A Nurse-Based Pilot Program to Reduce Cardiovascular Risk Factors in a Primary Care Setting

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Objective: To evaluate the effectiveness of a nurse-based cardiovascular disease (CVD) risk factor reduction program among patients at a primary care outpatient clinic.

Study Design: Preintervention and postintervention longitudinal, prospective pilot study to evaluate patients' achievement of CVD risk factor reduction.

Patients and Methods: A total of 436 patients at a primary care clinic in suburban Minneapolis, Minnesota, were enrolled in 2 years; 286 patients were followed up with additional visits. The nurse intervention included comprehensive CVD risk assessment, patient education, and counseling. Algorithms guided the development of individualized care plans based on laboratory test values, blood pressure readings, tobacco use, and history of cardiovascular events. Physicians were consulted for serious changes in patients' medical conditions or for medication changes. Three measures were compared from baseline to the end of the program: blood pressure, low-density lipoprotein cholesterol levels, and tobacco use.

Results: Statistically significant reductions were achieved from baseline to the final nurse visit in systolic blood pressure (from 155.8 to 143.4 mm Hg), diastolic blood pressure (from 94.4 to 84.0 mm Hg), and dyslipidemia (low-density lipoprotein cholesterol, from 4.15 to 3.80 mmol/L [from 160 to 147 mg/dL]) ($P < .001$ for all). Of the 40 tobacco users who participated in the program, 12 discontinued use (30%).

Conclusions: This pilot study provides preliminary evidence of the effectiveness of a nurse-based CVD risk reduction program. Further study is needed to target high-risk patients and to compare results in the nurse intervention group with those in patients receiving usual care.

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Cardiovascular disease (CVD) is the most common cause of mortality in the United States (>950,000 deaths each year).[1] According to 1996 estimates, 12 million Americans have coronary heart disease, with approximately 7 million experiencing a myocardial infarction (MI) and more than 6 million having angina pectoris.[1] A high proportion of adults in the United States also have significant CVD risk factors. It is estimated that 25% to 30% of adults have hypertension (HTN),[2,3] 20% have high serum cholesterol levels,[3] and 23.5% smoke cigarettes.[4] There is also a significant amount of overlap in risk factors, with many patients who present with HTN also having dyslipidemia (DL).[5] Most of these patients go to their primary care physician for healthcare and thus present an opportunity for CVD management through medication and lifestyle changes.

It is well known that exercising regularly, quitting smoking, and eating a low-fat, high-fiber diet can significantly reduce the risk of developing CVD.[6-8] Cardiovascular disease can also be prevented by controlling HTN and DL.[9-11] Drug protocol and behavioral counseling have been shown to be effective in reducing HTN, DL, and smoking rates.[11-14] These treatments, however, are underused in the primary care setting, where only about half of all patients with HTN receive treatment, and only 29% are controlled.[15] Less than half of all patients with DL and known CVD undergo annual lipid testing, 39% take lipid-lowering drugs, and only 25% are controlled.[16,17] Less than half of all smokers report that their physicians have advised them to stop smoking.[18] Some problems with managing CVD risk factors in the primary care setting include underuse of effective medications, inadequate follow-up, and lack of time for patient education and counseling.

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Primary CVD intervention seeks to control risk factors before the occurrence of an adverse event, such as an MI. Several studies have evaluated nurse-based primary intervention programs for patients with CVD risk factors in primary care settings. Two large British studies, the Family Heart Study[19] and the OXCHECK Study,[20] found that nurse interventions in primary prevention programs only modestly reduced coronary risk factors, thus raising the question of the cost-benefit ratio of a nurse CVD prevention program. A nurse-based community CVD primary prevention program conducted in Maine demonstrated reductions in mortality rates, but the program depended highly on continuous high-intensity interventions.[21]

Other programs have targeted single risk factors in the primary care setting. A recent meta-analysis[22] of nursing interventions for smoking cessation found a small but significantly positive effect for nursing interventions, with the greatest effect for hospitalized patients and for those with known CVD. In 2 of these studies,[23,24] the quit rate in the nurse intervention approximately doubled that in the control condition. Other nurse-based programs have focused on cholesterol and more recently lipid management and have achieved mixed results in improving cholesterol levels.[25,26]

Studies of nurse CVD interventions have demonstrated greater effectiveness in secondary prevention. For patients who have already experienced a cardiac event, interventions such as tobacco cessation, increased physical activity, and improved diet and medication management can significantly reduce the likelihood of future cardiac events and improve long-term survival.[14,27,28] In Scotland, a randomized clinical trial[29] found that a low-cost nurse intervention improved blood pressure (BP) management, lipid management, physical activity, and diet but not smoking cessation rates for patients with CVD. In Canada, 97% of patients recovering from MI who attended a nurse-based cholesterol clinic had low-density lipoprotein (LDL) cholesterol levels less than 3.2 mmol/L (<124 mg/dL) at the end of the program compared with 64% at the beginning of the program.[30] In a Swedish study,[31] a nurse intervention improved the dietary habits and smoking cessation rates of patients after MI but did not improve patients' physical activity levels. A nurse intervention for hospitalized patients significantly improved the smoking cessation rate (from 45% to 71%) for patients after an MI.[32] A Canadian nurse-based program for patients awaiting coronary artery bypass graft surgery improved patients' quality of life and decreased their length of stay after surgery.[33]

Secondary prevention nurse intervention studies in patients with diabetes mellitus have also reported success. A randomized trial[34] comparing glycemic control in patients with diabetes mellitus receiving a nurse-coordinated intervention and those assigned to usual care found that fasting blood sugar levels were significantly lower in patients in the nurse group. The same researchers[35] also found that more patients in the nurse intervention group received lipid-lowering medications than in the usual-care group and that more patients reported smoking cessation (although subsequently not verified by carbon monoxide measurement). Other secondary prevention studies[36-40] with less intense interventions primarily in follow-up care, or those focusing on a single risk factor, such as DL or tobacco cessation, found little benefit for their programs.

