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Original Article

Increasing Physician Involvement in Cholesterol-Lowering Practices

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Abstract: *The study tested a multifaceted educational intervention designed to increase physician cholesterol-lowering practices. This three-group randomized controlled trial involved 51 Nova Scotia family physicians. Seventeen group I and 19 group II physicians attended a training workshop addressing the management of elevated serum cholesterol. Supporting print materials were provided for physicians and patients. Access to consultants was provided throughout the study. Group II physicians also used a "cuing" intervention to facilitate identification of eligible patients. Fifteen control group physicians received no intervention. Physician management practice was measured by medical record audit, dietary counselling practice by patient telephone interview. Patient serum cholesterol levels were measured on three occasions: baseline, 6 weeks, and 6 months. Physician patient management scores on chart audit were similar across study groups. However, physician dietary counselling scores were significantly higher for both intervention groups than the control. Patient serum cholesterol levels were not significantly different across study groups. However, in the intervention groups, patients' low-density lipoprotein levels decreased significantly overall from baseline to second follow-up, compared to increases in the control group. This intervention produced a change in physician dietary counselling associated with lowered patient low-density lipoprotein levels. Physician behavior change, leading to small changes in cardiovascular risk, may contribute to improved patient health outcomes.*

Key Words: Cardiovascular risk, continuing medical education, physician behavior change, physician counselling practice

Cardiovascular disease (CVD) remains a major contributor to morbidity and mortality in North America. Disease incidence has been linked to numerous risk factors, among them high blood pressure, smoking, and elevated serum cholesterol (S.CHOL). Increasingly, evidence supports the belief that reduction of risk factors can delay or prevent the onset of disease, lower morbidity and premature death rates, and improve the population's health. Heart Health initiatives at both the individual and the population levels are ongoing across North America[1,2] and in Europe.

Many factors interact to determine levels of cardiovascular (CV) risk, and a multifactorial approach is required to make meaningful change in health status. Health professionals have an important role to play in the approaches implemented. Among health professionals, physicians

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are important in the reduction of CV risk. Their knowledge is highly valued by patients,[3] more than 70% of the population visit them yearly,[4] and they see themselves as having an important role in this area.[5]

A baseline study[5] involving 50 family physicians revealed that, although physicians held a positive attitude toward preventive activities, there existed several barriers to the effective integration of these activities into practice. These barriers are discussed in detail elsewhere;[6] however, in summary, they included perceived lack of knowledge and skills, barriers within the practice environment, and the perception that reinforcement for integration of preventive activities was low.

Based on this needs assessment study, we developed an educational program as well as physician education materials. We report here on a test of the effectiveness of a systematically developed educational intervention to enhance physician involvement in cholesterol-lowering practices.

Study Hypotheses

The study was designed to test two hypotheses: (1) physicians who participate in a multifaceted educational intervention addressing the identification and management of patients with elevated S.CHOL will demonstrate better achievement of the program educational objectives, as measured by patient management records and patient interviews, than physicians who have not participated; (2) when physicians participate in this educational intervention, there will be positive benefits to patient health, as measured by reduced levels of total S.CHOL in their patients.

Background and Related Literature

Much debate has concerned whom to screen for elevated S.CHOL and at what levels to intervene. In general, recommendations for intervention are very similar, emphasizing a dietary intervention for at least 6 months, as the initial management for patients with elevated S.CHOL.[7,8] Much less attention has been given to how family physicians can intervene effectively within the context of regular practice. Recent surveys of physicians indicate that simply providing guidelines is insufficient to alter practices.[9,10] There is growing evidence that a multifaceted approach is required to effect changes in physician practices. A recent review of 50 randomized trials in continuing medical education[11] concluded that to encourage sustained change in physician behavior requires a combination of both education and changes in the practice environment, which enable or reinforce the new practices.

The PRECEDE model, which guided our baseline study,[5] provided a useful framework for the design and analysis of a multifaceted educational intervention.[12] The model posits multiple factors which affect behavior, including factors that predispose an individual to certain behaviors such as knowledge; those that enable the behavior, such as skills; and reinforcing factors, such as patient satisfaction. A recently reported study within the Pawtucket Heart Health Program[13] also applied this classification of determinants of physician behavior to an educational intervention in cholesterol lowering.

Two recent studies reported that, since the advent of continuing education campaigns and exposure to cholesterol-related practice guidelines, physician practices have improved in this area.[14,15] However, in both studies, physicians felt less effective in changing cholesterol levels than other risk factors and they wished to have further information on cholesterol management. These findings matched those in our baseline study.[5]

This study examined the effect of an educational intervention on the physicians' management of persons identified to have elevated S.CHOL. We report here on (1) the patient management behavior of study physicians, as measured by an audit of participating physicians' records; (2) the dietary counselling practices of study physicians, as measured by a structured telephone

interview with patients-in-care; and (3) the effect on patient health as determined by measures of serum lipid levels.

Methods and Procedures

Sample Selection

A random sample of physicians was drawn from the mailing list of all Nova Scotian physicians, maintained by the Division of Continuing Medical Education at Dalhousie University. From those in full-time family practice, with 5 to 25 years of practice experience, an initial list of 255 names was generated. Dalhousie faculty members were removed; also, only the first name of a shared practice was retained. As a result, 38 of the 255 physicians were ineligible. Of the remaining 217, 59 (27.2%) entered the study. Reasons for nonentry included the following: no response = 30; too busy = 86; no longer in general/family practice = 14; moved or moving = 9; in part-time practice = 7; inadequate numbers of adult patients = 5; maternity leave = 3; and no interest = 4. Sample size calculations of 20 to 25 physicians per group were based on estimates that each physician would see approximately 400 patients over the study period.

