assessment methods" (1). Hence, in an effort to improve quality, the IOM is recommending that students and health professionals should be required by accreditation agencies to get continuing education, and the effects of these programs should be directly measured by care processes and patient outcomes.

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Recognizing the importance of informed physicians, many states have already mandated participation in continuing medical education (CME) programs as a condition for medical licensure with the expectation that these programs will result in better care. Mandatory CME first came into existence in the U.S. in 1934 as a program designed to enhance the education of urologists. In the 1960s, the American Medical Association created an honorary certificate for physicians willing to complete 150 h of CME

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Abbreviations and Acronyms

ACCME = Accreditation Council on Continuing Medical Education
AMI = acute myocardial infarction
CCP = Cooperative Cardiovascular Project
CME = continuing medical education
IOM = Institute of Medicine
OR = odds ratio

during a 3-year period (2). Since that time, the growth of CME has been exponential. According to data from the Accreditation Council on Continuing Medical Education (ACCME), in 2002 over 5.4 million physicians and 2.6 million non-physician health care providers participated in CME activities at a total cost of over $1.5 billion.

Unfortunately, there is little evidence linking the presumed relationship between a requirement for education through CME programs and a change in physician competency, performance, and patient outcomes: the specific mandate of the IOM. Therefore, we sought to investigate the association between state CME requirement and use of evidence-based therapies and outcomes in patients with acute myocardial infarction (AMI).

METHODS

Data source. We used data from the Cooperative Cardiovascular Project (CCP). The characteristics of this database have previously been published (3). This database, collected from 1994 to 1996, contains over 130,000 patients admitted to hospitals in 46 states nationally with the diagnosis of AMI identified in the Medicare National Claims History file using the International Classification of Diseases-9th Revision Code. The four states that underwent the original CCP quality improvement project were excluded from the analysis. Prespecified demographic, clinical, and treatment variables were abstracted from hospital records. Random charts were re-abstracted to confirm the validity of the database, with overall variable agreement of 95% (3).

Clinical characteristics previously found to influence outcome of the patients presenting with AMI were extracted from the database. These characteristics included age, gender, socioeconomic status, Killip class, location of the infarction, presence of diabetes mellitus, hypertension, and do not resuscitate orders. These characteristics were assessed in patients presenting to states with and without CME requirements.

Information was also collected on hospital-level data for patients presenting with an AMI in states with and without CME. These variables included whether the patient was admitted to a teaching hospital, a hospital with a catheterization laboratory, and the number of physicians in the patient's metropolitan statistical area. Physician-level data included age, years from medical school graduation, board certification, and primary specialty of care.

Quality indicators for processes of care for AMI were developed by the Health Care Financing Administration, now known as the Centers for Medicare and Medicaid Services, in conjunction with the CCP quality improvement project (3). These indicators (aspirin use, beta-blocker use, and reperfusion therapy—patented thrombolytic or primary coronary angioplasty) have been validated and incorporated into national guidelines of care (4,5). For each indicator, patients without documented contraindications were identified as "ideal patients." These "ideal" candidates for therapy were used in the analysis.

Information on states that required CME was obtained from the American Medical Association. Individual state medical boards were contacted to confirm CME requirement for the years of 1994 to 1996. During this time period, 22 states mandated CME and 24 states did not mandate CME.

Statistical analysis. To test for differences between patients in states with CME requirements and in those without, we used *t* tests for continuous variables and chi-square or Fisher exact tests for categorical variables. A multivariable model controlling for hospital, physician, and patient characteristics was developed to examine the association between state-mandated CME requirements and the use of evidence-based therapies. To account for the natural similarity or clustering within states, we calculated robust estimates of variance using the method described by Huber (6) and White (7). Because all of the outcomes of interest (use of evidence-based therapies, 30-day and 1-year mortality) were binary variables, we used logistic regression models. In each model, the outcome was regressed with regard to "ideal patient" status, demographics (age, gender, race), socioeconomic status (zip code with a median income <200% of poverty level), rural versus urban zip code, patient medical history (history of previous myocardial infarction, diabetes mellitus, stroke, dementia, Killip class), hospital characteristics (teaching hospital, admission to a hospital with a catheterization laboratory), and physician characteristics (including the total number of physicians in the patient care). Use of evidence-based therapies and 30-day and 1-year outcomes are reported both unadjusted and after adjustment using the multivariable model. Odds ratios (OR) were reported. Statistical analyses were performed using SAS Version 8.02 (SAS Institute, Cary, North Carolina) and STATA Version 7.0 (StataCorp, College Station, Texas).