The results of these studies suggest that the effectiveness of CVD prevention programs may be related to program design and intensity. Follow-up care with additional nurse visits or telephone calls may be necessary to sustain patients' behavior changes, understand patients' medication needs, and assist patients in adhering to medications while resuming an active life.[41] The challenge is to implement low-cost CVD prevention strategies in primary care. In this article we describe a pilot program of a nurse-provided CVD risk reduction program in a community-based primary care clinic. This program was developed to determine whether several CVD risk factors (HTN, DL, and tobacco use) could be substantially reduced in high-risk patients. The goals of the program were as follows: (1) to reduce BP to 140/90 mm Hg or less in patients diagnosed as having HTN; (2) to lower LDL cholesterol levels to 3.36 mmol/L or less (≤130 mg/dL) in patients at risk for CVD and to less than 2.59 mmol/L (<100 mg/dL) for those with established CVD; and (3) to enable patients who used tobacco to quit. A secondary goal was to determine the feasibility of this nurse-provided CVD program in a primary care setting.

··· METHODS ···

The CVD prevention program had its beginnings as a nurse-based HTN management service at the Park Nicollet Clinic, a large multispecialty clinic in suburban Minneapolis, Minnesota.[42] A nurse-based pilot smoking cessation program had also been in place at this clinic from 1990 to 1993.[43] Because many patients had multiple CVD risk factors, the

program was expanded in 1997 to a more comprehensive nurse-based CVD risk factor management program. The purpose of the program was to provide appropriate CVD risk factor education and management to patients with 1 or more modifiable risk factors, including DL, HTN, and tobacco use.

This nurse-based pilot program was implemented at one geographic site of the Park Nicollet Clinic (Minnetonka, Minnesota). This site has 6 providers: 3 internal medicine physicians, 2 family practice physicians, and 1 physician assistant. There were approximately 10,500 patient visits per year in 1999 and 2000. During those years, 58% of patients were seen in family practice and 42% were seen in internal medicine. Approximately 21% of the visits were covered by Medicare, and 2.9% were covered by Medicaid and other government programs. Approximately one third of the remaining visits were covered by a prepaid managed care plan, and the rest by private insurance.

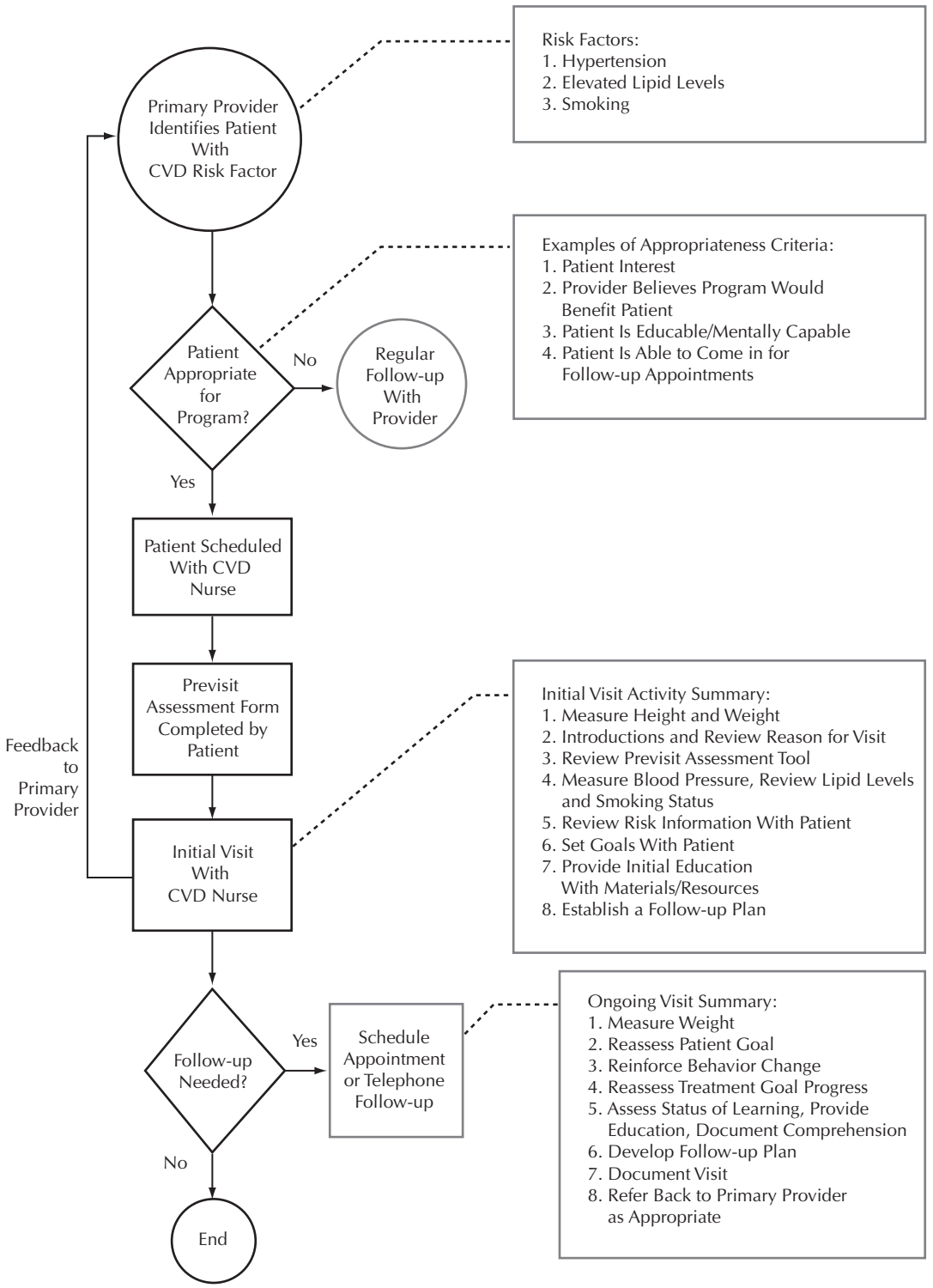
Physicians were encouraged to recommend the nurse CVD clinic to their patients with refractory DL (LDL cholesterol level >3.36 mmol/L [>130 mg/dL]), refractory HTN (BP >140/90 mm Hg), and/or tobacco use (cigarettes, cigars, pipes, or chewing snuff). Some patients were referred for only 1 visit if they just needed education or advice, and others received recommendations to work with the nurse for a period of time if more intensive counseling and support were needed to help them achieve their health goal(s). All patients 18 years or older who spoke English and had at least 1 of the health conditions listed previously were eligible for inclusion. The program also included patients with diabetes mellitus who needed better treatment of coronary risk factors and patients with established heart disease. Exclusion criteria were inability to speak English and severe cognitive impairment. After risk factors were identified during the physician visit, patients were advised to make an appointment with the CVD nurse before leaving the office. Rolling enrollment took place between October 1997, and November 1999.

