Articles

Physician Management of Hypercholesterolemia

A Randomized Trial of Continuing Medical Education

WARREN S. BROWNER, MD, MPH; ROBERT B. BARON, MS, MD; SHARON SOLKOWITZ, MPH; LINDA J. ADLER, MA; *and* DAVID S. GULLION, MD, *San Francisco, California*

To determine the effect of continuing medical education (CME) on compliance with the recommendations of the National Cholesterol Education Program Expert Panel on high serum cholesterol levels in adults, we randomly assigned primary care physicians in 174 practices to 3 groups, 2 that underwent either standard or intensive CME and a control group. The standard CME group was offered a free 3-hour seminar on high serum cholesterol levels; the intensive CME group was offered in addition follow-up seminars and free office materials. After 18 months, we audited 13,099 medical records from the 140 practices that remained in the study. There were no significant differences ($P > .15$) in screening for high serum cholesterol or compliance with guidelines between the groups receiving continuing medical education (51% screening; 33% compliance) and the control group (57% screening; 37% compliance). In the prespecified subgroup of patients with hypercholesterolemia, there was a trend toward a modest benefit from the continuing medical education interventions: compliance was 21% in the control group, 23% in the standard CME group, and 27% in the intensive CME group ($P = .07$ overall). These results emphasize the need for better ways to change behavior in practicing physicians and the importance of studying the implementation of preventive health recommendations.

(Browner WS, Baron RB, Solkowitz S, Adler LJ, Gullion DS: Physician management of hypercholesterolemia—A randomized trial of continuing medical education. West J Med 1994; 161:572-578)

Continuing medical education (CME) is the third and final phase of medical education. Physicians participate in CME to update their medical knowledge, to improve their medical practice, and in many states, to maintain their medical license. Despite the enormous expenditure of time and resources—about $3 billion a year in the United States—the efficacy of CME on physician performance and health outcomes is not certain; studies have demonstrated mixed results.[1-6]

There are several problems in evaluating the efficacy of CME. Physicians may have only a relatively few patients with some conditions, making it difficult to demonstrate changes in patient outcome. For more common conditions, physicians may have already developed a complex style of practice that can be difficult to change. Many physicians are already functioning at a high level, which makes demonstrating improvements difficult. Finally, most studies have assessed the effects of CME in groups of residents, physicians in health maintenance organizations, or in volunteer physicians, often with recruitment rates of 10% or less, limiting the ability to generalize results to community physicians.[2,7-10]

We therefore chose to evaluate the efficacy of CME in improving the management of high serum cholesterol levels by non–university-affiliated physicians in private practice. Guidelines for screening and management were developed by the National Cholesterol Education Program (NCEP) and published in 1988.[11] They have since been widely disseminated, but not as yet widely adopted in practice.[12,13] Most physicians do not have extensive experience treating patients with high serum cholesterol levels, and the recent public interest in the topic has made physicians eager to improve their knowledge and management skills.[14,15]

Our specific aim was to determine whether randomly assigning primary care physicians in private practice to receive CME, with or without intensive follow-up, about the detection and treatment of high serum cholesterol levels would result in better management of patients compared with the patients of a control group of physicians.

From the General Internal Medicine Section, Department of Veterans Affairs (VA) Medical Center (Dr Browner and Ms Solkowitz); and the Division of General Internal Medicine (Dr Baron), the Department of Medicine (Ms Adler and Dr Gullion), University of California, San Francisco, School of Medicine, San Francisco, California.

This work was supported in part by Public Health Service grants HL 31305 and HL 46297.

Reprint requests to Warren S. Browner, MD, MPH, General Internal Medicine Section 111A1, VA Medical Center, San Francisco, CA 94121.