Study Design

As physicians agreed to participate, they were assigned, in previously generated random order, to one of the following study groups:

1. **Workshop group.** This group of physicians received all of the elements of the educational intervention, which is described below.
2. **Workshop + cue group.** In addition to all of the elements of the educational intervention, this group of physicians received a cuing intervention.
3. **Control group.** This group received none of the program elements. However, they were offered the intervention at the study's completion.

Initial Physician Interview

Investigators visited all physician participants in their offices to explain the study and to obtain physician consent. At this time, we ensured that physicians and office staff understood all study protocols. For the workshop + cue group, this included instructions for putting the cuing stickers on the charts of patients at high risk for elevated S. CHOL. The cuing intervention is explained below.

Educational Intervention

The educational intervention was based on learning theory,[16] principles of adult learning,[17] and instructional design.[18] It incorporated the study objectives and the barriers identified by physicians in our baseline study.[6,19] The relationship of the intervention to each of the barriers is shown in Table 1. The intervention consisted of five components, as follows:

1. **A training workshop.** All physicians in the workshop and workshop + cue groups attended a half-day training workshop. An interprofessional team led the workshop, including a family physician, educational specialists, a nutritionist, and an internist. The workshop emphasized current information regarding case finding and management, based on the Canadian Consensus Conference on Cholesterol recommendations.[7] Detailed instruction in and opportunities for practice in specific dietary counselling to reduce dietary saturated fat were provided. As part of making dietary change, physicians were also instructed in how to assist patients to increase their physical activity.[7] The dietary counselling intervention was developed to fit within the usual 10-minute office visit. Strategies for enhancing compliance were discussed. Finally, the internist also discussed approaches to pharmacologic management,

Table 1 Relationship of the Educational Intervention to Barriers Identified by Physicians in our Baseline Study[5]

Barrier	Proposed Intervention
Predisposing Factors	
a. Lack of guidelines and information regarding cholesterol management.	a. Provision of materials to physician containing up-to-date information regarding cholesterol as a risk factor and its management.
b. Lack of counselling and behavior change skills.	b. Skill-training workshop, where participants can observe, practice, and receive guided feedback.
c. Lack of belief in personal effectiveness.	c. Same as above.
d. Lack of belief in efficacy of cholesterol lowering.	d. Opportunities to consider and discuss current epidemiologic and clinical evidence.
Enabling Factors	
e. Lack of conducive practice organization.	e. Identification of potential screenees by the office nurse or receptionist. Provision of checklist to help physicians manage identified patients systematically.
f. Lack of available, accessible referral.	f. Provision of telephone access to specialist physician and/or dietitian to discuss patient problems or to refer patient.
g. Lack of appropriate patient education materials.	g. Provision of materials for patients that provide information to promote behavior change and maintenance.
h. Lack of time.	h. Demonstration of counselling within a typical 10- to 15-minute office visit.
i. Lack of knowledge of available resources.	i. Provision of information regarding available services in the physicians' geographic area.
Reinforcing Factors	
j. Lack of patient compliance.	j. Provision of materials as in (g) to promote compliance. Workshop discussion regarding promoting compliance.
k. Lack of reinforcement for activities.	k. Telephone contact with specialist physician and or dietitian to allow for problem solving and to reinforce efforts and successes. Provision of checklists to reinforce systematic treatment.

should dietary management be unsuccessful.

2. **Print materials for the physician.** The physician educational package entitled "Cholesterol: Working Together to Reduce the Risk" was developed by the investigators. It included current recommendations regarding identification and management of patients with elevated S.CHOL, as well as tips for effective dietary counselling, exercise prescription, enhancing patient compliance, and assisting patients with the making and maintaining of behavior change. An overview of pharmacologic

therapy was provided. Also included was a checklist that suggested how to fit the intervention into regular practice.

3. **A complementary package of patient education materials.** Titled similarly to those for the physician, the patient materials emphasized practical skills in implementing and maintaining behavior change. Included were information on reducing dietary fat intake, low-fat recipes, a food diary, and tips on exercise, shopping, and making lifestyle changes. Both patient and physician materials were piloted and evaluated prior to use.
4. **Videotaped doctor-patient interviews.** A 30-minute videotape was produced to provide current information about recommendations for reducing S.CHOL and to demonstrate the family physician conducting a counselling session during a normal 10- to 15-minute office visit. The videotape was evaluated prior to use by practicing family physicians. Three shorter 5- to 7-minute video vignettes also served as a stimulus for discussion. They dealt with aspects of patient management, counselling patients about screening, and discussions with colleagues about the relative benefits and costs of screening.
5. **Ongoing professional support and reinforcement.** Physicians in the workshop and the workshop + cue groups were encouraged to access, through collect calling, the project nutritionist and the specialist physician whenever special problems arose in identifying, counselling, or managing patients with regard to S.CHOL levels. Specific times for telephone contact were identified.