The nurse intervention consisted of an initial consult with the patient for comprehensive risk assessment, patient education, and lifestyle counseling (**Figure**). The nurse reviewed current laboratory test values and BP readings and determined which CVD risk factors were present. Algorithms developed for the management of HTN, DL, and tobacco use guided the nurse in formulating an individualized care plan for each patient. The nurse discussed the recommended frequency of regular medical tests, provided instruction on dietary changes, educated patients about the benefits of aerobic exercise, and reviewed the importance of medications (eg, lipid-lowering drugs and antihypertensives) to decrease the risk of CVD. The CVD nurse was trained in tobacco cessation counseling, and she offered telephone follow-up care to support the patient attempting to quit. Physicians were consulted for patients needing changes in medication or if there was a serious change in the patient's condition. Follow-up visits, telephones calls, or both were arranged at the initial consult. The length of the program for participants was variable based on clinical circumstances. Patients were charged for a level 1 (Current Procedural Terminology code 99211) visit for each nurse visit. Sessions with the nurse usually lasted 40 minutes for the initial visit and 20 minutes for each follow-up visit. The nurse documented patient visits on paper in the medical chart and in an electronic database that was not part of the online medical record system used by clinicians.

Measures

At the first visit with the CVD nurse, information was gathered on age, body frame size, current medical conditions, medication use, and previous hospitalizations. Blood pressure, blood lipid levels, and tobacco use were assessed during this first visit (baseline) and at the subsequent follow-up visits. Blood pressure was measured following the American Heart Association standards—with the patient in a seated position, legs uncrossed, and using the same arm at each visit. At least 2 readings were taken at every visit after the patient rested. A mercury sphygmomanometer, measured for cuff size, was used for BP readings. Patients were considered to be hypertensive if their systolic BP (SBP) (first sound) was greater than 140 mm Hg or if their diastolic BP (DBP) (last sound) was greater than 90 mm Hg. Blood samples for cholesterol measurement were obtained by venipuncture, and cholesterol was measured using the modified Friedewald equation (cholesterol–high-density lipoprotein –triglycerides/5). A diagnosis of DL may involve any of the following: total cholesterol level greater than 5.17 mmol/L (>200 mg/dL), high-density lipoprotein cholesterol level less than 0.90 mmol/L (<35 mg/dL), LDL cholesterol level greater than 3.36 mmol/L (>130 mg/dL), and triglyceride level greater than 2.26 mmol/L (>200 mg/dL). For the purpose of this study, DL was defined only as an LDL cholesterol level of 3.36 mmol/L or greater (≥130 mg/dL) at baseline. A patient was considered a tobacco user if

Figure. Flowchart for a Nurse-Based Cardiovascular Disease (CVD) Program: Referral Process and Interventions



he or she used any type of tobacco (cigarettes, cigars, pipes, or chewing tobacco) at the time of the initial assessment. Clinical data gathered at each visit were entered into the CVD Risk Factor Management System for Windows provided by Bristol Myers Squibb (Lawrenceville, NJ). Analysis was conducted based on the change from baseline to the last in-person nurse visit for risk factors needing laboratory measurements (eg, LDL cholesterol levels and BP) or to the last patient contact (telephone or in-person) for patients attempting to quit using tobacco. Patients with only 1 visit to the nurse intervention program (n = 150) are not included in this analysis.

Data Analysis

The data were first analyzed by descriptive procedures (means, medians, ranges, and frequencies) and were then stratified by number of CVD nurse contacts: 1 or more than 1. Except to highlight differences between patients attending 1 time only and those returning, analyses only included patients who had more than 1 nurse visit. The Student *t* test and analysis of variance were used to compare the means of continuous variables, and the Mantel-Haenszel χ^2 test was used to compare categorical variables. The Wilcoxon signed rank test was used to compare clinical variables before and after program participation. Unconditional logistic regression was used to look for variables related to successful accomplishment of clinical goals (yes/no), with the Wald χ^2 statistic used to determine statistical significance. All tests were 2-tailed, and differences were considered statistically significant at $P \leq .05$. Confidence intervals were set at 95%. All analyses were done using SAS statistical software (SAS Institute Inc, Cary, North Carolina).