RESULTS

Baseline characteristics of patients with AMI in the 22 states with CME requirements and in the 24 states without CME requirements are presented in Table 1. In general, the groups are similar, with a mean age of 77 years, 47% anterior location of infarcts, and 8% with admission systolic blood pressure <100 mm Hg. There were slightly more women and diabetics admitted to states without a CME require-

Table 1. Baseline Characteristics of Patients

	States With No CME Requirement	States With CME Requirement	p Value
Total number of AMI patients, N = 134,609	63,299	71,310	
Age, mean (SD)	77.0 (7.4)	76.9 (7.5)	0.1904
Female gender, n (%)	31,888 (50.4%)	34,914 (49.0%)	<0.0001
Killip class			
I, n (%)	30,360 (48.0%)	34,960 (49.0%)	<0.0001
II, n (%)	7,930 (12.5%)	8,717 (12.2%)	0.0911
III, n (%)	23,167 (36.6%)	25,584 (35.9%)	0.0059
IV, n (%)	1,842 (2.9%)	2,049 (2.9%)	0.6889
Patients with anterior infarct, n (%)	29,979 (47.4%)	33,694 (47.3%)	0.6842
Patients with SBP <100 mm Hg, n (%)	5,116 (8.1%)	5,651 (7.9%)	0.287
Patients with median income <200% of poverty level,* n (%)	6,393 (10.2%)	7,311 (10.5%)	0.0639
Patients with diabetes mellitus, n (%)	19,825 (31.3%)	21,600 (30.3%)	<0.0001
Patients with hypertension, n (%)	39,052 (61.7%)	44,207 (62.0%)	0.2609
Patients smoking on admission, n (%)	9,161 (14.5%)	10,532 (14.8%)	0.1242
Patients with do not resuscitate order on admission,† n (%)	12,717 (20.1%)	14,563 (20.4%)	0.1311

*Socioeconomic status is proxied by an indicator of median income in zip code area less than 200% of poverty level. The indicator variable can be calculated for 62,628 patients in the no CME states and for 69,509 patients in the CME requiring states. †Data were provided by 63,298 patients from the no CME requiring states and 71,310 patients from CME requiring states.
AMI = acute myocardial infarction; CME = continuing medical education; SBP = systolic blood pressure.

ment (50.4% vs. 49.0%; $p < 0.0001$) and (31.3% vs. 30.3%; $p < 0.0001$), respectively.

Table 2 lists the baseline characteristics of the medical system. There were more admissions to teaching hospitals in states without CME requirements (41.2% vs. 37.3%; $p < 0.0001$). However, states with CME requirements had more patients with AMI admitted to hospitals with cardiac catheterization laboratories (75.6% vs. 70.0%; $p < 0.0001$). The average age of the physicians taking care of patients was 46 years old. Although cardiologists cared for more patients in states requiring CME (42.8% vs. 40.3%; $p < 0.0001$), more physicians were board certified in states without CME requirements (81.8% vs. 80.8%; $p = 0.0001$).

The unadjusted quality indicators for AMI in states with and without CME requirement are presented in Table 3. Evidence-based quality indicators such as aspirin use on admission, beta-blocker use on admission and discharge, and smoking cessation counseling were similar in both groups. In fact, although there was some geographic variation in the use of evidence-based therapies, rates were similar in various regions of the country (Table 4). States with a CME requirement were associated with a higher rate of reperfusion therapy at the time of admission (53.1% vs. 47.9%; $p < 0.0001$). This unadjusted rate was higher for primary coronary intervention and patented thrombolytic therapy use.

After controlling for demographic characteristics, illness severity, physician, hospital characteristics, and socioeconomic status, states with a CME requirement were associated with a higher rate of reperfusion therapy on admission (OR 1.16; $p = 0.026$) (Table 5). This association was strongest for reperfusion using patented thrombolytic therapy (OR 1.15; $p = 0.016$). Rates of other evidence-based therapies, aspirin, beta-blocker, and smoking cessation counseling were similar in states with and without CME requirements. Analysis was also performed on 30-day and one-year mortality. The unadjusted and adjusted 30-day and 1-year mortality were similar in both groups (Table 6).