Cuing Intervention

Based on reports that reminding the physician increased the numbers of patients appropriately identified as having elevated CV risk factors such as smoking,[20] a simple cuing intervention was devised. Physicians in the workshop + cue group were provided with a supply of fluorescent green stickers marked "CV Risk." The office receptionist for each physician was instructed to place the stickers on the charts of patients visiting the office who might be at risk of elevated S.CHOL. We particularly emphasized the identification of men between the ages of 35 and 59.

Patients-in-Care

Following attendance at the educational workshop, physicians began case finding, according to the Canadian Consensus guidelines.[7] From patients so identified, each physician was asked to enter, during the ensuing 6-month period, at least 25 persons called "patients-in-care," each of whom would be followed for a 6-month period. Based on frequency estimates of patient visits, we anticipated that this number of patients could be recruited over a 6-month period. Patients-in-care were of either gender, aged 30 to 59 years, with a total S.CHOL of ≥ 6.2 mmol/L, or ≥ 5.2 to < 6.2 mmol/L, with identified lipoprotein abnormalities consistent with the Canadian Consensus guidelines.[7] To determine eligible patients, an initial total S.CHOL measurement was taken in the patient's local hospital laboratory. Patients with total S.CHOL exceeding recommended levels had a repeat blood test, fasting, using special study requisitions. These repeat tests included lipoprotein analyses, and specimens were transported to Halifax for analysis in the study laboratory to ensure comparable results. Results were recorded and a copy sent to the study physician. Patients identified through their S.CHOL levels as potential patients-in-care were assigned a study number. Due to slower than anticipated patient accrual, recruitment lasted 9 months, rather than the intended 6. With a 6-month follow-up for all patients, the total study period extended 15 months from the training workshop.

Outcome Measures

Three outcome measures were employed as follows:

1. **Measures of physicians' management behavior.** Measures of physician behavior were taken to determine to what extent the physician's management behavior, as recorded on the patient record, met the study objectives. A chart audit instrument was developed that reflected all of the potential ways that the study physicians might record their actions in relation to the study objectives. The behaviors of note are shown in Appendix 1. These measures were obtained through a chart audit for all patients-in-care at the end of the study period (15 months after the study began). The audit was conducted by four qualified health record abstractors who together had completed a 1-week training period. Abstractors reviewed the file of each identified patient-in-care and noted any information recorded by the physician that was relevant to the study objectives. All data were reviewed, corrected where required, and entered into the study database.
2. **Measures of physician dietary counselling practices.** This measure was employed to explore physician behavior further, particularly regarding patient counselling within the office visit. Beginning 1 month after the workshop, a trained research assistant contacted each practice regularly to obtain the names of patients-in-care seen at the office within the past 3 to 5 days. Up to five patients per study physician were contacted only once by telephone and interviewed using a pretested structured interview format containing both closed and open-ended questions. All interviews occurred within 3 to 5 days of the patient's most recent visit. The research assistant was unaware of the group assignment of the patient's physician.
3. **Measures of patient S.CHOL levels.** All patients-in-care had determinations of S.CHOL and lipoprotein analyses at study entry. Patients were asked to have repeat determinations 6 weeks and 6 months later. Once patients had entered the study, all determinations were made at the central study laboratory.

Exit Physician Interview

We conducted individual semistructured interviews with each physician in the workshop and workshop + cue groups at the completion of the study. Our purpose was to enhance our understanding of physician perceptions regarding the study intervention, rather than to test the study hypotheses.

Data Analysis

For all of the following measures, the study physician formed the basic unit of analysis:

1. **Measures of physicians' management behavior.** For each patient-in-care, a chart audit score was developed to record the physician's management behavior. The total score possible was 10, which was comprised of (a) a diet score, including management behaviors recorded in the patient's chart related to the patient's diet (five items) and (b) an exercise score (four items) and a smoking score (one item). The items are shown in Appendix 1. One point was given for each appropriate behavior recorded in the patient's chart at least once during the audited period. For each physician, the diet, exercise, and total scores of each patient-in-care were computed. The score was a reflection of physician behavior. The scores were compared across groups, using analysis of variance with the following model:[21]

$$y_{ijk} = \mu + B_j \gamma_{i(j)} + \epsilon_{ijk}$$

where y_{ijk} = diet, exercise, or total score for doctor i, study group j, patient k

B_j = study group (fixed)

$\gamma_{i(j)}$ = doctor i in study group j (random) (phys [study group])

ϵ_{ijk} = error (random)

There was wide variation in the number of visits per patient, and not all chart records of visits contained any indication of study-related activity. Therefore, a specific behavior was counted as occurring only once per patient, even if recorded more frequently. Four items that were collected from the chart audit were eliminated from analysis of total scores as their occurrence was too low to permit useful comparisons. These were referrals to medical specialists, to a nurse, to a community program, and to other resources. In addition to total scores, individual behaviors recorded in the patient's file by the physician were compared across groups using chi-square analysis.

2. **Measure of physicians' dietary counselling practice.** A total interview score was developed based on the interview content to assess counselling practice. The total possible score was 16, comprised of (a) a diet score, which included counselling related to cholesterol (seven items); and (b) a cholesterol score (seven items) and an exercise score (two items). Scores were computed for each physician's patients. Appendix 1 details these scores. Differences across physician groups were examined using analysis of variance. The model was similar to that used in the measures of physician management behavior.
3. **Measures of patient S.CHOL levels.** Patient S.CHOL values were grouped according to the study group assignment of their physician. Mean total S.CHOL levels were analyzed for change from baseline to first and baseline to second follow-up. Repeated measures analyses of variance were also employed. Analyses of differences across study groups were conducted both with and without the baseline S.CHOL level as a covariate. Changes in serum lipoprotein levels were also analyzed.