··· RESULTS ···

A total of 436 patients attended the nurse-based intervention program between October 15, 1997, and November 8, 1999. **Table 1** shows the distribution of patients by sex, age, medical conditions, CVD risk factors, number of visits, and length of time in the program. Males and females were equally represented and ranged in age from 16 to 89 years, with a median age of 57 years. The most common cardiovascular risk factor among this patient group was HTN (35.1%). Forty-three patients attending the program had existing heart disease, representing approximately 11% of the clinic's total number of patients with heart disease. Number of patient visits in the program ranged from 1 to 15. Approximately one third of the patients (34.4%) did not return to the nurse intervention program for a second visit and were subsequently excluded from further analyses. Persons who attended the program only 1 time were younger (52.4 vs 61.0 years; $P < .0001$) and were more likely to be tobacco users (30.7% vs 14.0%; $P < .0001$) than were people who attended the program more than once. There were no statistically significant differences between 1-time attendees and more than 1-time attendees in sex, incidence of heart disease or diabetes mellitus, or risk factors for DL or HTN.

For patients who continued in the nurse CVD program after the initial assessment (n = 286), length of participation varied greatly. The mean number of patient visits was 4.1 (range, 2-15), and the mean period of those visits was 6.9 months (range, 1 week to 24 months). Almost one fourth of the patients (22.7%) stayed in the program for more than a year.

Hypertension

A total of 274 patients were diagnosed as having HTN (155 with elevated systolic BP only, 20 with elevated diastolic BP only, and 99 with elevations in both). Forty-six patients (29.7%) with elevated systolic BP did not return after the initial visit, and subsequent analyses for this group are reported for the remaining 208 patients. Mean systolic BPs at baseline did not differ significantly between patients who attended only once and those who continued in the program (150.5 vs 154.1 mm Hg; $P = .64$). Because some patients had elevated SBP but not DBP, and vice versa, changes in BP readings are reported separately for these 2 measures.

Table 2 shows the characteristics of the 208 patients with SBP greater than 140 mm Hg at baseline. This condition was significantly more common in females than in males (60.1% vs 39.9%; $P = .0001$). The group mean SBP at baseline was 155.8 mm Hg (range, 140-204 mm Hg). By the time of the last program visit, mean SBP was 143.4 mm Hg, a decrease of 12.4 mm Hg ($P < .0001$). The average time in the program for these hypertensive patients was 210.5 days (range, 7-733 days), with an average of 4.4 visits per patient.

Antihypertensive medication had been prescribed for 68.8% of the patients with elevated SBP and for 62.3% of patients with high DBP. Factors significantly associated with prescriptions for antihypertensive drugs were older age (62.5 vs 57.8 years; $P = .002$), established heart disease (90.6% vs 63.4%; $P = .002$), and higher mean baseline SBP (157.7

vs 151.7 mm Hg; P = .0006). Females were somewhat more likely to be prescribed these drugs than were males (72.9% vs 61.5%; P = .08). Baseline differences in DBP between those prescribed vs not prescribed medications were not significant.

Although decreases in mean BP were statistically significant, only 89 (42.8%) of 208 patients with elevated SBP brought their values to the normal range (≤140 mm Hg) by the last program visit (**Table 3**). Unconditional logistic analysis showed that the factors significantly associated with achieving normal SBP in a multivariate model were younger age (P = .006) and having a lower baseline SBP (P = .0005). Pre-scriptions for antihypertensive drugs were marginally associated with SBP improvements from baseline to program end (–13.5 mm Hg for users vs –9.9 mm Hg for nonusers; P = .066). There was no statistically significant difference in return to normal SBP between males and females or between smokers and nonsmokers at baseline.

Elevated DBP was present in 93 patients at baseline, 81 of whom also had elevated SBP (Table 2). Elevated DBP readings were equally distributed between males and females, but males had significantly higher baseline DBPs than females (95.3 vs 93.3 mm Hg; P = .04). The mean DBP of the group at baseline was 94.4 mm Hg and at the final program visit was 84.0 mm Hg, a reduction from baseline of 10.4 mm Hg (P < .0001). The average time in the intervention program for people with elevated DBP was 175.4 days. There was no statistically significant difference in the baseline DBP of patients who

Table 1. Clinical and Demographic Variables of Patients Referred to Nurse-Based Cardiovascular Disease Intervention Program

	Patients, No. (%)		
Characteristic	**1 Visit Only (n =150)**	**> 1 Visit (n = 286)**	**Total (n = 436)**
Sex			
M	74 (49.3)	131 (45.8)	**205** (47.0)
F	76 (50.7)	155 (54.2)	**231** (53.0)
Age at first visit, y			
< 30	10 (6.6)	2 (0.7)	**12** (2.8)
30-39	16 (10.7)	10 (3.5)	**26** (6.0)
40-49	31 (20.7)	41 (14.3)	**72** (16.5)
50-59	52 (34.7)	77 (26.9)	**129** (29.6)
60-69	22 (14.7)	70 (24.5)	**92** (21.1)
70-79	18 (12.0)	71 (24.8)	**89** (20.4)
≥80	1 (0.7)	15 (5.2)	**16** (3.7)
Age, y			
Mean	52.4	61.0	**58.0**
Median	53	61	**57**
Medical conditions at baseline			
Obesity	28 (18.7)	75 (26.2)	**103** (23.6)
Tobacco use	46 (30.7)	40 (14.0)	**86** (19.7)
Diabetes mellitus	13 (8.7)	3 5(12.2)	**48** (11.0)
Heart disease*	11 (7.3)	32 (11.2)	**43** (9.9)
CVD risk factors			
Hypertension only	19 (12.7)	134 (46.8)	**153** (35.1)
Hyperlipidemia only	32 (21.3)	28 (9.8)	**60** (13.8)
Hypertension and hyperlipidemia	25 (16.7)	57 (19.9)	**82** (18.8)
Smoking only	24 (16.0)	6 (2.1)	**30** (6.9)
Other combinations of risk factors	50 (33.3)	61 (21.3)	**111** (25.5)
Visits, mean, No.	1.0	4.1	**3.0**
Length of time in program, mo			
< 1	NA	57 (19.9)	NA
1-3	NA	58 (20.3)	NA
>3-6	NA	47 (16.4)	NA
>6-9	NA	36 (12.6)	NA
>9-12	NA	23 (8.0)	NA
> 12	NA	65 (22.7)	NA
Mean	NA	6.9	NA

CVD = cardiovascular disease; NA = not applicable.
*Includes diagnoses of myocardial infarction, congestive heart failure, angina pectoris, status after coronary artery bypass graft, and coronary atherosclerosis.

attended the intervention program once vs more than once (91.6 vs 93.3 mm Hg; $P = .06$).