Table 2. Baseline Characteristics of Medical System

	States With No CME Requirement	States With CME Requirement	p Value
Patients admitted to teaching hospitals, n (%)	26,070 (41.2%)	26,610 (37.3%)	<0.0001
Patients admitted to hospital with Cath lab,* n (%)	40,269 (70.0%)	47,618 (75.6%)	<0.0001
Physician level†			
Age as of 1994	45.97 (9.1)	46.04 (8.9)	0.0112
Years from medical school graduation as of 1994	19.43 (9.2)	19.45 (9.1)	0.0989
Specialty of MD			
Family practice	9,576 (15.9%)	8,763 (13.0%)	<0.0001
Internal medicine	21,030 (34.9%)	23,605 (34.9%)	0.9061
Cardiology	24,285 (40.3%)	28,953 (42.8%)	<0.0001
Board certified	49,286 (81.8%)	54,682 (80.8%)	<0.0001

*Data were provided by 57,518 patients from states with no CME and 62,961 patients from CME requiring states. †Physician-level information is available for 60,223 admissions in states with no CME requirement and for 67,658 admissions in CME requiring states.
Cath lab = catheterization laboratory; CME = continuing medical education.

Table 3. Unadjusted Use of Evidence-Based Therapies and Outcomes in "Ideal" Patients With Acute Myocardial Infarction, n (%)

	States With No CME (n = 63,299)	CME Requiring States (n = 71,310)	p Value
Aspirin use			
During	33,663 (79.4)	38,297 (79.9)	0.088
At discharge	24,694 (72.5)	27,825 (72.5)	0.9479
Beta-blocker use			
During	3,695 (63.3)	3,851 (61.6)	0.0455
At discharge	3,234 (55.3)	3,356 (53.6)	0.0675
Ca+ channel use at discharge	18,611 (37.2)	21,348 (37.7)	0.0818
Smoking cessation counseling	3,261 (35.6)	3,697 (35.1)	0.4768
Reperfusion at admission	3,138 (47.9)	3,920 (53.1)	<0.0001
Primary coronary intervention or thrombolytics use	3,459 (52.8)	4,296 (58.2)	<0.0001
Primary coronary intervention	1,218 (18.6)	1,543 (20.9)	0.0007
Thrombolytics use	2,791 (42.6)	3,484 (47.2)	<0.0001
Mortality			
30-day	12,976 (20.5)	14,761 (20.7)	0.4668
1-year	22,281 (35.2)	24,959 (35.0)	0.5637

CME = continuing medical education.

DISCUSSION

The IOM has called for direct measurement of education programs through care processes and patient outcomes (1). We performed an analysis in a large Medicare database (CCP) to determine the effect of state-mandated CME requirements on the use of evidence-based therapies in patients with AMI. States with CME requirements did have higher rates of reperfusion therapy, mainly owing to a higher use of patented thrombolytic therapy. However, there were no statistically significant differences in other markers of care, including aspirin use (both during index hospitalization and at discharge) and beta-blocker use at discharge, after adjustment for patients, physician, and hospital-level characteristics. There was also no difference in 30-day and 1-year mortality of patients presenting with AMI in states with a CME requirement versus states without such a requirement.

Several potential explanations exist for these findings. One possibility is that there is a lack of effect of CME on physician behavior and practice, or the effect is too small to be measured with current tools. If the effect of CME cannot be measured using the detailed data on the rates of evidence-based therapies in the CCP database, then this has important implications for both the utility of CME and the IOM's call for outcome measures.

A second possibility is that state CME requirements have differential effects that may represent physician-pharmaceutical

Table 4. Unadjusted Use of Evidence-Based Therapies and Outcomes by Region in "Ideal" Patients With Acute Myocardial Infarction, n (%)

