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The effect of cholesterol-related knowledge on patients' ability to reach target cholesterol levels

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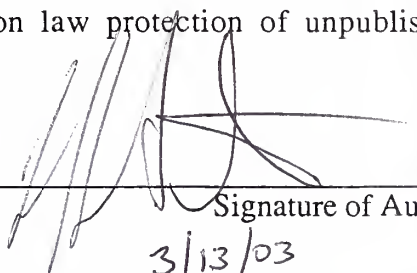

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The Effect of Cholesterol-related Knowledge on Patients' Ability to Reach Target Cholesterol Levels

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Jeffrey A. Seiden

2003

THE EFFECT OF CHOLESTEROL-RELATED KNOWLEDGE ON PATIENTS' ABILITY TO REACH TARGET CHOLESTEROL LEVELS.

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The purpose of this study is to determine whether patients with coronary artery disease (CAD) are more likely to reach their target cholesterol levels if they possess an understanding of cholesterol's relationship to heart disease. Utilizing a patient population with known CAD who were admitted to the hospital for a cardiac event or preventive intervention, we analyzed subjects' baseline responses to the open-ended question, "What can you tell me about the relationship of cholesterol to heart disease?" Patients were divided into one of two groups based on their responses: one with knowledge, Group A (n=561), and one without knowledge, Group B (n=177). Using bivariate and multivariate statistical analysis, we determined that age ≥65 years and lack of any college education were independent predictive factors for lacking sufficient cholesterol-related knowledge, as defined in this study. Further analysis demonstrated that patients in Group A were more likely to reach their target level for low-density lipoprotein (LDL) after one year of follow-up (71.4% in Group A versus 58.3% in Group B, p=0.003). In addition, those patients in Group A were more likely to reach their target for all cholesterol parameters (total cholesterol, LDL, and high-density lipoprotein (HDL)) after one year (49.9% versus 40.4%, respectively, p=0.04). These results indicate that while educational efforts after hospitalization for CAD may be effective in increasing target compliance, not all patients respond equally to such interventions. A baseline understanding of cholesterol and its relationship to cardiac disease is predictive for success in reaching one's cholesterol target values one year after hospital admission. Efforts by primary care physicians, especially directed toward those patients over 65 years old and those without any college education, may help improve the population's baseline understanding of cholesterol, thus leading to improved outcomes in patients diagnosed with CAD.

Acknowledgements

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Introduction

For nearly twenty years, elevated plasma cholesterol has been considered a significant risk factor for coronary artery disease (CAD), thus contributing greatly to the leading cause of mortality in the United States. In 1985, the National Heart, Lung, and Blood Institute (NHLBI) created the National Cholesterol Education Program (NCEP) in an attempt to increase the American population's awareness of cholesterol, in addition to improving the treatment and control of elevated cholesterol levels.(1,2) Since the launch of such initiatives, several studies have investigated their efficacy in improving cholesterol-related knowledge and hypercholesterolemia control in the population. These studies, which relied on knowledge surveys of the general adult population, demonstrated a significant improvement in the awareness of high blood cholesterol and its negative health effects.(3,4)

There has been no published research regarding cholesterol knowledge among patients with known CAD. In 1994, the NCEP published its second Adult Treatment Panel goals, which outlined recommendations for the control of blood cholesterol levels in patients with established CAD.(5) Allison *et al.*, however, found that only 39% of patients with known CAD were reaching their target for low-density lipoprotein (LDL) cholesterol levels.(6) Many variables have been investigated as independent factors in a patient's ability to reach the target cholesterol level. Drug therapy, diet, and exercise have all been shown to be significant in determining a patient's success in achieving this goal.

There has been very little investigation in the area of cholesterol knowledge and its link to achieving target cholesterol levels. This is an important and clinically

significant question, since compliance with target cholesterol levels, especially in patients with known CAD, is so poor. Many studies have demonstrated the importance of diet, exercise, and lipid-lowering medications in reducing the risk of adverse cardiac events. Primary care physicians have focused on these factors in their attempts to lower their patients' cholesterol levels. They have had some degree of success in these efforts, though it is clear that there is much room for improvement. Indeed, some research in other areas has demonstrated that the effectiveness of a patient's attempt to alter his lifestyle or behavior depends at least partially on the physician's ability to help build a foundation of knowledge and attitudes that is conducive to change.(7,8) Therefore, a focus on improving patients' knowledge and understanding regarding cholesterol and its role in heart disease may assist in increasing the percentage of patients that reach their target cholesterol level. As a result, fewer patients will experience adverse cardiac events, and fewer preventive interventions, e.g. CABG or PTCA, will need to be performed.