ABBREVIATIONS USED IN TEXT

CI = confidence interval
CME = continuing medical education
HDL = high-density lipoprotein
LDL = low-density lipoprotein
NCEP = National Cholesterol Education Program

Methods

Participants

The recruitment of physician practices was carried out between September 1988 and March 1990. Lists of possible participants from the east San Francisco Bay Area (Contra Costa, Solano, and Alameda counties excluding Berkeley) were drawn from local medical societies, hospital rosters, and medical building directories. Private or small group (3 or fewer physicians) practices in internal medicine, family practice, or general practice were screened for three criteria: adult primary care making up at least 50% of the practice, accepting new patients, and planning to remain in the current area through 1991. Physicians were contacted by a letter stating that we were conducting a study of CME and cholesterol management, then by a follow-up phone call, and finally by a visit by a member of our staff. We enrolled 197 physicians (in 174 practices) out of 302 contacted, for an overall recruitment rate of 65%. Of the total, 16 (8%) were women and 50 (25%) were members of ethnic minority groups (29 Asian, 14 African American, and 7 Hispanic). Of those who declined to enroll, the most common reasons given for refusal were "lack of time" and "unwilling to participate in research."

Physician practices were randomly assigned (using an off-site computer-generated list) to either a control group (n = 62 practices), a standard-CME group (n = 55 practices), or an intensive-CME group (n = 57 practices). The proportions of women and of minorities were similar in the three groups.

Interventions

Members of the control group received a letter shortly after recruitment explaining that they had been randomly assigned to the control group and that they would be entitled to attend a seminar on hypercholesterolemia and receive our packet of educational materials in about 18 months, after completion of the study. Thereafter, they received no contact until the chart review.

The educational interventions for the standard-CME group and for the intensive-CME group began in October 1988 and were completed in May 1990, before the recent controversy about the appropriateness of some of the NCEP recommendations.[16,17] Both groups were invited to attend a three-hour free CME seminar on "Appropriate Management of Hypercholesterolemia" for which they received three hours of educational credit. As much as possible, the seminars followed the format of usual CME activities. Each seminar provided extensive instruction on the scientific background for the NCEP guidelines, the guidelines themselves, patient counseling techniques, dietary recommendations, and drug therapy. Seminars were held at convenient times and locations in small groups of 10 to 20 physicians, and low-fat, low-cholesterol meals were served. A syllabus was provided, which was mailed to those who failed to attend one of several scheduled seminars. Following completion of the seminar, the standard-CME group received no contact until the chart review.

In addition to the seminar, the intensive-CME group was offered supplemental educational materials, office visits, and follow-up seminars. A staff member visited the office to explain the use of the following free educational materials:

- The book, *Eater's Choice*, which was given to all physicians.[18] They were encouraged to read and use the system outlined in the book for themselves as well as for their patients.
- A patient manual entitled "A Change of Heart." The manual emphasized a positive attitude, behavioral aspects of lifestyle change, goal setting, ways to reduce dietary saturated fat and cholesterol, the importance of reading food labels, and rewards for goals reached. Refrigerator magnets with the "Change of Heart" logo for displaying the food charts in the patient manual and pocket-sized food tables showing calorie and saturated-fat content for common foods were included. These were used by physicians in 79% of the practices.
- A seven-minute companion videotape, also called "A Change of Heart," emphasizing a positive attitude, humor, heart-healthy grocery shopping, and the importance of screening. One tape was provided to each physician, to be loaned to patients or viewed in the office. This was used by physicians in 43% of the practices.
- Table tents for office display as a reminder to patients to ask for a cholesterol test and to view the videotape. These were used by physicians in 19% of practices.
- Pocket-sized laminated cards and larger, blotter-sized versions of the cholesterol management algorithms containing the guidelines issued by the NCEP. These were used by physicians in 33% of practices.
- Postcard reminders for use by physicians to bring patients to the office for a cholesterol test. These were used by physicians in 7% of practices.
- Chart reminder "post-its" for physicians to use in patients' records as a prompt to check for cholesterol screening, diet counseling, or drug therapy. These were used by physicians in 9% of practices.