A total of 75 (81%) of 93 patients with elevated DBP brought their levels to normal (≤90 mm Hg) by the time of their last program visit (Table 3). The only variable significantly associated with reaching this goal was a lower baseline DBP ($P = .02$). Having been prescribed antihypertensive drugs resulted in a marginally significant difference in DBP decline over the course of the program (11.4 vs 8.5 mm Hg; $P = .065$). Patient age, sex, length of time in the program, and tobacco use status at baseline were not significant predictors.

Table 4 shows changes in clinical variables stratified by length of time in the intervention program. Changes in both SBP and DBP seemed to take place quickly: patients attending the program for only 1 to 3 months experienced almost as dramatic a change in BP as did patients who attended for a year or more. On the other hand, there was a linear relationship between ending SBP and length of time in the program ($P = .006$ for trend). On average, it took patients 6 months or more to reach a normal SBP (140 mm Hg).

Dyslipidemia

A diagnosis of DL was made on the basis of an LDL cholesterol level of 3.36 mmol/L or greater (≥130 mg/dL) at baseline. A total of 175 patients were diagnosed as having DL, but only the 104 (59.4%) who attended the program for more than 1 visit are included in the analysis. Patients who

Table 2. Systolic and Diastolic Blood Pressure (BP) by Sex and Medication Use in Hypertensive Patients

	Sex			Medication*			
	Systolic Blood Pressure						
	Males (n = 83)	Females (n = 125)	*P* (M vs F)	Yes (n = 143)	No (n = 65)	*P* (Yes vs No)	Total (n=208)
Characteristic							
Age at baseline, y	64.4 (10.3)	63.1 (12.3)	.40	64.9 (11.5)	60.7 (11.1)	.01	63.6
Systolic BP, mm Hg							
Baseline	154.1 (13.0)	157.0 (12.2)	.11	157.7 (13.2)	151.7 (10.1)	.0006	155.8
Last visit	141.5 (12.5)	144.7 (12.9)	.08	144.2 (13.4)	141.8 (11.3)	.22	143.4
Change (baseline to last visit)	-12.6 (13.9)†	-12.3 (12.7)†	.87	-13.5 (13.1)†	-9.9 (13.1)†	.07	-112.4†
	Diastolic Blood Pressure						
	Males (n = 49)	Females (n = 44)	*P* (M vs F)	Yes (n = 58)	No (n = 35)	*P* (Yes vs No)	Total (n=93)
Age at baseline, y	57.6 (12.2)	55.0 (11.8)	.30	57.8 (12.2)	54.0 (11.6)	.14	56.4
Diastolic BP, mm Hg							
Baseline	95.3 (5.6)	93.3 (3.7)	.04	94.8 (5.2)	93.6 (4.2)	.26	94.4
Last visit	85.0 (6.7)	83.0 (6.2)	.15	83.4 (6.0)	85.1 (7.4)	.21	84.0
Change (baseline to last visit)	-10.3 (8.6)†	-10.3 (6.8)†	.98	-11.4 (7.1)†	-8.5 (8.6)†	.07	-10.4†

Data are given as mean (SD).
*Antihypertensive medications, including diuretics, β-adrenergic blocking agents, calcium channel blockers, angiotensin-converting enzyme inhibitors, angiotension II receptor blockers, and combinations of the above.
†Change in BP from baseline to last visit significant at $P < .0001$.

attended the program only once were younger (54.0 vs 61.1 years; P = .0002) and had higher mean LDL cholesterol levels (4.38 vs 4.15 mmol/L [169 vs 160 mg/dL]; P = .05) than patients who returned for additional visits. There was no difference in attendance rates by sex or tobacco usage.

Characteristics of patients with DL are shown in **Table 5.** Females made up 53% of the patient group and tended to be older than males (63.0 vs 59.0 years; P = .11). The mean LDL cholesterol level at the time of the last program visit was 0.23 mmol/L (9.3 mg/dL) higher in females than males, a difference that approached statistical significance (P = .08). Female patients decreased their LDL cholesterol levels a mean of 0.32 mmol/L (12 mg/dL) from baseline, whereas males dropped their levels an average of 0.24 mmol/L (15 mg/dL). Both decreases are statistically significant (P < .0001). As a whole, patients with DL dropped their LDL cholesterol levels over the course of the program from 4.15 to 3.80 mmol/L (160 to 147 mg/dL) (P < .0001).

About one third (34.6%) of the patients with DL attending the nurse program more than once had been prescribed lipid-lowering medications by the physician. These patients had significantly lower LDL cholesterol levels at the time of the last clinic visit than patients who had not been prescribed these medications (3.41 vs 4.00 mmol/L [132 vs 155 mg/dL]; P <.0001).

Dyslipidemic patients attended the intervention program for an average of 202.0 days (range, 5-728 days). Patients made an average of 3.9 visits during this period. Table 4 shows that dyslipidemic patients had lower LDL cholesterol levels at the last program visit if they remained in the program for longer than 3 months.