The Reinforcing Education About CHolesterol (REACH) trial was designed to assess the efficacy of a nurse-based educational intervention in increasing the percentage of patients with known CAD whose LDL levels meet the target established by the NCEP. This randomized control trial demonstrated that the educational intervention did not significantly improve patient compliance with LDL targets after one year of follow-up. However, awareness of LDL targets did improve in the intervention group compared to the control group (19.6% vs. 6.7%, p=0.001).(9) General knowledge regarding cholesterol and heart disease was not assessed in this study. One question raised by this study is whether awareness of one's goal needs to be paired with an understanding of

why lowering one's cholesterol is important in preventing heart disease. The patients enrolled in the REACH trial were interviewed at baseline to assess their knowledge regarding cholesterol and its relationship to heart disease.

The goal of this project is to determine whether patients with CAD are more likely to reach their target cholesterol levels if they possess an understanding of cholesterol's relationship to heart disease. Using the patient population and the data collected in the REACH trial, patients' cholesterol-related knowledge will be analyzed as an independent predictive factor in their ability to reach their target levels for blood cholesterol. Results of this study may emphasize the importance of patient education in the effort to lower patients' blood cholesterol levels.

Purpose and Hypothesis

The purpose of this study is to assess whether patients with CAD are more likely to reach their target cholesterol levels if they possess an understanding of cholesterol's relationship to heart disease. This project will determine if knowledge level is an independent predictive factor for reaching target cholesterol levels. Results of this study may emphasize the importance of patient education in the effort to lower patients' blood cholesterol levels.

Our hypothesis is that patients with greater cholesterol-related knowledge are more likely to reach their target cholesterol level as set by the NCEP Adult Treatment Panel.

Methods

Study Subjects

Subjects for this study were those enrolled in the REACH trial. Between December 1998 and January 2000, consecutive medical patients admitted to Yale-New Haven Hospital (YNHH) were screened for participation in the study. Within 24 hours of admission, patients were evaluated for evidence of CAD, which was defined as a current or past diagnosis of an acute myocardial infarction (AMI), current or past coronary artery bypass grafting (CABG), current or past percutaneous coronary intervention (PCI), or coronary artery stenosis ≥70% as documented by cardiac catheterization. Exclusion criteria included: age ≤30years or ≥80 years, out-of-state residence, terminal illness, contraindications to treatment with lipid-lowering medication, residence in a long-term care facility, and/or any condition precluding informed consent or the ability to be interviewed. Of the 2657 consecutive patients screened, 1469 (52%) were deemed ineligible by the above criteria. Another 432 patients were not enrolled due to their refusal or discharge prior to being interviewed by research staff. Of the 756 patients enrolled in the study, we excluded from this analysis 16 patients aged ≥80 years, who were inadvertently enrolled in the REACH trial, as well as 2 patients whose baseline interviews were missing and could not be reviewed. The institutional review board of the Yale University School of Medicine approved the study, and all participants gave written informed consent for their participation in the study.

Data Collection

Patients enrolled in the REACH trial were interviewed by trained research staff a mean of 3.7±3.4 days after admission. The standardized interview was designed to assess

each patient's knowledge, attitudes, and behaviors related to cholesterol and CAD. In addition, we inquired about socioeconomic status as measured by education level, employment status, and occupation. Demographic and clinical data, such as medical history, diagnostic tests and procedures, surgical interventions, laboratory data, and medications, were collected from each patient's medical record from the index admission. Serum lipid samples were drawn upon enrollment and were analyzed by the YNHH laboratory, providing measures of triglyceride, total cholesterol, and high-density lipoprotein (HDL) levels. Those patients who had undergone CABG surgery did not have baseline serum lipid levels drawn, since they would be artificially low after surgery. At the time of each patient's one-year follow-up appointment, whole blood samples were taken using the fingerstick technique and analyzed by the Cholestech LDX System to provide follow-up data for the above measurements. All LDL levels were calculated using the Friedewald formula. Patients with triglyceride levels ≥400 mg/dl did not have LDL levels calculated.

Cholesterol Knowledge Measures

During the baseline interview, all patients were asked, "What can you tell me about the relationship of cholesterol to heart disease?" Patients' responses tended to fall into one of two categories; some patients explicitly addressed the role of high cholesterol as a risk factor for heart disease, while others responded by explaining the mechanism by which cholesterol leads to heart disease (e.g. "cholesterol clogs the arteries of the heart"). Responses in each of these categories were deemed to be equally valid and correct answers to the question. As a result, responses were evaluated and scored based on these two parameters: the understanding of high cholesterol as a risk factor for adverse cardiac

events and the understanding of the mechanism by which cholesterol causes CAD and heart disease.