A month after the office visit, physicians attended a two-hour follow-up seminar. Case histories were presented, and treatment guidelines were reviewed. Physicians were also reminded about the use of the educational materials and asked for their evaluations of the materials. A staff member also visited physicians' offices to meet with the staff and to explain the physician's participation in the project and the use of educational materials. Physicians also received encouraging phone calls from the project staff and a letter with recent journal articles. A

month later, physicians received a second office visit by a staff member, and a free general medical book—*Current Medical Diagnosis and Treatment*—was provided.[19] The use of educational materials was reinforced, and physicians were asked for additional comments. Two to three months later, physicians were invited to attend a third education session to review treatment guidelines, answer questions that had arisen, and discuss new information when appropriate. Following this seminar, the physicians received no contact until the chart review, although many continued to contact project staff with clinical questions or requests for additional materials.

Chart Review

A year and a half after randomization, we reviewed the medical records of as many as 100 randomly selected patients per practice to determine compliance with NCEP recommendations and to measure the effectiveness of the educational methods. The chart abstractors used prepared lists of random numbers to select records for audit. Different lists were provided for different practice sizes. If the selected medical record met eligibility criteria for review, it was audited; if not, the next record was selected. Medical records were eligible for review if all of the following criteria were met:

- At least one visit was made to the practice in the previous 18 months.
- Patient was between the ages of 20 and 70 years.
- No disease existed that would preclude the need for screening (such as the acquired immunodeficiency syndrome, chronic pulmonary disease requiring oxygen, metastatic cancer, or dementia).

Medical records were audited in physicians' offices by two full-time chart abstractors who were blinded to the physicians' group assignments and used standardized data collection forms. We ascertained a patient's age and sex; all total cholesterol, triglyceride, and high-density lipoprotein (HDL)-cholesterol measurements (with dates); and the use of dietary recommendations and drug therapy for at least the previous five years. In addition, we reviewed records for known or suspected coronary artery disease, by searching for phrases such as "myocardial infarction", "ischemic heart disease," "possible angina," and "positive stress test." We also recorded the presence or absence of the following risk factors: male sex, history of hypertension or blood pressure higher than 140/90 mm of mercury, current smoking of at least ten cigarettes per day, diabetes mellitus, obesity, peripheral vascular or cerebrovascular disease, and an HDL-cholesterol level of 35 mg per dl (0.90 mmol per liter) or lower, based on NCEP criteria.[11] All patients with coronary artery disease or with two or more cardiac risk factors were classified as "high risk."

A research assistant reviewed each data collection form. All patients with average total cholesterol levels of greater than 240 mg per dl (>6.20 mmol per liter) or greater than 200 mg per dl (> 5.15 mmol per liter) if high risk, any with cholesterol measurements of greater than 300 mg per dl (>7.75 mmol per liter), or patients who were taking cholesterol-lowering medications (a total of 1,718 patients) were referred for blinded review by three physicians to determine compliance with NCEP guidelines.[11] Our interpretation of the guidelines allowed physicians some discretion in management, especially for the frequency of follow-up in adequately controlled cases (discussed later). The three physician-investigators met and discussed each of these 1,718 cases; disagreements were resolved by consensus in all instances.

The management of all patients was classified as compliant with NCEP recommendations or not. Compliance with recommendations required as many as three steps:

- *Screening for total cholesterol.* All patients must have had at least one total cholesterol level measured within the past five years. If the most recent (or the average, whichever was lower) cholesterol level was less than 240 mg per dl (< 6.20 mmol per liter) or less than 200 mg per dl (< 5.15 mmol per liter) if high risk, and the patient was not on any pharmacologic therapy for hypercholesterolemia, then management was compliant. If the patient had not been screened for a high serum cholesterol level, then management was not compliant.
- *Determination of low-density lipoprotein (LDL)-cholesterol level.* If the initial cholesterol level was 240 mg per dl or higher (≥ 6.20 mmol per liter) or 200 mg per dl or higher (≥ 5.15 mmol per liter) if high risk, at least one determination of LDL-cholesterol level was required. If the most recent (or the average, whichever was lower) LDL-cholesterol level was less than 160 mg per dl (<4.15 mmol per liter) or less than 130 mg per dl (< 3.35 mmol per liter) if high risk, management was compliant. If the patient had an LDL-cholesterol of greater than 160 mg per dl (> 130 mg per dl if high risk) and was not on any therapy for hypercholesterolemia, the management was not compliant. We did not require annual LDL-cholesterol measurements in those with an initial LDL-cholesterol level of less than 160 mg per dl (< 130 mg per dl if high risk).
- *Treatment of elevated LDL-cholesterol level.* All patients with an LDL-cholesterol level of 160 mg per dl or higher (130 mg per dl if high risk) (≥4.15 mmol per liter [3.35 mmol per liter]) should have had a three- to six-month trial of a cholesterol-lowering diet. We allowed physicians to use drug treatment without a diet trial if the LDL-cholesterol level was 220 (high risk, 190) mg per dl or higher (≥5.70 [5.00] mmol per liter). Pharmacologic intervention was required in those with LDL-cholesterol levels of 190 (160) mg per dl or higher (≥5.00 [4.15] mmol per liter) despite a diet trial, with a therapeutic goal of an LDL-cholesterol level of less than 160 (130) mg per dl (<4.15 [3.35] mmol per liter). The institution of pharmacologic therapy required that at least two LDL-cholesterol determinations had been done, with an average level of 190 (160) mg per dl or higher (≥5.70 [5.00] mmol per liter); otherwise, management was not compliant. In this last situation, we did not consider psyllium a pharmacologic agent.

If the LDL-cholesterol goal was not met within six months, compliance required that the physicians make an appropriate change in therapy—for example, instituting a stricter diet, adding a medication to an unsuccessful dietary regimen, increasing a medication dosage, or changing medications—at least every three months. Management was considered compliant if the LDL-cholesterol level was high, but the physician was attempting or planning to attempt to lower it. We required checking an LDL-cholesterol level annually in patients while they were on pharmacologic therapy.

The following situations that did not meet these criteria were allowed as compliant management:

- The patient was screened for hypercholesterolemia during the final three months of the abstract period (or if the first elevated cholesterol level was detected then).
- The patient was being treated successfully (with diet or drugs) for a high LDL-cholesterol level to achieve a level of less than 130 (high risk, 160) mg per dl (< 3.35 [4.15] mmol per liter) at the time he or she became a patient in that practice.
- The patient refused further follow-up for high serum cholesterol levels, and that refusal was noted in the chart.
- The patient had at least two measurements of HDL-cholesterol and triglyceride levels that were stable. In these cases, we allowed the use of the total cholesterol level as an LDL-cholesterol surrogate for follow-up.

The primary outcome variable was the proportion of patients in a practice whose management complied with NCEP guidelines. Prespecified secondary outcome variables were the proportion of all patients in a practice who were screened for high serum cholesterol levels and the proportion of those with an initial cholesterol level that was high (≥ 240 mg per dl [≥ 6.20 mmol per liter] or ≥ 200 mg per dl [5.15 mmol per liter] if high risk) whose management was compliant with guidelines.

Statistical Analysis

We compared the overall proportions of patients whose management complied with guidelines, the proportions of patients screened for hypercholesterolemia, and the proportions of patients with elevated cholesterol levels whose subsequent management was compliant, using techniques that adjust for the effect of cluster sampling.[20] These techniques take into account that physicians' practices, not patients, were the units of randomization, but that patients were the units of analysis. They allow the determination of adjusted χ^2 values and confidence intervals. We compared physician characteristics using χ^2 or Fisher's exact test. The primary comparisons were between the intervention groups and the control group; we also compared the two intervention groups with each other. Statistical significance was set at a two-sided $P < .05$. We did not adjust for multiple comparisons.[21]

Results

Of the 174 practices that were initially randomized, 34 (20%) were lost to follow-up (Table 1). There were no significant differences in the proportion lost to follow-up (either total or cause-specific) in the three groups (all $P > .25$). All reported analyses are based on the 13,099 patients in the remaining 140 practices (48 in the control group, 45 in the standard-CME group, and 47 in the intensive-CME group), which included a total of 168 physicians. Of this total, 13 (8%) were women, and 43 (26%) were members of minority groups (28 Asian or Middle Eastern, 13 African American, and 2 Hispanic); there were no significant differences in the proportion of women and of minorities in the three groups. Of the 140 practices, 83% had at least 90 eligible patients, and 91% had at least 70 eligible patients.