Exit interview data were reviewed and analyzed. These data were examined for frequencies of responses and their content was used to assist us in understanding the study findings.

Results

Physician study participants. Table 2 describes the characteristics of the physician study participants.

The reasons for attrition did not differ across the groups and included lack of time (n = 5), patient noncompliance (n = 1), geographic relocation (n=1), and reason withheld (n=1). There were no statistically significant demographic differences between the physicians who completed the study and those who did not. Also, the groups are similar with respect to proportions of male and female physicians (Fisher's Exact Test; p = .57). These proportions reflect the physician population from which they are drawn.

Patients-in-care. A total of 560 patients-in-care entered the study. There were no differences among the groups with respect to age (F = 1.63; p = .20) or gender (Fisher's Exact Test; p = .97).

Measures of physician management behavior. A total of 560 charts were audited. No significant effect of study group was seen on physician management in dietary (p = .5), exercise (p = .22), or total score (p = .31) or on smoking behavior. In contrast, the effect of within-group variation among physicians was highly significant for all three outcomes (p = .0001). The scores are shown in Table 3.

In addition to total scores, we explored the proportion of patients in each study group for whom each individual element in each component of

Table 2 Demographic Characteristics of Study Physicians by Study Group

Characteristic	Group		
	Workshop	**Workshop + Cue**	**Control**
Number of physicians entered	20	21	18
Number of males/females	15/5	18/3	16/2
Number of dropouts	3	2	3
Mean age in years (SD)	42.4 (7.8)	42.9 (7.7)	45 (6.3)
Mean years of practice (SD)	15.1 (7.4)	15.5 (7.1)	17.4 (6.3)
Type of practice n (%)			
Group	13 (65%)	17 (81%)	14 (77.8%)
Solo	7 (35%)	4 (19%)	4 (22.2%)
Practice location n (%)			
Rural	8 (40%)	10 (47.6%)	7 (38.9%)
Urban	12 (60%)	11 (52.4%)	11 (61.1%)

the score was recorded. In this analysis, the following statistically significant differences emerged. Both of the workshop and workshop + cue groups' physicians more frequently recorded on their patients' files that they (1) discussed low-fat diets ($\chi^2 = 17.1$, $p \leq .001$); (2) reviewed low-fat diets ($\chi^2 = 7.9$, $p = .02$); (3) referred to community programs ($\chi^2 = 6.4$; $p = .04$); (4) discussed exercise ($\chi^2 = 15.3$, $p \leq .001$); (5) prescribed exercise ($\chi^2 = 11.1$, $p = .004$); and (6) discussed smoking ($\chi^2 = 10.1$, $p = .006$) with their respective patients-in-care than did the control group.

Measures of physician dietary counselling practices. Of 178 patients contacted, 173 telephone interviews were conducted (workshop = 74; workshop + cue = 59; control = 40). The characteristics of those patients who participated in the telephone interviews are displayed in Table 4, along with the characteristics of the total study group. There are no significant differences among the interview groups with respect to age ($F = 0.09$; $p = .91$) or gender (Fisher's Exact Test; $p = .19$).

A total score was calculated for the measures of dietary counselling based on the interview responses. Scores for diet, cholesterol, and exercise and total scores are shown in Table 5. As shown, physician study group membership had a statistically significant effect upon both individual score components and total scores. In each case, physicians in the workshop and workshop + cue

Table 3 Mean Scores for Physician Management of Patients-in-care as Indicated by Audit of Physician Records

Management Area (Maximum Score)	Study Group			p Value
	Workshop (n* = 196)	**Workshop + Cue (n = 218)**	**Control (n = 146)**	
Diet (max = 5)	2.78 (1.16)†	2.44 (1.21)	2.28 (1.18)	.5
Exercise (max = 4)	1.27 (1.14)	0.93 (1.11)	0.87 (1.05)	.22
Smoking (max = 1)	0.37 (0.48)	0.23 (0.42)	0.27 (0.44)	.55
Total (max = 10)	4.42 (2.28)	3.61. (2.27)	3.42 (2.13)	.31

*n refers to the number of records audited in the group; †standard deviations are shown in parentheses.

Table 4 Characteristics of Patients who Participated in the Telephone Interview Compared with the Total Patient Study Group

	Total Patient Group			Telephone Interviewees		
	Workshop (n = 198)	**Workshop + Cue (n = 217)**	**Control (n = 145)**	**Workshop (n = 74)**	**Workshop + Cue (n = 58)**	**Control (n = 40)**
Male (%)	65.7	66.8	65.5	58.1	72.5	70.0
Female (%)	34.3	33.2	34.5	41.9	27.6	30.0
Mean age (yr)	45.8	47.2	47.1	47.3	47.8	47.2
Mean cholesterol at study entry (mmol/L)	6.16	6.2	6.22	6.07	6.27	6.25

groups performed significantly better than the control group members. The physician-within-group variation was also statistically significant (p = .001).