For this analysis, subjects were divided into two groups, one with knowledge (Group A) and one without knowledge (Group B) regarding cholesterol and its relationship to heart disease. As illustrated in Figure 2, Group A was defined as those subjects who demonstrated an understanding of either risk or mechanism as described above, while Group B was defined as those subjects who demonstrated an understanding of neither risk nor mechanism.

Patients were also asked during the baseline interview to report the importance of cholesterol control utilizing the question, "Considering all of the things that are going on in your life, how important of a priority to you is taking care of your cholesterol level?" Subjects were given the choices: extremely important, very important, important, not very important, or not important at all.

Target Cholesterol Levels

Target cholesterol levels used in the analysis for this study were taken from the NCEP Adult Treatment Panel II recommendations for patients with established CAD: LDL cholesterol ≤100 mg/dL, HDL cholesterol >35 mg/dL, and total cholesterol <200 mg/dL. (5)

Statistical Analysis

Statistical analysis was performed primarily by Susan Cheng. We used chi-square tests to evaluate bivariate associations between each dependent variable and patient demographic and clinical characteristics. Based on clinical relevance and the results of bivariate analyses, relevant characteristics (e.g. age ≥65 years, less than college

education, priority < very important) were selected and entered into a logistic regression model. To assess the independent relationship of each characteristic with the different cholesterol knowledge components, a separate model was constructed for each variable. Statistical analyses were conducted with SAS statistical software, version 8.01 (SAS Institute Inc., Cary, NC).

Results

As illustrated in Figure 1, 738 patients from the REACH trial were divided into two groups. Group A, those patients with knowledge about cholesterol, comprised 74.2% of the 756 subjects enrolled in REACH, while Group B, those patients without knowledge about cholesterol, comprised 23.4%. 18 patients (2.4%) enrolled in the REACH trial were not analyzed for this study.

Cholesterol-related Knowledge

Table 1 displays selected demographic information for each of the study groups. Patients in Group B were older than those in Group A (mean age 65.3 ± 9.8 versus 62.7 ± 9.6 respectively, p=0.0014) and were more likely to be over 65 years old (59.9% versus 46.7%, p=0.002). Members of Group B were also more likely to be non-white (14.3% versus 8.24%, p=0.018). While mean years of education were similar in both groups (13.8 ± 3.2 in Group A versus 12.3 ± 3.3 in Group B, p=0.069), the proportion of patients who attended college for any amount of time was significantly greater in Group A than in Group B (53.9% versus 35.9% respectively, p=0.001). Both groups were similar with respect to gender (27.3% women in Group A versus 34.5% women in Group B, p=0.066). Participation in the REACH trial should not have any differential effect on the two groups for this study, since a similar proportion of each were randomized to the

intervention arm of the REACH study (51% in Group A versus 44.6% in Group B, p=0.141).

As shown in Table 2, patients were similar in their cardiac risk factors, defined by the NCEP as older age (men ≥45, women ≥ 55), history of hypertension, history of diabetes mellitus, current smoker, and HDL ≤35 mg/dL. Those with cholesterol knowledge (Group A) were more likely to have had a recent cholesterol test (84.6% versus 72.5%, p=0.001), and they were also more likely to be taking a lipid-lowering agent (56.1% versus 41.2%, p=0.001). In addition, patients in Group A were more likely to report that cholesterol management was "extremely important" or "very important" in their lives (75.5% versus 59.9% in Group B, p=0.001).

Multivariate analysis, illustrated in Table 3, showed that patients aged 65 years or older (OR 0.62, 95% CI 0.43-0.90), patients without any college education (0.68, 0.46-0.99), patients not taking a lipid-lowering medication (0.66, 0.45-0.96), and those who rated cholesterol management less than "very important" (0.58, 0.32-0.89) were less likely to exhibit sufficient cholesterol-related knowledge.

Cholesterol Target Compliance

As Table 4 demonstrates, Groups A and B had similar blood cholesterol levels (total cholesterol, HDL, and LDL) at baseline. For one year after their index admission, all patients in the REACH trial received some degree of education regarding cholesterol and heart disease. Those in the control group received the usual and standard care, defined by YNHH protocol, which included standard patient education materials, a baseline assessment of lipid status, referral to a dietician, and written discharge instructions. Further, all patients were given a written summary of their current

cholesterol levels, their recommended target levels, and a list of strategies for overall risk modification. Those patients randomized to the REACH intervention group experienced a more intensive nurse-based educational intervention, including frequent telephone contacts and monthly mailings.(9) At the end of one year, Table 5 shows that patients in Group A had lower LDL levels (89.1 ± 32.4 versus 95.5 ± 35.2 respectively, p=0.04). Values for total cholesterol and HDL were similar between both groups after one year.