TABLE 1.—*Reasons Why Physician Practices Did Not Participate in Study, by Randomized Group*

Reason for Exclusion	Randomized Group, No.		
	Control (n=62)	Standard CME (n=55)	Intensive CME (n=57)
Ineligible*	0	1	1
Died	1	0	1
Moved	5	3	3
Retired, changed practice	4	1	1
Refused chart audit	4	4	3
<40 Eligible patients	0	1	1

CME = continuing medical education

*Two practices were determined to be ineligible at the time of chart review because they did not do primary care.

Physicians from 38 (84%) of the 45 standard-CME practices and 42 (89%) of the 47 intensive-CME practices attended the initial seminar; the percentages attending the two follow-up sessions for the intensive-CME group were 79% (37 of 47) and 55% (26 of 47), respectively.

The age, sex, and risk status of the 13,099 patients were similar in the three groups of practices (Table 2). Overall, 58% of the patients were women, and 52% were older than 55 years. About 28% of patients had coronary artery disease or were at high risk of coronary artery disease. There were no statistically significant differences in patient characteristics in analyses that adjusted for the effects of clustering.

Compliance With National Cholesterol Education Program Guidelines

More than half of all patients had been screened for high serum cholesterol levels, and about one in three patients were managed in compliance with the NCEP recommendations (Table 3). Although overall compliance rates were 3% to 4% higher in the control group than in the CME groups, there were no significant differences between the groups. The 95% confidence interval (CI) for the difference between the standard-CME group and the control group, for example, was from −10% to +2%. Screening rates were higher, but not statistically so, in the control group, with a 95% CI for the difference between the CME and control groups of −14% to +2%.

Of the 4,536 patients whose management was considered in compliance, 3,782 (83%) had acceptable screening cholesterol levels (< 240 mg per dl [< 6.20 mmol per

TABLE 2.—*Characteristics of Patients, by Group**

Patient Characteristic	Group: Control (n=4,491) No. (%)	Standard CME (n=4,157) No. (%)	Intensive CME (n=4,451) No. (%)
Female sex.....	2,505 (55.8)	2,423 (58.3)	2,613 (58.7)
Age, years†	46.6 ± 14.1	46.4 ± 13.9	47.2 ± 14.1
High risk‡.....	1,232 (27.4)	1,146 (27.6)	1,317 (29.6)

CME = continuing medical education

*Data on sex were missing for 8 patients (5 control, 2 standard CME, and 1 intensive CME). Data on age were missing for 1,076 patients (360 control, 324 standard CME, and 392 intensive CME).

†± 1 standard deviation.

‡Patients with known or suspected coronary artery disease or with two or more cardiac risk factors were considered at high risk.

liter] or 200 mg per dl [5.15 mmol per liter] if high risk). These patients required no additional management. When the analysis was restricted to the prespecified subgroup of patients who had a screening cholesterol level that was high (≥ 240 mg per dl, [≥ 6.20 mmol per liter] or 200 mg per dl [5.15 mmol per liter] if high risk), about one in four of these patients was managed in compliance with NCEP guidelines (Table 3). There was a trend toward better compliance ($P = .07$) in the two CME groups. Compliance rates were 6% higher (95% CI, +1% to +11%; $P = .02$) in the intensive-CME group than in the control group.