	States With No CME				CME Requiring States			
	East	Midwest	South	West	East	Midwest	South	West
Number of patients	25,157	13,796	17,990	6,356	9,884	20,307	24,170	16,949
Aspirin use								
During	13,933 (78.7)	7,208 (79.9)	9,003 (79.4)	3,424 (82.1)	5,724 (80.9)	10,634 (82.2)	12,241 (76.7)	9,575 (81.1)
At discharge	9,900 (70.4)	4,775 (73.8)	6,470 (73.5)	2,636 (76.0)	4,210 (73.1)	7,378 (75.3)	7,939 (68.9)	7,179 (73.5)
Beta-blocker use								
During	1,850 (70.6)	583 (56.3)	890 (57.1)	373 (60.0)	747 (78.8)	964 (59.2)	999 (56.3)	1,138 (59.9)
At discharge	1,585 (62.3)	488 (48.7)	745 (48.9)	324 (52.8)	687 (73.5)	809 (51.5)	811 (47.3)	950 (51.3)
Ca+ channel use at discharge	6,793 (34.3)	4,275 (39.5)	5,829 (40.9)	1,683 (32.7)	2,970 (36.6)	5,906 (36.6)	7,494 (39.9)	4,975 (36.6)
Smoking cessation counseling	1,112 (37.0)	633 (30.8)	1,122 (35.8)	398 (41.1)	551 (41.3)	1,040 (34.0)	1,167 (30.3)	942 (41.2)
Reperfusion during stay	1,210 (43.3)	681 (50.5)	838 (49.8)	408 (56.3)	542 (49.4)	1,070 (55.5)	1,237 (52.1)	1,069 (53.9)
PCI or thrombolytics	1,297 (46.4)	790 (58.6)	929 (55.2)	442 (61.0)	569 (51.9)	1,178 (61.1)	1,360 (57.3)	1,190 (60.0)
PCI	293 (10.5)	393 (29.1)	367 (21.8)	168 (23.2)	75 (6.8)	457 (23.7)	520 (21.9)	494 (24.9)
Thrombolytics	1,128 (40.4)	578 (42.9)	743 (44.3)	343 (47.5)	508 (46.5)	917 (47.6)	1,134 (47.9)	911 (46.0)
Mortality								
30-day	5,057 (20.1)	2,939 (21.3)	3,724 (20.7)	1,271 (20.0)	1,838 (18.6)	4,163 (20.5)	5,317 (22.0)	3,458 (20.4)
1-year	9,082 (36.1)	4,870 (35.3)	6,261 (34.8)	2,053 (32.3)	3,489 (35.3)	7,047 (34.7)	8,701 (36.0)	5,729 (33.8)

CME = continuing medical education; PCI = primary coronary intervention.

Table 5. Association Between AMI Admission to a CME Requiring State and Therapies During Admission ("Ideal" Patients Only, Adjusted for Demographic, State, Socioeconomic, Physician Characteristics, and Hospital Characteristics)

Therapy	n	Odds Ratio Associated With Effect of CME Requiring States	p Value
Aspirin use			
During	88,351	1.01	0.934
At discharge	68,351	0.98	0.757
Beta-blocker use			
During	11,888	0.98	0.833
At discharge	11,909	0.97	0.787
Total reperfusion (primary coronary intervention or thrombolytic)	13,672	1.16	0.026
Primary coronary intervention	13,672	1.06	0.736
Thrombolytic	13,645	1.15	0.016
Mortality at 30 days*	130,794	1.05	0.388
Mortality at 1 year*	130,794	0.99	0.493

*The C-index for the multivariable model is C = 0.95 at 30 days and C = 0.88 at 1 year.

AMI = acute myocardial infarction; CME = continuing medical education.

industry interaction. In this study, the medication most closely tied to pharmaceutical marketing at the time was thrombolytic therapy. Unlike aspirin and beta-blockers, patented thrombolytic therapy had a relative lack of competing agents by class or generic formulations during the time period, such that marketing efforts were most likely to result in direct revenues to the sponsoring pharmaceutical firm.

In 2002, industry funding accounted for >60% of the $1.5 billion spent on CME activities (8,9). Industry-sponsored CME courses have been shown to highlight sponsors' drugs and affect physicians' prescription behavior (10,11). Physician attendance of industry-sponsored CME activities is often associated with academic detailing (12). The possible synergy between pharmaceutical marketing and greater use of evidence-based therapy is of interest. The similar rates of aspirin and beta-blocker prescription also raise concern regarding the ability of CME to improve care across all potential interventions, including generic therapies that do not represent marketing opportunities. Recently, in an effort to address the concerns over this interaction, the ACCME proposed new regulations to reduce the influence of the pharmaceutical industry (9).

Another possibility is that the association between a state CME requirement and reperfusion is related to state-specific characteristics of the health care systems in place. Previous studies have found teaching hospitals, physician specialty, and possible board certification to be associated with greater use of evidence-based therapies (13–15). Thus, it is potentially feasible that states with greater numbers of teaching hospitals and board-certified subspecialists might have demonstrated superior outcomes unrelated to CME status. However, although our analyses found more admissions to teaching hospitals and board-certified physicians in states without CME requirements, there were more admissions to cardiology specialists practicing in states with CME requirements. Additionally, significant interaction seems unlikely as many of the variables were equally distributed in this large national database, and our analysis adjusted for these physician- and hospital-level factors.