Figure 3 illustrates that a similar proportion of each group was in compliance with the NCEP target for LDL (46.5% in Group A versus 46% in Group B, p=0.928) at baseline. After one year, however, patients in Group A were significantly more likely to meet their LDL target (71.4% versus 58.3% respectively, p=0.003). When measured at baseline, the proportion of patients in each group who met the target values for all parameters (total cholesterol, HDL, and LDL) was similar (29.1% in Group A versus 20% in Group B, p=0.117), as shown in Figure 4. Again though, after one year, patients in Group A were significantly more likely to be in compliance with all cholesterol targets (49.9% versus 40.4% respectively, p=0.04). Multivariate analysis further indicated that not having sufficient cholesterol knowledge was a risk factor for failing to meet one's cholesterol targets at one year, independent of other variables such as age and education (OR for meeting target 0.60, 95% CI 0.42-0.87). In addition, female gender was also determined to be an independent predictive factor for failing to reach target (OR for meeting target 0.52, 95% CI 0.37-0.73).

Discussion

Among those with known CAD, our study demonstrates that 76% of patients possess an understanding of cholesterol and its relationship to heart disease. These

results may reflect the increase in cholesterol knowledge among the general population since the inception of the NCEP in 1985.(3,4) Though several studies have previously characterized patients' knowledge of their personal cholesterol levels and targets,(4,10) this study attempts to measure patients' knowledge of the association of elevated blood cholesterol with heart disease. The process of quantifying an inherently qualitative variable brings with it some degree of subjectivity, which may illustrate one limitation in considering the results of this study. Given that, however, our results demonstrate some important differences between those patients with sufficient cholesterol-related knowledge and those without such knowledge.

Our findings suggest that elderly patients (age 65 years or older) and those without any college education are significantly less likely to possess cholesterol knowledge (Table 3). These results echo the work of Cheng *et al.*, which demonstrated that these same patient characteristics are also predictive for failing to know one's cholesterol targets.(10) Additionally, patients with known CAD who were not taking lipid-lowering medication, as well as those that did not report cholesterol management as being at least "very important," were also less likely to understand the relationship of cholesterol and heart disease. Though previous work has shown that males and whites have significantly higher knowledge regarding personal cholesterol levels,(11,12,13) our results did not support such findings. Previous studies suggest that patient knowledge is important in achieving success in changing health-related behaviors and lifestyles.(7,8) Thus, identifying patient populations that are likely to lack sufficient cholesterol-related knowledge may provide physicians with the ability to target educational efforts efficiently.

Despite increased understanding of cholesterol and heart disease, we found no significant difference in cholesterol target compliance between knowledgeable patients and their counterparts at baseline (Table 4). These findings suggest that knowledge alone does not predict lower cholesterol levels. Lifestyle and behavior modifications such as weight loss, diet, and exercise are central to the success of patients' reaching their cholesterol goals. Knowledge and understanding may play a role in a patient's motivation to make these changes. Therefore, one may posit that an increased level of understanding at baseline will prepare a patient for the education offered by the physician with respect to lifestyle modifications, personal cholesterol levels, and targets.

Our results demonstrate that after one year, those patients with an understanding of cholesterol (Group A) were more likely to reach their target levels for LDL cholesterol (Figure 3). While both groups had similar LDL compliance at baseline (46% versus 46.5%, p=0.928), 71.4% of Group A reached their target after one year, while their counterparts in Group B had only 58.3% compliance with their LDL target (p=0.003). Similarly, patients with knowledge were more likely to meet *all* of their cholesterol targets (LDL, HDL, and total) after one year than those without knowledge, despite having similar compliance with all targets at baseline (Figure 4).

All subjects in this study, whether randomized to the REACH intervention group or to the REACH control group, were offered substantial guidance and education regarding CAD and cholesterol management after their index hospital admission. Ultimately, the aim of such time-intensive efforts by physicians is to improve their patients' medical outcomes. Though one year was not a sufficient time to measure our

subjects' medical outcomes, we used cholesterol target compliance as our endpoint because these targets are believed to have value in predicting positive outcomes.(2)

The results of our study demonstrate that, while education and guidance appear to be beneficial for all patients with CAD, those patients who possess a baseline understanding of cholesterol and heart disease are more likely to translate such educational interventions into lifestyle changes that result in lower blood cholesterol levels. This underscores the importance of physician-patient interactions, especially in the primary care setting. In addition to the education provided by specialists once a referral has been made, patients need to be educated about their health and risk factors for disease *prior* to experiencing an adverse event. As our results demonstrate, those patients that do receive such education are more receptive to further improvements in cholesterol management.

