

EDITORIALS

Benefits of Cholesterol Screening and Therapy for Primary Prevention of Cardiovascular Disease: A New Paradigm

One third of the approximately 1.5 million Americans who will experience a myocardial infarction (MI) in the United States this year will die; survivors will have serious morbidity, including congestive heart failure, arrhythmias, and an increased risk of sudden cardiac death.¹ Thus, the prevention of coronary heart disease (CHD), before its clinical manifestations, is an important public health issue. Cholesterol screening is firmly established as an effective strategy for CHD prevention because lipid-lowering therapy for patients with hypercholesterolemia reduces cardiac morbidity and mortality.²⁻⁶

In this issue of the *Journal*, Froom et al argue that lipid-lowering therapy for the primary prevention of cardiovascular events is unwarranted "with the possible exception of men aged 35 to 59" years.⁷ They criticize the National Cholesterol Education Program (NCEP) guidelines, especially in regard to primary prevention recommendations for women, young men, and elderly patients.^{2,7} They reached their conclusions by (1) an admittedly selective review of data from five major primary prevention trials, (2) a misleading interpretation of the results of the West of Scotland Coronary Prevention Study (WOSCOPS), and (3) reliance on selected observational studies of cholesterol levels and CHD risk in women and older patients.⁷

It is crucial to clarify some of the misrepresentations of Froom et al regarding cholesterol screening and lipid-lowering therapy in patients without CHD. We maintain that a scientifically rigorous overview of the results of all the primary prevention trials that takes into consideration the

results of several recent, prospective, randomized, clinical trials renders criticisms of the older studies irrelevant.^{4,8,9} Many of the trials cited by Froom et al studied lipid-lowering therapies that are no longer used except in life-threatening situations (clofibrate) or are unavailable for clinical use (probucol). More recent clinical trials, which used more potent and safer agents, validated the rationale behind the NCEP recommendations for cholesterol screening and strongly reinforce the NCEP guidelines for the primary prevention of CHD events.^{2,4,8-10}

Based on the results of these studies, a new paradigm for preventive cardiology has emerged. This paradigm suggests that patients should be treated based on the magnitude of their cardiovascular risk rather than their demographic characteristics. In clinical practice this means that all high-risk patients, including women and appropriate older patients, should be treated before they develop CHD, the disease most likely to cause death and disability for both men and women in the United States.^{1,2}

Evidence-based medicine requires a comprehensive evaluation of the literature, using generally accepted overview or meta-analysis techniques.¹¹ Rigorous reviews of the effects of lipid-lowering therapy on CHD morbidity and mortality rates have established the effectiveness and safety of treating high-risk persons to prevent cardiac events.^{3,12,13} The Froom et al article is an opinion piece that is selective in its use of the medical literature. It does not use a standard review methodology and neglects several important primary prevention trials, including trials with substantial numbers of female participants.^{3,8,14} Based on all of the available clinical trial data, the most recent estimates of the benefits of cholesterol reduction indicate a 37 percent reduction in the risk of cardiac deaths (RR = 0.63, 95 percent confidence interval [CI] 0.45-0.89) and a 26 percent reduction in overall mortality (RR = 0.74, 95 percent CI = 0.58-

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0.95) by statins, without important increases in noncardiovascular diseases or mortality, including cancer.³ A recent review of lipid-lowering therapy for primary prevention indicated that a 10 percent reduction in total cholesterol levels resulted in a 25 percent reduction in CHD events within 5 years (95 percent CI 15-35 percent).¹³

To illustrate this point, it is useful to evaluate the landmark primary prevention trial that used one of the more potent lipid-lowering agents (pravastatin). WOSCOPS⁴ enrolled 6595 men between the ages of 45 and 64 years, without antecedent cardiovascular events, but with total cholesterol levels greater than 252 mg/dL. Those who had a low-density lipoprotein (LDL) cholesterol level greater than 155 mg/dL after 4 weeks of dietary therapy were randomized to receive either placebo or pravastatin (40 mg daily at bedtime) and were observed for 5 years. The primary endpoint of nonfatal MI or CHD death was reduced by 31 percent (95 percent CI 17-43 percent, $P < 0.001$). Similar reductions in death rates from all cardiovascular causes (32 percent, $P = 0.033$) and the need for coronary revascularization procedures (37 percent, $P = 0.009$) were observed. All-cause mortality was reduced by 22 percent (95 percent CI 0-40 percent, $P = 0.051$).