Although statistically significant decreases in LDL cholesterol levels were realized by patients with DL, the number of patients who actually achieved a normal LDL cholesterol level (≤3.36 mmol/L [≤130 mg/dL]) by the time of the last program visit was low: only 20 (19.2%) of 104 patients (Table 3). Factors significantly associated with achieving a normal LDL cholesterol level were lipid-lowering medication therapy and longer time in the intervention program (P = .009) (Table 3). Sex, tobacco use, and age had no relationship to final LDL cholesterol status.

Tobacco Cessation

A total of 86 patients were identified as tobacco users (Table 1) and attended a baseline in-person visit with the cardiovascular nurse. Further tobacco cessation counseling was done over the telephone, and only 40 tobacco users (46.5%) participated. Patients who did not continue after the baseline visit were younger (46.2 vs 58.8 years; P < .0001) and were more likely to be male (P = .0007). Analyses

Table 3. Number of Patients Achieving Clinical Goal and Variables Associated With Goal Achievement

Condition	Patients, No.*	Program Goal	Patients Achieving Goal by Program End, No. (%)	Variables Significantly Associated With Goal Achievement
Hypertension, systolic (systolic BP >140 mm Hg)	208	Systolic BP ≤ 140 mm Hg	89 (42.8)	Younger age (P = .006) Lower baseline systolic BP (P = .0005)
Hypertension, diastolic (diastolic BP >90 mm Hg)	93	Diastolic BP ≤ 90mm Hg	75 (80.7)	Lower baseline diastolic BP (P = .02)
Hypertension, systolic and diastolic (BP >140/90 mm Hg)	220	Systolic BP ≤ 140 mm Hg *and* diastolic BP ≤ 90 mm Hg	85 (38.6)	Lower baseline systolic BP (P = .001)
Hyperlipidemia (LDL cholesterol >3.36 mmol/L <.0001) [>130 mg/dL])	104	LDL cholesterol ≤ 3.36 mmol/L (≤130 mg/dL)	20 (19.2)	Length of time in program (P = .009) Lipid-lowering medications (P

BP = blood pressure; LDL = low-density lipoprotein.
*Includes only those who returned to the clinic 1 or more times after the baseline visit.

Table 4. Changes in Clinical Variables by Length of Time in the Intervention Program

Time in Program, mo	Patients, No.	Baseline SBP, mm Hg	Ending SBP, mm Hg	SBP Change, mm Hg*	*P*
		Elevated Systolic Blood Pressure			
1 to < 3	79	155.5	145.1	-10.4	<.0001
3 to < 6	35	157.9	146.6	-11.3	<.0001
6 to < 12	45	156.4	140.6	-15.8	<.0001
≥ 12	46	154.0	140.9	-13.0	<.0001
Time in Program, mo	**Patients, No.**	**Baseline DBP, mm Hg**	**Ending DBP, mm Hg**	**DBP Change, mm Hg**	***P***
		Elevated Diastolic Blood Pressure			
1 to < 3	36	93.9	85.6	-8.3	<.0001
3 to < 6	13	97.5	84.4	-13.1	.0013
6 to < 12	21	93.3	81.1	-12.1	<.0001
≥ 12	23	94.3	83.9	-10.3	<.0001
Time in Program, mo	**Patients, No.**	**Baseline LDL, mmol/L (mg/dL)**	**Ending LDL, mmol/L (mg/dL)**	**LDL Change, mmol/L (mg/dL)**	***P***
		Elevated Low-Density Lipoprotein (LDL) Cholesterol Levels			
1 to < 3	44	4.11 (158.8)	3.97 (153.4)	-0.14 (-5.4)	.05
3 to < 6	15	4.11 (159.1)	3.68 (142.3)	-0.43 (-16.8)	.02
6 to < 12	24	4.25 (164.3)	3.69 (142.6)	-0.56 (-21.7)	.002
≥ 12	21	4.08 (157.6)	3.62 (139.8)	-0.46 (-17.8)	.02
Time in Program, mo	**Patients, No.**	**Quitters, No. (%)**			
1 to < 3	20	7 (35)			
3 to < 6	6	1 (17)			
6 to < 12	10	2 (20)			
≥ 12	4	2 (50)			
Total	**40**	**12** (30)			

*P = .006 for trend in BP reduction over time.
SBP = systolic blood pressure; DBP = diastolic blood pressure; LDL = low density lipoprotein.

are shown for the 40 tobacco users who attended the intervention program more than once (**Table 6**).

Sixteen tobacco users (40%) were male. Mean age of the group was 58.8 years (range, 39-86 years), with males being younger than females (56.9 vs 60.1 years). The average length of time in the program was 5.2 months (range, 1 week to 24.4 months), with a mean of 4.0 contacts with the intervention nurse.

Twelve (30%) of the 40 tobacco users quit smoking during the intervention—31% of the males and 29% of the females. Quitters were younger than nonquitters (55.8 vs 60.1 years). Participants who quit using tobacco tended to stay in the intervention program longer than nonquitters (6.4 vs 4.7 months) and had a slightly higher mean number of contacts (4.5 vs 3.8). Neither of these differences reached statistical significance, but this could be attributed to the small number of patients in the group.

The nurse CVD program operated for 24 months. Because the nurse's salary and benefits were greater than the revenues brought in by the nurse visits, the program as designed was not cost effective. Consequently, in November 1999, the program was discontinued as part of a system-wide cost-cutting effort of all noncritical programs that could not show a positive operating margin. Patients who were still in the program at that time were advised to continue the intervention strategies and to return to their primary care provider for follow-up.