Since intensive educational efforts by primary care physicians are quite time-consuming, it is important for physicians to be able to predict which patient populations are more likely to need such interventions. Demographically, our study suggests that elderly patients (age ≥65 years) and those without any college education are more likely to lack sufficient cholesterol knowledge (Table 3). Therefore, physicians might choose to focus their educational efforts on such patient populations. While patients who were not taking a lipid-lowering medication were also less likely to have cholesterol knowledge, this finding might be explained by the requisite education that is offered to patients by physicians upon beginning a new medication. Our findings also confirm that patients' attitudes toward their health is important in predicting their understanding of cholesterol. Not surprisingly, patients with CAD who do not view cholesterol management as at least

"very important" are less likely to understand the relationship between cholesterol and their disease. Again, this emphasizes the role of primary care physicians in addressing patients' attitudes towards their health via education and guidance regarding the modifiable risk factors for cardiac disease.

In conclusion, compliance with cholesterol targets is quite poor among patients with known CAD, despite high cholesterol's status as a major modifiable risk factor for cardiac disease. Educational efforts after hospitalization for CAD may be effective in increasing target compliance, though not all patients respond equally to such interventions. A baseline understanding of cholesterol and its relationship to heart disease is predictive for success in reaching one's cholesterol target values one year after hospital admission. Elderly patients and those without any college education, as well as individuals for whom cholesterol management is not a high priority, are less likely to possess this baseline understanding. More focused educational efforts and health guidance by primary care physicians may be effective in increasing cholesterol knowledge in patients at high risk for cardiac disease, which may result in improved cholesterol management and better medical outcomes for patients diagnosed with CAD.

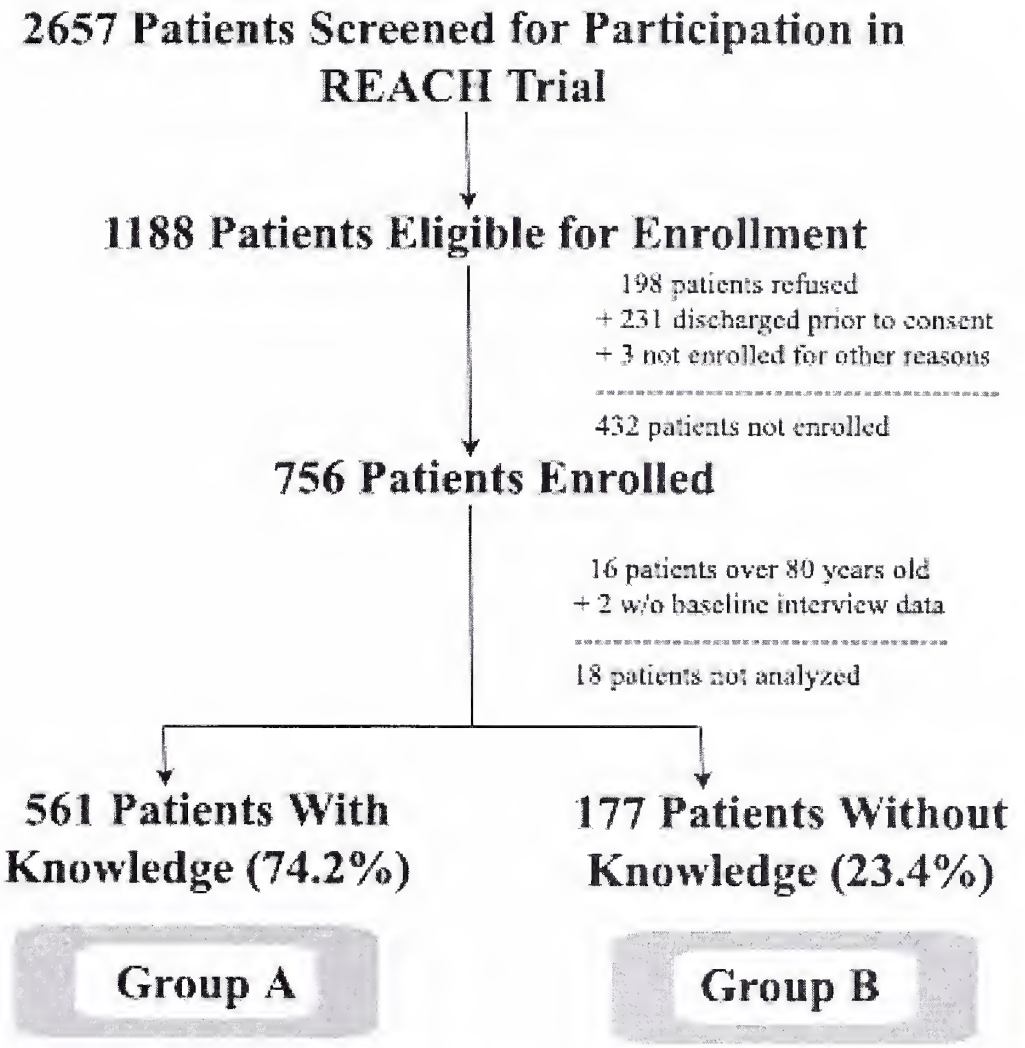

Figure 1. Subjects from the REACH trial were divided into two groups for the purposes of this study. REACH = Reinforcing Education About CHolesterol.