Froom et al emphasize that the P value for all-cause mortality in WOSCOPS (0.051) did not cross the traditional threshold for statistical significance (0.05) and state that all-cause mortality was unaffected.⁷ This conclusion misinterprets and artificially constrains the meaning of P values reported in clinical trials. A more accurate interpretation of the mortality reduction observed in WOSCOPS reflects the 95 percent confidence limits surrounding the 22 percent risk reduction observed in this study (95 percent CI 0-40 percent).⁴ WOSCOPS was able to show, with 94.9 percent certainty, that pravastatin either did not affect all-cause mortality or reduced it by up to 40 percent. In clinical terms, at a minimum, pravastatin therapy was safe and did not increase mortality; most likely it reduced all-cause mortality.

By multivariate analysis and adjustment for baseline variables, the mortality reduction observed in WOSCOPS was 24 percent, with a statistically significant P value (0.037).¹⁵ Analysis of the WOSCOPS patients who took at least three fourths of the prescribed medication indicated that pravastatin reduced all-cause mortality by 32 per-

cent ($P = 0.015$).¹⁶ To evaluate WOSCOPS primarily on all-cause mortality, which was not the primary endpoint of the trial, ignores the dramatic reduction in morbidity that was associated with the undeniable benefits of pravastatin in regard to preventing nonfatal MIs, CHD death, and coronary revascularization procedures in a relatively low-risk population (placebo event rate 9.3 percent).⁴

Although reluctant to ascribe any mortality-reducing benefit to cholesterol therapy in WOSCOPS because of a 0.001 variance from 0.05, Froom et al feel comfortable criticizing the Helsinki Heart Study and the Lipid Research Clinics Coronary Primary Prevention Trial for "nonsignificant increases" in noncardiac illnesses.⁷ Such selective use of evidence is statistically inappropriate and very misleading.

The benefits of primary prevention in WOSCOPS and other trials compare favorably with those of other common, highly effective primary and secondary preventive therapies such as aspirin, β -blockers, lipid-lowering therapy, and estrogen replacement therapy (Table 1).^{4-6,17-22} In a follow-up report from the WOSCOPS investigators, the benefit of pravastatin therapy for primary prevention of CHD events was compared with the benefit obtained by lipid-lowering for secondary prevention of CHD events and blood pressure-lowering therapy for stroke prevention in mildly to moderately hypertensive middle-aged men in the Medical Research Council trial.^{14,18} After 5 years of therapy, two to four times fewer middle-aged men with hypercholesterolemia needed to be treated with pravastatin to prevent one first CHD event than needed to be treated with a β -blocker or diuretic to prevent one stroke.

From a clinical practice standpoint, two important issues remain: (1) whether the magnitude of the benefits obtained by lipid-lowering therapy are clinically relevant given the relatively low placebo event rates in the primary prevention trials, and (2) whether similar benefits could be expected in subgroups of patients who would not have qualified for these studies (ie, nonwhites, women, older adults). The answers to these questions have important implications for health care policy, because the screening and treatment of all hypercholesterolemic patients might not be desirable or economically feasible.

The discussion of hyperlipidemia and CHD events in women and older patients by Froom et al

Table 1. Numbers Needed to Treat (NNT) to Prevent One Adverse Medical Outcome.