Among the 2,426 patients who were found to have elevated cholesterol levels (≥ 200 mg per dl if high risk, or ≥ 240 mg per dl, otherwise) the most common errors in subsequent management were failure to measure an LDL-cholesterol level (n = 806; 33%) and failure to institute treatment if the LDL-cholesterol level was elevated (n = 450; 19%). There were no differences in the frequencies of these errors in the three groups ($P > .10$).

There were no differences between practices in the two CME groups in overall compliance ($P > .90$), screening ($P > .90$), or compliance among patients with high cholesterol levels ($P = .22$).

Wide variations were seen in practice patterns in all three groups. For example, the proportion of patients who were screened for high serum cholesterol levels in the control practices ranged from a low of 12% to a high of 93%; the same two practices achieved overall compliance rates of 5% and 65%, respectively. Although one practice in the intensive-CME group achieved an overall 90% compliance rate and a 57% compliance rate (17 of 30) in patients with high cholesterol levels, another practice had an overall compliance rate of 10% and failed to manage a single patient (of 10 such patients) with an elevated cholesterol level in compliance with NCEP recommendations.

Comment

Our results indicate that continuing medical education for physicians, even when combined with intensive follow-up and office-based educational materials, did not elicit overall compliance with the NCEP expert panel's recommendations on the detection, evaluation, and treatment of hypercholesterolemia. About half of the 13,099 patients had not been screened for high serum cholesterol levels, and overall rates of compliance were between 33% and 37%, making it unlikely that we failed to detect an effect because levels of screening and management compliance were already high. We found no differences between the performances of practices assigned to the standard-CME group and the control group. A modest benefit of the intensive-CME intervention on compliance with recommended management was seen in the predefined subgroup of patients with elevated cholesterol levels who required more than a simple screening test.

We did not anticipate the trends that we observed toward higher screening and compliance rates in the control group and think that chance is the most likely explanation for these results. Another possibility is that the intervention-physicians were more aware of the complexity of the management process, and this discouraged them from screening some patients. Once screening was initiated, however, the intervention-physicians were somewhat more likely to manage those found to have elevated cholesterol levels according to guidelines. The net effect is that the (unknown) proportion of all patients with high cholesterol levels whose management met NCEP guidelines was probably similar in the three groups. The actual proportions are not known because cholesterol levels are missing, of course, for those who were not screened.

One of the strengths of this study is the representativeness of the participating physicians and their patients. The sample includes members from several ethnic groups whose practices are in a variety of socioeconomic circumstances in urban, suburban, and semirural areas of the San Francisco Bay Area. All were self-identified primary care providers. They were not selected on the basis of affiliation with an academic medical center. Our recruitment rate of nearly two thirds of all physicians contacted is high. These differences between our sample and those in other studies of continuing medical education, which have mainly enrolled residents, clinical faculty, or members of a health maintenance organization, often with

TABLE 3.—*Patients Screened for Hypercholesterolemia and Those Whose Management Complied With Recommendations of the National Cholesterol Education Program (NCEP), by Group*

Patient Characteristic	Group: Control No. (%)	Standard CME No. (%)	Intensive CME No. (%)	P* Value
Patients, No.....	4,491	4,159	4,451	
Screened	2,548 (57)	2,135 (51)	2,278 (51)	>.25
Compliant with NCEP.....	1,659 (37)	1,377 (33)	1,500 (34)	>.25
Cholesterol levels high, No.†.....	1,125	991	1,064	
Compliant with NCEP.....	236 (21)	232 (23)	286 (27)	.07

CME = continuing medical education

*All analyses adjusted for the effects of clustering by practice (see Methods).

†Screening cholesterol level ≥240 mg/dl (≥200 mg/dl if high risk) (620 mmol/liter [5.15 mmol/liter if high risk]).

much lower recruitment rates, may explain why we were unable to show an overall benefit. On the other hand, others have also found relatively low rates of treatment of patients with elevated cholesterol levels, similar to those we observed.[12,14,22] Given the recent study showing that women physicians are more likely to perform preventive services than their male counterparts,[23] it is unfortunate that our sample included only 13 women physicians, reflecting the small proportion of women in the practices that composed our sampling frame.