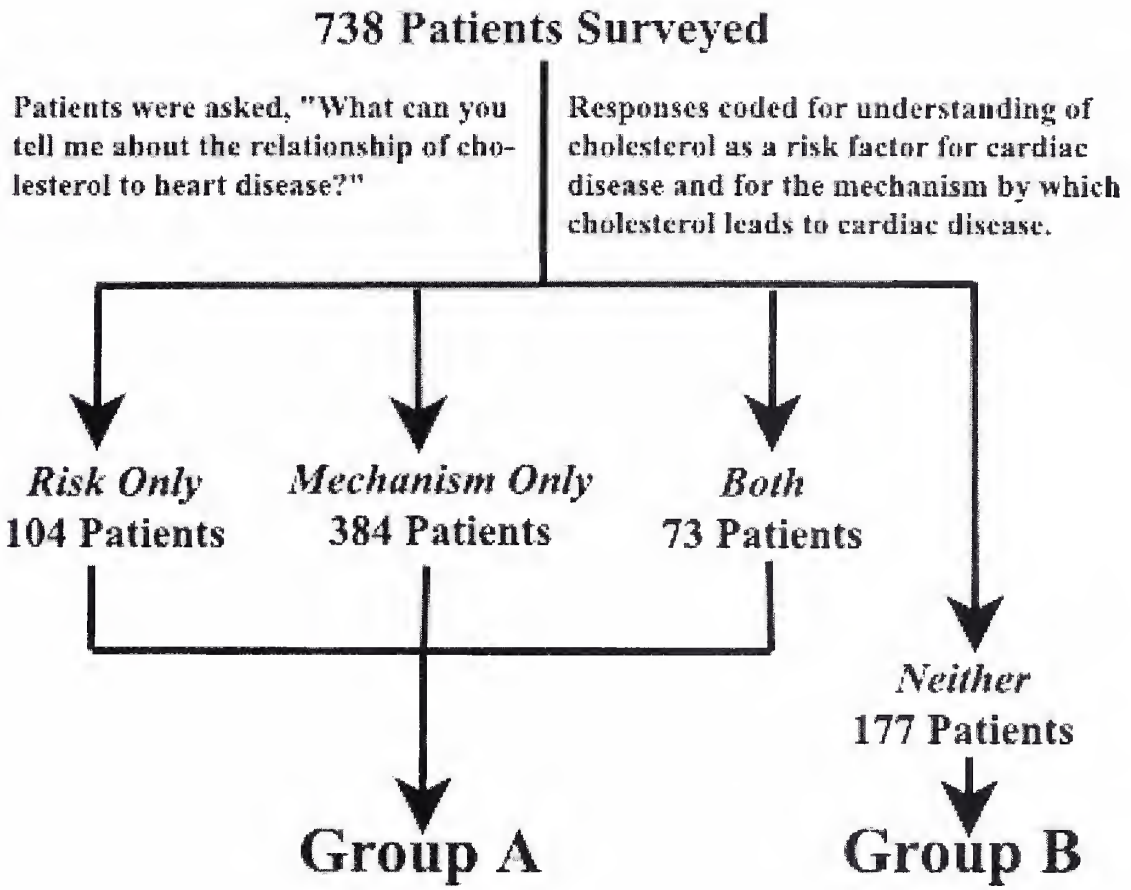

Figure 2. Subjects were divided into two groups based upon their understanding of cholesterol as it relates to heart disease. Those who understood the mechanism by which cholesterol leads to heart disease, as well as those that stated that cholesterol was a risk factor for heart disease, were placed into Group A (+ knowledge). Those that understood neither risk nor mechanism were placed into Group B (- knowledge).

Table 1. Sample Demographics

	Group A	Group B	*p* value
No. of Patients (% of sample)	561 (76.0)	177 (24.0)	
Age (yrs)	62.7 ± 9.6	65.3 ± 9.8	0.0014
Age ≥65 years (%)	46.7	59.9	0.002
Women (%)	27.3	34.5	0.066
Non-white race (%)	8.24	14.3	0.018
Education (yrs)	13.8 ± 3.2	12.3 ± 3.3	0.069
Any college education (%)	53.9	35.9	0.001
REACH Intervention[A] (%)	51	44.6	0.141

A = Patients randomized to the educational intervention in the Reinforcing Education About Cholesterol trial

Table 2. Cholesterol-related Characteristics at Baseline

	Group A	Group B	*p* value
Had Cholesterol Measured in Past 6 months (%)	84.6	72.5	0.001
On Lipid-Lowering Meds (%)	56.1	41.2	0.001
≥2 Cardiac Risk Factors (%)	81.1	84.8	0.272
Self-reported Priority[A] (%)			
Extremely or Very Important	75.5	59.9	0.001
Less than Very Important	24.5	40.5	

A = Patients' responses to the question, "Considering all of the things that are going on in your life, how important of a priority to you is taking care of your cholesterol level?" Answer choices were: Extremely important, Very important, Important, Not very important, or Not important at all.