··· DISCUSSION ···

Drug treatments and counseling strategies necessary to improve cardiac risk factors are well estab-

Table 5. LDL Cholesterol Levels by Sex and Medication Status in Participants with Dyslipidemia*

Characteristic	Sex			Medication†			Total (n = 104)
	Males (n = 49)	Females (n = 55)	*P* (M vs F)	Yes (n = 36)	No (n = 68)	*P* (Yes vs No)	
Age at baseline, y	59.0 (12.7)	63.0 (12.5)	.11	61.2 (10.0)	61.1 (14.0)	.99	61.1
LDL cholesterol level, mmol/L (mg/dL)							
Baseline	3.92 (0.55) [156.9 (21.4)]	4.23 (0.75) [163.5 (29.0)]	.19	4.28 (0.74) [165.5 (28.7)]	4.08 (0.62) [157.7 (23.9)]	.14	4.15 [160.4]
Last visit	3.68 (0.63) [141.9 (24.3)]	3.91 (0.74) [151.2 (28.8)]	.08	3.40 (0.74) [131.7 (28.5)]	4.00 (0.58) [154.8 (22.5)]	<.0001	3.80 [146.8]
Change (baseline to last visit)	-0.24 (0.64) [-15.0 (24.9)]‡	-0.32 (0.70) [-12.3 (27.1)]§	.60	-0.87 (0.76) -33.8 (29.4)‡	-0.08 (0.41) [-2.9 (15.9)]	<.0001	-0.35 [-13.6]‡

Data are given as mean (SD).
LDL = low-density lipoprotein.
* LDL cholesterol > 3.36 mmol/l (>130 mg/dL).
†Lipid-lowering drugs, such as statins.
‡Change in LDL level from baseline to last visit significant at $P < .0001$.
§Change in LDL level from baseline to last visit significant at $P < .001$.

Table 6. Characteristics of Smokers in the Nurse Cardiovascular Disease Intervention Program

Characteristic	Smokers, No. (%)		
	Quit (n = 12)	Did Not Quit (n = 28)	Total (n = 40)
Sex			
M	5 (42)	11 (39)	**16**
F	7 (58)	17 (61)	**24**
Age group at baseline, y			
30-39	1 (8)	0	**1**
40-49	2 (17)	5 (18)	**7**
50-59	4 (33)	10 (36)	**14**
60-69	5 (42)	7 (25)	**12**
70-79	0	4 (14)	**4**
80+	0	2 (7)	**2**
Mean age, y	55.8	60.1	58.8
Mean time enrolled in program, mo	6.4	4.7	5.2
No. of clinic visits, mean	4.5	3.8	4.0

lished, but implementing these strategies in a primary care medical practice to prevent coronary disease is a challenge. Clinical trials (eg, Campbell et al[29] in Scotland) and observational studies (eg, Baillargeon et al[30] in Canada) have shown that a nurse-led program can impact cardiac risk factor reduction in patients with CVD. Using a similar strategy in an American community-based practice, we found that cardiac risk factors (HTN, DL, and tobacco use) decreased significantly in patients participating in a nurse-led program.

An important strength of this intervention was that the CVD nurse in our study was well integrated into the practice. The CVD nurse was part

of the practice team; informal consultation between the CVD nurse and the physicians and other staff members occurred daily. Every physician in the practice referred many patients to the program, and patients readily accepted counseling from a nurse. Physicians found that the CVD nurse program was extremely useful in addressing some of the problems commonly encountered in primary care practice—patient underuse of drug therapy, lack of time for behavioral counseling or follow-up, and inadequate time to fully provide education and advice on CVD risk reduction. The physicians in the practice emphasized the usefulness of this program to their patients with CVD risk factors and found that most patients were receptive to the program. One method to further integrate the CVD nurse into the practice would be to make the CVD nurse notes part of the online medical record system used by clinicians. This would help with continuity of care and would allow reinforcement by the physician of clinical goals set between the patient and the nurse.

The major limitation of this study is that there was no control group with which to compare results. Improvements in HTN, DL, and tobacco use could have arisen from prescription medication use or from changes in patient behavior after being informed by the physician of his or her abnormal laboratory test results. Although changes in CVD risk factors were statistically significant, without a comparison group, it is not possible to unconditionally attribute change to the nurse-led program. However, the positive changes in clinical variables in patients in this nurse intervention program are consistent with those reported in the literature.[29-41] In these studies, positive health changes were attributed to the nurse's role in monitoring health status, facilitating referrals for new or continued problems, encouraging behavioral changes, and emphasizing compliance with medication regimens.

Also supporting the attribution of success to the nurse-based program is the fact that the improvements in BP and tobacco use noted in this study are considerably higher than those reported in the literature for the primary care setting. Whereas 29% of patients with HTN are reported to be controlled,[15] in the current study, 38.6% of patients achieved normal readings in both SBP and DBP. Tobacco cessation rates without intervention average 7% annually,[13] whereas, in the present study, 30% of smokers who made more than 1 contact with the nurse quit smoking. The percentage of patients whose LDL cholesterol levels were brought into the normal range of ≤3.36 mmol/L (≤130 mg/dL) was 19.2%, which is similar to the reported value of 25% among cardiac patients in another intervention study.[16] However, despite a relatively small percentage of patients reaching the desired threshold level, decreases in LDL cholesterol levels were statistically and clinically significant (–0.35 mmol/L [–13.6 mg/dL]). The inclusion of a control group of usual-care patients would help to establish the effectiveness of the nurse intervention program, but the present study was a pilot designed to assess the feasibility of the program and to measure patient changes in CVD risk status.

Self-selection bias could also partially account for the improvements noted in this study. Patients who agreed to schedule visits with the nurse may have been more motivated to change their behaviors to modify their cardiac risks than those who did not. In this case, it is difficult to differentiate changes resulting from the program and changes resulting from patient motivation.