Previous systematic reviews of CME strategies have found that traditional didactic sessions have little to no effect (16), whereas interactive sessions with practice-based interventions may lead to change (17). Indeed, a large Cochrane review of 32 studies on CME also found that interactive workshops have a moderate effect on physician behavior, whereas didactic sessions alone were unlikely to change physician behavior (18). A multifaceted approach of CME courses and academic detailing by the pharmaceutical industry may approximate interactive sessions and lead to change in physician behavior.

We recognize some of the limitations of our analysis. The CME activities in which the physicians participated during that time period may not have been directed toward myocardial infarction care. Nevertheless, the system in place for continuing education should have addressed the process of care for the leading cause of morbidity and mortality in the U.S. during that time period. Another limitation is that we cannot be certain that the similarities in medication use and outcomes were not due to the attainment of similar levels of CME by physicians in states without CME requirements. If state requirements are below levels that physicians are likely to attain regardless of mandates, such

Table 6. Association Between Admission to a CME Requiring State and Mortality From AMI

		30-Day Mortality			1-Year Mortality		
	N	OR	p Value	C-Index	OR	p Value	C-Index
No adjustment	134,609	1.01	0.4669	0.5012	0.99	0.564	0.5008
Adjusting for geographic regions	134,609	1.01	0.6822	0.5012	0.99	0.793	0.5008
Demographics of patients, adjusting for geographic regions	132,130	1.01	0.714	0.62	1.00	0.867	0.6465
Demographics of patients, reperfusion Tx, and hospital characteristics, adjusting for geographic regions	130,794	1.05	0.416	0.9505	0.99	0.488	0.8815
Demographics of patients, reperfusion Tx, and hospital characteristics and physician-level characteristics	130,794	1.05	0.388	0.9506	0.99	0.493	0.8816

OR = odds ratio. Other abbreviations as in Table 5.

requirements will have little effect on improving physician education or patient outcomes.

In a large Medicare database, we found state-mandated CME requirement was associated with higher rates of reperfusion therapy, largely because of patented thrombolytic therapy. Although this difference was statistically significant, the absolute difference in reperfusion may not represent a clinically significant difference. In addition, there was no difference in the use of other evidence-based therapies, such as aspirin and beta-blocker therapy, and no difference in mortality at one year. These findings are encouraging for a potential improvement in proven therapies for patients with myocardial infarction. However, they also raise a concern over differential effects of CME requirement on the use of patented therapies versus generic therapies. Since the time of this large observational study, the number of states mandating CME has increased from 22 to 34, with some states requiring specific areas of competency. The number of health care providers attending CME activities and the yearly expenditure continue to rise, with over $1.5 billion spent on CME in 2002.

The IOM recommended that students and health professionals be required by accreditation agencies to get continuing education. However, the recommendation that the effects of these programs be directly measured by care processes and patient outcomes remains a future goal. Our study utilizing specific rates of evidence-based therapies in a large Medicare database was not able to discern a clear universal benefit to mandatory CME programs.

We believe that, to achieve the IOM's stated goals, a specific framework needs to be in place to evaluate the effectiveness of CME programs. The quality indicators for process of care and outcome measures for patients with AMI have been validated and are currently incorporated into national guidelines. However, there is currently no structure in place to evaluate performance based on the specific disease processes or the individual physicians. This would require that CME not only be disease-specific, but also include minimum quality standards and target specific physician specialties.

Therefore, the goal of state-mandated CME should be to become incorporated into each state's cycle of quality improvement. Specifically, quality indicators for the care of patients with myocardial infarction such as use of evidence-based therapies, time to reperfusion, evaluation of left ventricular function, re-admission rates, and in-hospital complications as well as mortality should all be collected. These indicators could then be used to form these disease-specific CME programs. The CME activities of providers could then be cataloged and participation related to observed clinical practice. Feedback would then be given to clinicians, and the findings would help guide the improvement of existing CME programs. In this manner, the feedback loop would continue to improve CME and physician behavior. Eventually, CME data in addition to quality measures could be linked to payer databases to provide the final incentive for improvement.

Clearly, substantial infrastructure needs to be in place to evaluate the effect of CME. The first step may be rigorous acquisition of the type and manner of CME activities in which physicians are currently participating. Only after this basic information is collected will progress towards CME programs that are disease-specific and physician-specific be made. Therefore, investigators and state licensing boards should prioritize research on the relationship between CME and treatment practices to maximize the measurable effect of CME on the use of proven therapies irrespective of whether patented or generic medications are involved.

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