Table 3. Associations Between Selected Characteristics and Cholesterol Knowledge

	Had Cholesterol Knowledge		
Patient Characteristic	**Adjusted OR**	**95% CI**	***p* value**
Age ≥65 years	0.62	0.43 – 0.90	0.011
Female	0.93	0.63 – 1.38	0.720
Non-white race	0.68	0.32 – 1.16	0.158
Less than College Education	0.68	0.46 – 0.99	0.044
No Recent Cholesterol Test	0.72	0.47 – 1.11	0.136
Not on Lipid-Lowering Med	0.66	0.45 – 0.96	0.032
Cholesterol Mgmt less than Very Important[A]	0.58	0.32 – 0.89	0.014

A = Patients who self-reported the priority of cholesterol management to be "important," "not very important," or "not important at all," rather than "extremely important" or "very important."

Table 4. Baseline Cholesterol Levels

	Group A	Group B	*p* value
Total Cholesterol (mg/dL)	180.0 ± 45.0	179.3 ± 47.3	0.905
HDL Cholesterol (mg/dL)	40.7 ± 11.6	39.3 ± 11.9	0.362
LDL Cholesterol (mg/dL)	105.6 ± 37.7	104.0 ± 36.3	0.754
LDL at Target (%)	46.5	46	0.928
All levels at Target[A] (%)	29.1	20	0.117

A = Patients whose total cholesterol, HDL, and LDL meet the target value

Table 5. Follow-up Cholesterol Levels at One Year

	Group A	Group B	*p* value
Total Cholesterol (mg/dL)	164.7 ± 40.9	170.9 ± 43.6	0.111
HDL Cholesterol (mg/dL)	43.6 ± 14.0	43.4 ± 13.9	0.873
LDL Cholesterol (mg/dL)	89.1 ± 32.4	95.5 ± 35.2	0.04
LDL at Target (%)	71.4	58.3	0.003
All levels at Target[A] (%)	49.9	40.4	0.04