In our study, physician practices, not patients, were the unit of randomization and are thus the appropriate unit of analysis. Had we failed to account for the effects of clustering within practices, we would have erroneously concluded that screening for high serum cholesterol levels (unadjusted χ^2 2 degrees of freedom [*df*] = 35.48, $P < .0001$) and compliance with recommendations (unadjusted χ^2 $2df = 16.45$, $P < .001$) were more common in the control practices.

This study has several limitations. Not all physicians who were randomly assigned to the CME groups took advantage of all the interventions that we offered, and not all physicians who were originally randomly selected remained in the study. Despite our best efforts to identify physicians in stable practice settings, during the time of our study (from 1988 to 1991), there was great turmoil in medical practice in the San Francisco Bay Area; many physicians retired, moved, or changed practices. Others refused to allow chart audit. Although the proportion of physicians who were lost to follow-up was similar in the three groups, we cannot eliminate the possibility of differential loss to follow-up. That physicians in the CME groups whose management of hypercholesterolemia complied with NCEP recommendations would have been more likely to drop out than those in the control group seems unlikely.

We assumed that physicians do not remember management plans for individual patients unless they are written in the medical record. Thus, we may have underestimated the use of diet therapy, for example, if a physician failed to note it. On the other hand, we may have overestimated the use of diet counseling if a physician recorded doing so, but actually did not give such counseling—or did so ineffectively. We also may have overestimated screening rates because some of the cholesterol levels may have been ordered as part of a routine chemistry panel. In addition, longer follow-up would have resulted in a higher prevalence of screening in all three groups. Because most of the compliance with guidelines occurred by screening patients with normal cholesterol levels, overall compliance would likely also be higher. Because all auditing was done blinded to group assignment, these limitations would not affect the between-group comparisons, however.

The determination of compliance was based on NCEP guidelines, using a "benefit of the doubt" approach. These guidelines are complex, requiring several diagnostic and treatment steps.[11,24] Our results suggest that despite extensive educational efforts, the NCEP guidelines may be too cumbersome for many practitioners. Even given the possible benefit of the intensive-CME intervention among patients with high cholesterol levels, management was not in compliance with NCEP recommendations in more than three quarters of the patients in that group. This emphasizes the importance of determining the applicability of clinical guidelines before they are widely disseminated.[25] It would be of great interest to know whether a less complicated strategy would have greater applicability and more widespread public health effects.

The limitations of the standard-CME lecture format—in terms of demonstrating effects on patient care—are well-recognized.[4] Our study confirms those results, as well as those suggesting that physician-oriented approaches to preventive services may not be efficacious.[26] The results seem to suggest that programs that include more intensive education with enabling factors (such as patient handouts) and reinforcement (such as follow-up seminars) may modestly improve patient care, at least in the subgroup of patients who require more management. We are unable to determine which aspects of our intensive intervention were responsible for the possible benefit that we observed.

Given the substantial controversy that has arisen about the wisdom of screening and treating high cholesterol levels in many adults,[16,17] we cannot say whether the relatively low levels of compliance with the NCEP recommendations that we observed were good or bad. We can say that CME was not particularly effective in improving compliance with those guidelines among non–university-affiliated community physicians who practice primary care. That our results will apply to subsequent modifications of the NCEP guidelines[24] and perhaps to other expert guidelines seems likely. These results emphasize the need for better ways to change behavior in practicing physicians and the importance of studying the implementation of preventive health recommendations.

Acknowledgment

Gayle Pearson assisted in preparing the patient manual. We thank our chart abstractors, in particular Jean Ingram, for auditing charts, and the many San Francisco Bay Area physicians who participated in this study.