When the counselling elements were reviewed individually, we observed the following results: Physicians in the workshop and workshop + cue groups performed similarly to the control group in discussing cholesterol and the role of diet and drugs with their patients. However, the workshop and workshop + cue groups each scored significantly higher than the control group in discussing dietary change ($\chi^2 = 6.8$, p = .03); giving dietary advice regarding meats/poultry ($\chi^2 = 9.29$, p = .01); discussing cooking practices ($\chi^2 = 14.23$, p = .001); providing dietary advice regarding saturated fats ($\chi^2 = 12.5$, p = .002) and unsaturated fats ($\chi^2 = 12.47$, p = .002); and providing printed information ($\chi^2 = 20.07$, p = .001). In contrast, the control group used medication significantly more frequently than did either of the study groups ($\chi^2 = 6.2$; p = .04).

Measurements of patient total S. CHOL. Mean patient S.CHOL levels at each of pretest, 6 weeks, and 6 months after study entry are shown in Table 6.

There were no statistically significant differences between the control and workshop or workshop + cue groups for either the baseline to first follow-up change (p = .86), or baseline to second follow-up change in S.CHOL levels (p = .33) without reference to baseline level. When that covariate was included, there were still no significant differences, with respective p values of .79 and .43. Higher baseline levels of S.CHOL were associated with greater change from baseline level

Table 5 Physician Dietary Counselling Practices as Measured by Scores on the Telephone Interview

	Study Group			
Counselling Area (Maximum Score)	**Workshop (n* = 74)**	**Workshop + Cue (n = 59)**	**Control (n = 40)**	**p Value**
Diet (max = 7)	6.05 (1.46)†	6.24 (1.02)	4.95 (2.22)	.004
Cholesterol (max = 7)	5.85 (0.96)	5.97 (0.83)	5.37 (1.41)	.04
Exercise (max = 2)	0.96 (0.20)	0.90 (0.30)	0.88 (0.33)	.50
Total (max = 16)	12.86 (2.17)	13.10 (1.53)	11.20 (3.47)	.0005

*n refers to the number of interviewees; †standard deviations are shown in parentheses.

Table 6 Mean Total Cholesterol Value of Patients-in-care* in mmol/L at Baseline and Follow-up Visits

			Visit	
Study Group	**Initial**		**First Follow-up**	**Second Follow-up**
Control	N	159	70	81
	Mean	6.22	6.13	6.09
	SD	0.81	0.91	0.88
Workshop + Cue	N	225	76	83
	Mean	6.20	6.07	6.13
	SD	0.75	0.93	0.82
Workshop	N	212	90	69
	Mean	6.16	5.93	6.00
	SD	0.70	0.82	0.93

*Patient S.CHOL levels are grouped according to the study group membership of their physician.

to first and to second follow-up values ($p = .0001$ for both).

Repeated measures analysis of mean total S.CHOL at baseline, 6 weeks, and 6 months found no significant differences among the control, workshop, and workshop + cue groups, either without ($p = .44$) or with ($p = .11$) consideration of the baseline level. As seen in Table 6, for all groups, the S.CHOL value fell slightly from the initial screen to the first follow-up, and then increased again at the second follow-up although not back to the initial level. The time trend is similar for all groups. This change is statistically significant ($p = .0001$ when the baseline covariate was included but not significant without $p = .02$).

Many patients-in-care qualified for the study due to elevated low-density lipoprotein (LDL) levels in the presence of a total S. CHOL. of $> 5.2 - < 6.2$ mmol/L. Analysis of variance revealed a significant effect of physician study group on changes in serum LDL ($p = .02$). In both the workshop and workshop + cue groups, there was a significant decrease in mean LDL following the intervention. Mean LDL in the workshop group fell from 4.12 (SD = .73) at the initial screen to 3.80 mmol/L (SD = 1.01) at the second follow-up ($p = .0002$). Similarly, the mean LDL in the workshop + cue group fell from 3.95 (SD = 1.07) to 3.7 mmol/L (SD = 1.22) over the same period ($p = .004$). The control group mean LDL of 3.76 (SD = 1.22) at initial screen rose slightly to 3.79 mmol/L (SD = 1.05) at second follow-up. Repeated measures analysis found a significant downward trend from baseline to first and second follow-up in the workshop group ($F = 5.59$, $p = .004$). The trend was similar but not significant in the workshop + cue group ($F = 2.18$, $p = .12$).

For high-density lipoprotein (HDL), no effect of study group was seen. At the initial screen, mean HDL levels in all of the workshop, workshop + cue, and control groups were 1.02 (SD = .26), 1.05 (SD = .29), and 1.00 mmol/L (SD = .26), respectively. At the second follow-up, the levels were 1.08 (SD = .30), 1.06 (SD = .28), and 1.03 mmol/L (SD = .23).

There were no significant differences in serum triglyceride levels across study groups.

Discussion

The discussion of the study findings reflects the complexity of both the intervention and of research on changing physician behavior. In addition to discussion of specific outcomes, we will also discuss briefly our findings in the light of the PRECEDE model, which formed the conceptual basis for the intervention. Finally, implications for research, theory, and practice will be presented.

Physician management behavior. Physician recording of management of patients-in-care was much lower than expected. As reflected in the number of observations available for analysis (n = 560), recordings that reflected the congruence of physician behavior with the objectives were few. This limited recording by physicians may have contributed to the lack of statistically significant differences among the three study groups on this measure. It also suggests that chart audit may underestimate the degree to which the participant physicians met the study objectives. It should be noted that the within-group variability of physician behavior was highly significant (p = .0001) in all of the study groups.