A = Patients whose total cholesterol, HDL, and LDL meet the target value

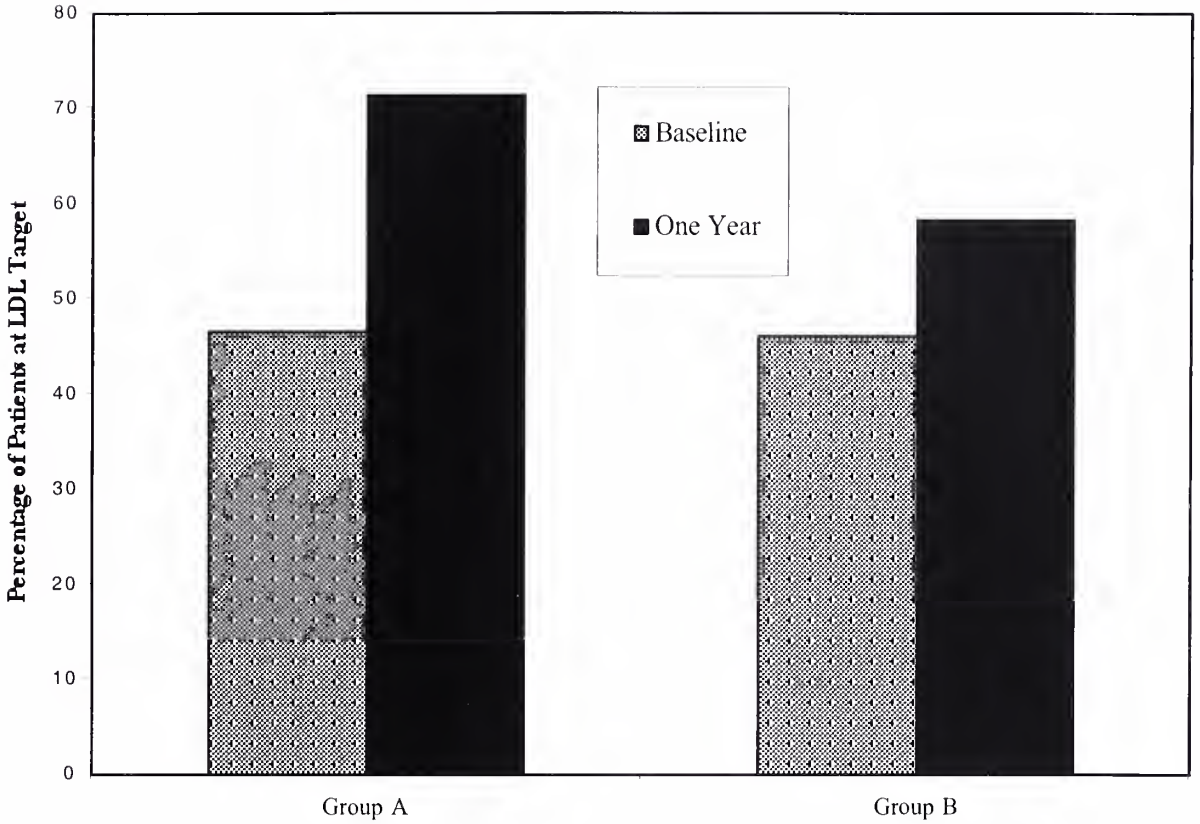

Figure 3. LDL Target Compliance

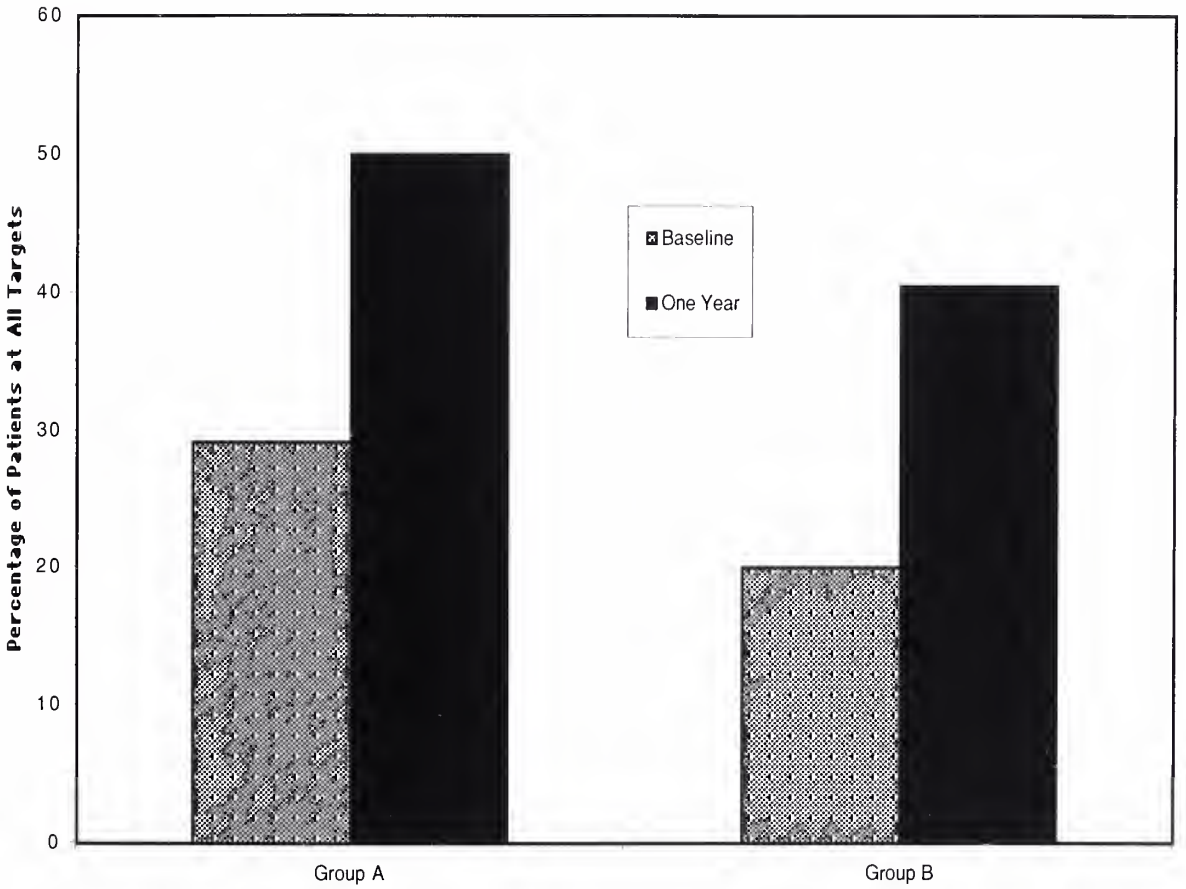

Figure 4. Cholesterol Target Compliance for HDL, LDL, and Total Cholesterol

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