Therapy	Adverse Event	Population	Years	NNT
<i>Primary Prevention</i>				
Estrogen ¹⁷	Hip fracture	Postmenopausal women ≥ 60 y	10	488
	MI	Postmenopausal women ≥ 50 y	10	106
Bendrofluazide ¹⁸	Stroke	35-64 y	5	167
Propranolol		Men, 55-64 y	5	91
Aspirin ¹⁹	MI	Men ≥ 50 y	5	63
Pravastatin ^{4,14,15}	Nonfatal MI/CHD death	Men, 45-64 y	5	40
		Men, 45-64 y, HDL ≤ 43 mg/dL	5	33
		Men, 45-64 y, smokers	5	29
<i>Secondary Prevention</i>				
Pravastatin ^{5, 20, 21}	Nonfatal MI/CHD death	Cholesterol < 240 mg/dL plus CHD	5	33
		Women	5	16
		≥ 65 years old	5	*
Propranolol ^{17, 22}	MI	Post-myocardial infarction	2	17
Simvastatin ^{6,28,29}	Nonfatal MI/CHD death	Cholesterol 212-309 mg/dL plus CHD	5	13
		Women	5	14
		≥ 65 years old	5	10

NNT - number needed to treat to prevent one clinical event during the time period specified, MI - myocardial infarction, CHD - coronary heart disease, HDL - high-density lipoprotein.

*32% relative risk reduction.

is limited to selected observational studies rather than a comprehensive or systematic literature review, and their conclusions are not based on the results of randomized clinical trials.

The main study findings Froom et al use to argue that cholesterol levels do not predict CHD in the elderly actually were based on a small sample (less than 35 percent) from a larger study of older patients.^{23,24} This small, incomplete study had several serious limitations, including the use of nonfasting cholesterol values and failure to account for regression-dilution bias, which could have obscured the association between cholesterol levels and clinical endpoints.²³ More important, the study included only 63 men (less than 16 percent) who had total cholesterol levels exceeding 240 mg/dL, so meaningful statements about hypercholesterolemia in older patients could not be made.²³ When all of the centers from the trial were evaluated and established risk factors for CHD and markers of poor health were adjusted for, elevated total cholesterol levels strongly predicted the risk of death from CHD.²⁴ In addition, the risk of death from CHD increased in parallel to total cholesterol levels.²⁴ The apparent adverse health effects associated with low cholesterol levels were secondary to comorbidity and frailty,

which suggests that chronic illness caused low cholesterol levels and increased mortality, not the other way around.^{24,25}

The safety of statin medications in older patients and women is well-established.^{8,20,21,26-29} Indeed, the major lipid-lowering trials that included older patients and women showed clinical benefit equal to or exceeding the benefits obtained in younger, male patients.^{8,20,21,26-30} To deny the benefits of lipid-lowering therapy to dyslipidemic women, women with other risk factors for coronary artery disease, and older patients or to wait until they have a CHD event to begin treatment is to deny a potentially lifesaving therapy for high-risk patients. The new paradigm suggests that the decision to initiate lipid-lowering therapy depends on a patient's risk of experiencing a cardiovascular event, not merely their age, sex, cholesterol level, medical history, or family history as isolated risk factors. This approach strongly supports the NCEP guidelines, which are based on overall risk.²

The rationale for the NCEP recommendation to screen for dyslipidemias in young men, premenopausal women, and children from high-risk families is to detect an increased risk of CHD. Detecting increased risk in patients allows them to be counseled and to make informed decisions about

modifying life habits or receiving treatment before atherosclerotic vascular disease develops.^{2,31} This positive attitude toward the procurement and disclosure of prognostic medical information is diametrically opposed to unsubstantiated concerns of Froom et al about stigmatization and labeling.⁷ Adverse effects of being labeled as a result of knowing about high cholesterol levels have not been shown, but a serious failure of physicians to treat high-risk persons has been shown repeatedly.³¹⁻³³

Determining early which patients are at high risk also facilitates early intervention in the form of nutritional change, physical exercise, weight control, and health education. Coronary atherosclerosis begins in childhood, and it has been established that the total cholesterol level in the third decade of life predicts the rate of development of CHD during the following 30 to 40 years.^{30,34,35} It also is important to ascertain which children and families are at high risk to find out whether they have common genetic cholesterol disorders that are associated with premature CHD.³⁴ It is erroneous to assume that the risk associated with atherosclerosis which has taken decades to develop can be mitigated later in life by initiating therapy after a CHD event or a certain age threshold is reached. CHD event rates in patients receiving clearly effective secondary prevention therapies still remain unacceptably high.^{5,6} Waiting for the greater than 30 percent mortality rate associated with the first manifestation of CHD is simply unacceptable.