Physician dietary counselling practices. The strongest effect of our intervention was seen in this outcome. The dietary counselling measure was intended to complement the measures obtained through review of participating physicians' records. Although there were statistically significant correlations between the two measures, they were quite different. On each individual management behavior (e.g., discussing diet), the physician received a single score, averaged over all visits for a single patient. In contrast, the dietary counselling score was calculated for one visit with one patient. In this more detailed information, small but important differences may be seen, which have been obscured in the chart audit score.

Power analyses of the dietary counselling scores revealed the power to be > .80. We therefore have confidence that these findings reflect true differences in physician behavior. Possibly, these differences are not seen in the chart audit score due to (a) the information lost in averaging and (b) the paucity of charted interventions in the physician record.

Measures of patient S.CHOL levels. The lack of significant changes in S.CHOL level is not surprising when one considers the relatively low mean values at study entrance. However, the low mean S.CHOL level for patients-in-care was unexpected, in view of the results of the Nova Scotia Heart Health Survey,[1] which indicated a high level of CV risk factors in the Nova Scotia population. Several factors may account for this: (1) secular changes in levels of S.CHOL in the population may have occurred, resulting in there being less eligible patients. Such changes have been reported elsewhere, and, given the Nova Scotian milieu where a comprehensive Heart Health Project was under way, would not be surprising; (2) physicians may already have treated patients with extremely elevated S.CHOL, with either drugs or diet, and therefore they were not eligible for this study; (3) patients may have declined entry; and (4) persons with higher levels of CV risk may also have other contributing factors (e.g., socioeconomic constraints), resulting in less likelihood of visiting a physician and therefore of entering this study.

In spite of the low overall S.CHOL measures and the lack of demonstrated change, we were able to demonstrate statistically significant lowering of serum LDL levels in both the workshop and workshop + cue groups from the initial study measure to the second follow-up. As many of our patients-in-care had abnormalities in LDL in the presence of total S.CHOL between > 5.2 to < 6.2 mmol/L, this change may have been the more appropriate one to occur. These changes are consistent with our findings concerning physician dietary counselling practices. As there were no marked abnormalities in serum HDL levels or serum triglycerides, the lack of demonstrated change is expected. It is also important to note that even small reductions in risk, when applied to populations, result in lower morbidity and mortality.[22]

Patient enrollment/sample size. Although our estimated numbers of patients visiting the physician were consistent with our observations, the rate of accrual was slower for many study physicians. Two possible explanations for this outcome are suggested. First, the high rate (approximately 50%) at which our study physicians in all groups were screening patients prior to the workshop was unexpected. Second, we asked study physicians, during the exit interview, to estimate what proportion of eligible patients they had

entered in the study. Estimates ranged from 1% to 100%. The median estimates for the workshop, workshop + cue, and control groups were 25%, 30%, and 20%, respectively. Participants' reasons for not entering eligible patients were (1) patient refusal, (2) patients in the practice had already been screened, (3) perceived patient noncompliance, and (4) they were too busy or forgot.

Two components of the educational intervention did not occur as intended. These were the cuing intervention and the telephone support intervention.

Cuing intervention. In previous studies, where cuing by receptionists was given strong support from research staff, it has had a powerful effect on physician behavior.[20] When that support is not present, others have reported difficulty in implementing cuing mechanisms in office practice.[23] The latter was our experience.

The nurse/receptionist and the physician in each group II office were given a supply of stickers and detailed instructions in their application during the study orientation visit. Audit of physicians' charts, however, revealed an average rate of sticker application of only 9.6% (range: 0–31%). Twenty-six percent of group II supplied no stickers at all. The exit interview allowed us to explore why this intervention had failed. The reasons offered by physicians for nonuse of the stickers included (1) the office was too busy (4/19), (2) the office staff did it when they remembered (6/19), and (3) it "labelled" patients (3/19).

The reasons for the lack of office staff compliance are unclear. We had considered the possibility of monitoring sticker use by a research assistant. However, we had rejected the idea because such monitoring would decrease the generalizability of the results. Possibly, cuing interventions are not easily implemented in busy physician offices; perhaps, also, the requirement of applying stickers daily for 6 months was excessive. A further uncertainty is whether, in those cases where stickers were applied, the presence of the sticker had any effect on the physician's management of that patient.

Telephone support intervention. Access to both a specialist physician and a nutritionist were provided throughout the 6-month period following the workshop. Participating physicians could call these persons collect, at specified times that were circulated to all participants. Our purpose had been to provide physicians access to two resources that our baseline survey had identified as desirable but inaccessible. We also hypothesized that physicians would find it useful to have ready answers to specific questions concerning both overall CV risk management and specific nutrition counselling. Physicians had also indicated the need for a mechanism to have some questions answered when a full referral did not seem necessary. Unexpectedly, participating physicians made almost no use of this resource. A total of seven calls were received by the specialist physician and two by the nutritionist. To explore the reasons for this, we asked participants in the exit interview whether there were occasions when they could have used these services. Of 36 physicians in the intervention groups, 29 had had no need to call. Of the seven physicians who used these services, three found the times specified inconvenient. Twenty-four participants used their local resources, and only two expressed concern about accessibility and availability of resources.