REFERENCES

1. Maiman LA, Becker MH, Liptak GS, Nazarian LF, Rounds KA: Improving pediatricians'compliance-enhancing practices—A randomized trial. Am J Dis Child 1988; 142:773-779

2. Kottke TE, Brekke ML, Solberg LI, Hughes JR: A randomized trial to increase smoking intervention by physicians—Doctors Helping Smokers, Round I. JAMA 1989; 261:2101-2106

3. White PT, Pharoah CA, Anderson HR, Freeling P: Randomized controlled trial of small group education on the outcome of chronic asthma in general practice. J R Coll Gen Pract 1989; 39:182-186

4. Davis DA, Thomson MA, Oxman AD, Haynes RB: Evidence for the effectiveness of CME—A review of 50 randomized controlled trials. JAMA 1992; 268:1111-1117

5. Wentz DK, Osteen AK, Cannon MI: Continuing medical education—Unabated debate. JAMA 1992; 268:1118-1120

6. Manning PR, DeBakey L: Lifelong learning tailored to individual clinical practice (Editorial). JAMA 1992; 268:1135-1136

7. Cummings SR, Richard RJ, Duncan C, et al: Training physicians about smoking cessation: A controlled trial in private practices. J Gen Intern Med 1989; 4:482-489

8. Cummings SR, Coates TJ, Richard RJ, et al: Training physicians in counseling about smoking cessation—A randomized trial of the 'Quit for Life' Program. Ann Intern Med 1989; 110:640-647

9. Jennett PA, Laxdal OE, Hayton RC, et al: The effects of continuing medical education on family doctor performance in office practice: A randomized control study. Med Educ 1988; 22:139-145

10. Jack BW, Gans KM, McQuade W, et al: A successful physician training program in cholesterol screening and management. Prev Med 1991; 20:364-377

11. The Expert Panel: Report of the National Cholesterol Education Program Expert Panel on detection, evaluation, and treatment of high blood cholesterol in adults. Arch Intern Med 1988; 148:36-69

12. Landzberg JS, Heim CR: Physician recognition and treatment of hypercholesterolemia. Arch Intern Med 1989; 149:933-935

13. Schucker B, Wittes JT, Santanello NC, et al: Change in cholesterol awareness and action—Results from national physician and public surveys. Arch Intern Med 1991; 151:666-673

14. Whiteside C, Robbins JA: Cholesterol knowledge and practices among patients compared with physician management in a university primary care setting. Prev Med 1989; 18:526-531

15. Block L, Banspach SW, Gans K, et al: Impact of public education and continuing medical education on physician attitudes and behavior concerning cholesterol. Am J Prev Med 1988; 4:255-260

16. Hulley SB, Newman TB, Grady D, Garber AM, Baron RB, Browner WS: Should we be measuring blood cholesterol levels in young adults? JAMA 1993; 269:1416-1419

17. Sox HJ: Screening for lipid disorders under health care systems reform. N Engl J Med 1993; 328:1269-1271

18. Goor R, Goor N: Eater's Choice. Boston, Mass, Houghton-Mifflin, 1987

19. Schroeder SA, Krupp MA, Tierney LM, McPhee SJ: Current Medical Diagnosis and Treatment, 28th edition, San Mateo, Calif, Appleton & Lange, 1989

20. Donner A, Donald A: The statistical analysis of multiple binary measurements. J Clin Epidemiol 1988; 41:899-905

21. Rothman KJ: No adjustments are needed for multiple comparisons. Epidemiology 1990; 1:43-46

22. Headrick LA, Speroff T, Pelecanos HI, Cebul RD: Efforts to improve compliance with National Cholesterol Education Program guidelines—Results of a randomized controlled trial. Arch Intern Med 1992; 152:2490-2496

23. Lurie N, Slater J, McGovern P, Ekstrum J, Quam L, Margolis K: Preventive care for women—Does the sex of the physician matter? N Engl J Med 1993; 329:478-482

24. Summary of the Second Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel II). JAMA 1993; 269:3015-3023

25. Browner WS: Estimating the impact of risk factor modification programs. Am J Epidemiol 1986; 123:143-153

26. Belcher DW: Implementing preventive services—Success and failure in an outpatient trial. Arch Intern Med 1990; 150:2533-2541