The cost effectiveness of preventive strategies is a complex issue that requires rigorous methodology, not the type of crude pencil-and-paper estimates presented by Froom et al, which only focused on retail medication and screening costs and did not determine actual costs related to clinical outcomes. In a more sophisticated analysis, the undiscounted cost of pravastatin in the WO-SCOPS primary prevention trial was approximately \$12,000 per year of life saved (PYOLS).³⁶ This cost compares quite favorably with other accepted public health interventions, such as medical therapy for severely hypertensive patients (\$20,000 PYOLS), the difference between tissue plasminogen activator and streptokinase for treatment of acute MI (\$22,000 PYOLS), and hemodialysis for chronic renal failure (\$35,000 PYOLS). A high-cost therapy might be acceptable if

a therapy is highly effective. The cost effectiveness of lipid-lowering therapy for high-risk persons has been established firmly.³⁷

The most effective strategies for disease prevention include population-based approaches that are low cost and low risk (eg, dietary modification, exercise), and selective targeting of high-risk individuals.^{2,37,38} Dietary and lifestyle modifications effectively reduce cholesterol levels and prevent CHD.^{2,38-41} As Americans have reduced their intake of saturated fats, total cholesterol levels steadily dropped from a mean level of 214 mg/dL to 203 mg/dL in approximately one decade.⁴¹ A population-based change from the current American diet to the NCEP nutritional recommendations would be expected to reduce average serum LDL cholesterol values by an average of 10 percent.^{31,32,40} More intensive therapy lowers LDL cholesterol levels even more dramatically and has been shown to reduce CHD events.^{40,42}

In summary, screening high-risk patients for cholesterol disorders and treating these disorders are safe strategies that reduce the incidence of CHD and its complications with consequent reductions in overall mortality rates. The veracity of this observation is supported by powerful data collected in prospective randomized clinical trials and comprehensive overviews of primary prevention trials.^{3,4-6,8,9,12} The magnitude and cost effectiveness of cholesterol therapy for the primary prevention of CHD events are greater than observed with several other accepted medical therapies.^{36,37}

The generalizability of the benefits of primary prevention strategies is firmly rooted in the understanding that we as physicians care for patients with composite levels of cardiovascular risk, not collections of individual risk factors and demographic characteristics. Concerns about overprescription of lipid-lowering medications are not borne out by the literature, where underutilization of preventive strategies has been the rule.³¹⁻³³ When evaluating the safety and efficacy of therapies for the prevention and treatment of common illness, such as CHD, it is crucial that appropriate and rigorous scientific methods are used, because of the far-reaching public health and clinical practice implications of inappropriate conclusions. It is time to move beyond selective, narrow opinions of preventive strategies and on to the new paradigm that, on the basis of a proper

and circumspect analysis of all of the available data, requires finding patients who are at high risk and providing treatment before they develop CHD and its complications. This not only is good science, it is good medicine.

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Process Instead of Prayer: Moving Toward Active Management of Patient Care

Physicians have traditionally been skeptical of practice guidelines and protocols in the belief that they are too rigid to be relevant to the ever-changing, highly variable world of medicine, in the faith that good, well-trained physicians will do the right thing, at least most of the time. Numerous articles in the recent literature, however, have shown that especially in preventive medicine, where the potent reinforcers of adverse outcomes are delayed and infrequent, faith and good intentions will not get the job done.

Preventive care must be institutionalized. Systems must be developed in each primary care practice to define a process that ensures that high-quality preventive care will be offered to all patients.

Leininger and colleagues,¹ in a report sponsored by the American Cancer Society, have re-

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