Whether our study population or their local resource environment had changed since our original study is not certain. However, with the increased activity on all CV health and disease initiatives occurring concurrent with the Nova Scotia Heart Health Project, this is certainly possible.

The PRECEDE framework and our findings. A recent review of the effectiveness of CME interventions[11] argued for a typology of interventions based on the PRECEDE framework. The review found evidence for increasing effectiveness when predisposing elements (e.g., knowledge and skills) were combined with strategies that enabled and reinforced practice change.

Predisposing factors. Our findings on the measure of physician counselling skills strongly

indicate that the intervention produced change in this predisposing factor. Physicians in the workshop and workshop + cue groups confirmed this; 55% believed that they had improved their dietary counselling skills as a result of the workshop.

Enabling factors. Of the five enabling factors (see Table 1) toward which we directed our intervention, physician participants unanimously commended the patient education materials developed for the project. The remaining enabling factors were more resistant to change. Physicians generally did not use the telephone access provided to a specialist internist and to a nutritionist. Given the physicians' counselling practices emerging from the telephone interview, the need for access to the dietitian immediately may have been reduced.

Physicians have traditionally viewed most patient encounters as too short to accomplish effective counselling, especially for complex tasks like achieving dietary change. We were unable to monitor the length of physician encounters with their patients; however, it appears that physicians were effective in including the 10-minute counselling intervention in the visit time allowed.

A checklist of suggested activities to guide patient management was provided to physicians in the workshop and workshop + cue groups. Thirty-three of 36 physicians reported using it in this way. To the extent that reminders affect patient care, the organization of those physicians' care of patients in the study may have been affected slightly. We could not assess the effect of the cuing stickers, as only 10% of eligible patient records were found to have stickers applied.

Reinforcing factors. We hypothesized that providing physicians with improved skills and appropriate patient education materials would enhance patient compliance, therefore reinforcing the physician's actions. However, we did not attempt to measure compliance, and a single intervention would be unlikely to affect patient adherence substantially on its own. Access to the specialist and nutritionist was intended to provide reinforcement for physicians who used the service. With the observed infrequent usage, this opportunity was lost.

In summary, our findings are consistent with the PRECEDE framework in describing a multifactorial environment in which education and change occur. Among the predisposing factors, skills were positively affected. However, even in the presence of improved skills, important enabling factors were difficult to change.

Gans et al. and Jack et al. have reported success in changing both physician perceptions[13] and behavior[24] using a multifaceted approach based on the PRECEDE model. The lack of a control group in this study makes interpretation difficult. More importantly, the reported intervention occurred in a relatively controlled environment (a family practice residency program), which may explain the larger impact on physician practice, compared to our study.

We must also consider the many other concurrent influences on physician behavior in CVD risk reduction, including the continuing debate about the merits of S.CHOL reduction and the many heart health initiatives at both the professional and public levels. The presence of these cointerventions may have obscured some effect of our intervention.

Implications for Research, Theory, and Practice

Research in CME. Studies of educational interventions aimed at changing physician behavior are increasingly challenging to conduct. First, physicians must commit to an extended period of involvement (in our case, 15 months). Moreover, there is also a daily commitment to recruitment and/or follow-up and the attendant administrative work. Second, the emphasis on outcomes assessment necessitates the inclusion of a patient health indicator (in our case, total S.CHOL levels). The importance of such an indicator is not questioned; however, it is almost impossible to make a direct causal link between the physician's behavior and the patient's health indicator. Many

variables affect patient behavior and total cholesterol levels; the levels obtained cannot be attributed solely to physician behavior.

Third, physician behavior varies so widely, even in the presence of an educational intervention, that both large sample sizes and considerably proscriptive and intrusive interventions are required to demonstrate differences with the necessary degree of confidence in the results. The generalizability of such interventions to practice must be questioned. Finally, the classical approach of a randomized controlled trial, while essential to demonstrate some types of effects, also fails to permit an understanding of the many interacting variables in physician behavior, patient behavior, and the practice environment. Careful, creative approaches to answering these important questions will need to be developed to both further the field and improve feasibility and generalizability.

Further research is necessary to explore the development of an effective cuing intervention. It is important to determine which factors hinder and which improve the effectiveness of such an intervention. It may be that cuing's reported effect is not generalizable to interventions that are less controlled.

Implications for CME practice. Providing training in specific skills through an educational workshop appears to be effective. Particularly in the measures of dietary counselling obtained through telephone interview, changes were found in the behavior of those physicians who had participated in the training sessions, and physicians believed that their behavior had changed. Future programs should retain the central "training" component.

The practice environment is a critical factor in the effectiveness of interventions designed to change behavior. The involvement of the office staff is probably necessary as they influence and understand the office and practice environment; however, the staff must be committed to the change and their contributions reinforced.

Implications for CME theory development. Our findings are consistent with the theoretical framework in which the study was set. We encountered a dynamic interchange between the physician and the environment, and our findings supported the multiple influences of the practice environment upon the physician. Social learning theory guided the development of our training, rehearsal, and feedback approach to incorporating new dietary counselling skills; both subjectively, in respondents' perceptions, and objectively, as measured by our outcomes, these skills were improved in the physicians who participated in the intervention.

Clearly, a single intervention will be insufficient to both initiate and maintain changes in physician behavior. Attention should be given to providing ongoing feedback, reinforcement, and other educational strategies that can be incorporated into a busy clinical practice.

Conclusion

Our findings suggest that, although we demonstrated important changes in physician counselling practices, the variability of individual physicians' motivation and usual practice is impressive and is more powerful than the effect of a systematic educational intervention. We will look further at the specific behaviors of those physicians in whom the intervention appears to have had a marked effect to determine what elements most effectively assist physicians to change their behavior.

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References

1. Report of the Nova Scotia Heart Health Survey. Halifax, NS: Nova Scotia Department

of Health and Department of National Health and Welfare, 1986.

2. Health and Welfare Canada. The Canadian Heart Health Initiative. A policy in action. Health Prom 1992; 30(4).
3. Rimer BK, Strecher VJ, Engstrom PF. A survey of physicians' views and practices on patient education for smoking cessation. Prev Med 1986; 15:92–98.
4. Battista R, Beaulieu MD, Feightner JW, Mann KV, Owen G. The Periodic Health examination. 3. an evolving concept. Can Med Assoc J 1984; 130:1288–1292.
5. Mann KV, Putnam RW. Physicians' perceptions of their role in cardiovascular risk reduction. Prev Med 1989; 18:45–58.
6. Mann KV, Putnam RW. Barriers to prevention: physician perceptions of ideal versus actual practices in reducing cardiovascular risk. Can Fam Phys 1990; 36:665–670.
7. Canadian Consensus Conference on Cholesterol. Final report. Can Med Assoc J 1988; 139:1–8.
8. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. 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 11). JAMA 1993; 269:3015–3023.
9. Maiman LA, Greenland P, Hildreth NG, Cox C. Patterns of physicians' treatments for referral patients from public cholesterol screening. Am J Prev Med 1991; 7:273–279.
10. Troein M, Rastam L, Selander S. Dissemination and implementation of guidelines for lipid lowering. Fam Pract 1991; 8:223–228.
11. 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.
12. Green LW, Eriksen MP, Schor EL. Preventive practices by physicians: behavioral determinants and potential interventions. Am J Prev Med 1988; 4:S101–S107.
13. Gans KM, Jack B, Lasater TM, Lefebvre RC, McQuade W, Carleton RA. Changing physicians' attitudes, knowledge and self-efficacy regarding cholesterol screening and management. Am J Prev Med 1993; 9:101–106.
14. McBride PE, Plane MB. Hypercholesterolemia: the current educational needs of physicians. Am Heart J 1992; 123:817–825.
15. Reeder BA, Horlick L. Physicians' management of hyperlipidemia in Saskatchewan: temporal trends and the effect of a CME program. Can J Cardiol 1991; 7:385–390.
16. Bandura A. Social learning theory. Englewood Cliffs, NJ: Prentice-Hall, 1977.
17. Merriam SB, Caffarella RS. Learning in adulthood. San Francisco: Jossey-Bass, 1991.
18. Dick W, Carey L. The systematic design of instruction. 2nd Ed. Glenview, IL: Scott, Foreman, 1985:30–77.
19. Mann KV, Putnam RW, Lindsay EA, Davis DA. Cholesterol-decreasing the risk: an educational program for physicians. J Cont Educ Health Prof 1990; 10:211–222.
20. Cohen SJ, Christen AG, Katz BP. Counselling medical and dental patients about cigarette smoking: the impact of nicotine gum and chart reminder. Am J Public Health 1987, 77:313–316.
21. Colton T. Statistics in medicine. Boston: Little, Brown, 1974:164–165.
22. Rose G. Strategy of prevention: lessons from coronary heart disease. Br Med J 1981; 282:1847–1851.
23. Kottke TE, Solberg LI, Brekke ML. Doctors helping smokers: the development of a clinic based smoking intervention system. In: Tobacco and the clinician: interventions for medical and dental practice. NIH Publication No 94–3693. Bethesda, MD: National Institutes of Health National Cancer Institute, 1994.
24. Jack BW, Gans KM, McQuade W, Culpepper L, Lasswell A, Hume A, Dowling PT, Carleton RA. A successful physician training program in cholesterol screening and management. Prev Med 1991; 20:364–377.

Appendix 1 Components of Scores for Measures of Study Physicians' Patient Management and Dietary Counselling Behavior

Patient Management		Dietary Counselling	
Score	**Items**	**Score**	**Items**
Diet	Diet discussed	Cholesterol	Cholesterol discussed generally
(max = 5)	Diet prescribed	(max = 7)	Patient cholesterol discussed
	Diet reviewed		Discussed lowering cholesterol generally
	Diet revised		Discussed lowering with diet/drugs
	Referral to dietitian		Discussed other lowering methods
			Printed information on cholesterol given
Exercise	Exercise discussed		
(max = 4)	Exercise prescribed	Diet	Discussed dietary change
	Exercise reviewed	(max = 7)	Diet advice given — dairy
	Exercise revised		Diet advice given — meat/poultry
			Diet advice given — cooking
Practices smoking	Smoking discussed		Diet advice given — saturated fats
(max = 1)			Diet advice given — unsaturated fats
			Diet advice given — other
		Exercise	Discussed exercise
		(max = 2)	Exercise advice given
Total score	Diet + exercise + smoking	Total score	Cholesterol + diet + exercise
(max = 10)		(max = 16)	