Another limitation of the study was the inability to ascertain the effectiveness of the program for patients who had only 1 visit. Because no follow-up measurements were available to compare with those taken at baseline, we could not determine if 1 visit alone might have helped patients achieve their clinical goals over time. Similarly, it is not possible from the database to differentiate "dropouts" (those who were advised to return for additional visits but who did not follow through) from those who were advised by their physician that 1 visit would be sufficient for their needs. Better documentation of the reasons for 1-time visits would be helpful.

Two types of data that could have strengthened this study were not gathered: information on patient quality of life and physician satisfaction with the program. Patient quality of life may well have improved owing to the continuing support of the nurse and help with medication questions or adverse effects. Physician acceptance of the program was not measured directly with surveys or questionnaires but rather was done informally by comments and by noting that all of the physicians were making referrals to the nurse. No projection of expected patient numbers was made at the outset of the program, making it difficult to later assess whether the program had had a successful "capture." A more systematic, objective approach to testing physician acceptance would have made it easier to determine whether our secondary goal in this program (determining feasibility) was met.

A disappointment of this pilot study was the relatively low participation rates among patients with

established CVD. Only 10% of patients (n = 43) attending the nurse CVD program had actual CVD (rather than CVD risk factors only), and it was this group that was expected to benefit the most from the program. An audit of clinic records showed that these 43 patients represent approximately 11.1% of the 1999 clinic patients with existing CVD, so it is obvious that most patients with CVD did not attend the program. Because most of these patients would be in the older age range, representing a higher risk group, both in terms of adverse events and healthcare costs, attracting them to the program would have been advantageous. Mailings to remind patients with coronary disease and their physicians about the CVD program might have resulted in greater participation by these target patients. In the study by Feder et al,[37] postal prompts to patients who survived a coronary event increased consultation rates but did not improve physician treatment or behavior. A CVD registry has recently been established in the practice and will probably increase the focus on treatment of patients with CVD.

The low participation rate of tobacco users was another disappointment, especially given the high quit rate (30%) among users who did enroll. It may be more difficult, however, to attract tobacco users to a CVD prevention clinic than persons with HTN or hyperlipidemia. The fact that many patients using tobacco had other CVD risk factors that plugged them into the program was a plus: tobacco use could be addressed along with HTN or DL.

Reimbursement for the nurse visits was inadequate to cover the expense of the program, and compensation was not available for telephone calls. This made the program expenses unacceptable to the medical organization, and, as a result, the program was discontinued. Some changes in the program might have improved the financial results, making the program more feasible. First, changes in the nurse's duties could have improved efficiency. Because this was a pilot study and the data were needed for evaluation, the nurse had to document her work in duplicate (paper record and electronic database). The CVD nurse was also required to attend meetings at another site to train other nurses—an important task, but an additional expense. Furthermore, the nurse could have provided care that was done by the more highly paid physicians, such as calling patients with laboratory test results and managing prescription refills. If these services were conducted by the nurse and included in the financial analysis, it may have improved financial feasibility. More extensive financial analysis would be useful, but it was beyond the scope of this study.

More rigorous studies of nurse-based interventions are needed if we are to better understand how to improve the provision of CVD prevention services in primary care. Our results suggest that a nurse CVD program merits further consideration, especially in light of a recent study[44] that demonstrated poor secondary control of cardiovascular risk factors among a high percentage of survivors of cardiovascular events. More effort should be focused on patients with existing CVD because secondary prevention is highly effective in reducing CVD mortality and morbidity rates.[44] The present study provides preliminary evidence of effectiveness, but similar projects in the future might be more successful by making 3 changes: (1) instituting methods to attract more patients with heart disease, (2) marketing the program directly to patients as well as to clinicians, and (3) making the program more financially feasible in a fee-for-service environment.

A future randomized trial for CVD patients is planned, using a similar nurse specialist intervention, including American Society of Anesthesiolo-gists management, but this time using a control group of patients receiving usual care. A CVD registry will be used to actively recruit high-risk patients rather than relying on the healthcare providers for referrals. Given the prevalence of CVD in the population, it is essential to incorporate strategies in primary practice to help patients control their risk factors, and a nurse-based program may be the most effective method of achieving this goal.

··· REFERENCES ···

1. American Heart Association. *2001 Heart and Stroke Statistical Update.* Dallas, TX: American Heart Association; 2000.

2. Lloyd-Jones DM, Evans JC, Larson MG, et al. Cross-classification of JNC VI blood pressure stages and risk groups in the Framingham Heart Study. *Arch Intern Med* 1999;159:2206-2212.

3. National Heart, Lung, and Blood Institute. *Morbidity & Mortality 1998: Chartbook on Cardiovascular, Lung and Blood Diseases.* Bethesda, MD: National Heart, Lung, and Blood Institute; 1998.

4. Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion. *Cigarette Smoking Among Adults—United States, 1999.* Available at: http://www.cdc.gov/tobacco/research_data/adults_prev/mm5040.htm. Accessed May 6, 2002.

5. National Heart, Lung, and Blood Institute. *The Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.* Bethesda, MD: National Heart, Lung, and Blood Institute; November 1997. NIH publication 98-4080.

6. Liu S, Stampfer MJ, Hu FB, et al. Whole-grain consumption and risk of coronary heart disease: Results from the Nurses' Health Study. *Am J Clin Nutr* 1999;70:412-419.

7. Lee IM, Hennekens CH, Berger K, Buring JE, Manson JE. Exercise and risk of stroke in male physicians. *Stroke* 1999;30:1-6.

8. Strandberg TE, Salomaa VV, Vanhanen HT, et al. Mortality in participants and non-participants of a multifactorial prevention study of cardiovascular diseases: A 28 year follow up of the Helsinki Businessmen Study. *Br Heart J* 1995;74:449-454.

9. Lowe LP, Greenland P, Ruth KJ, et al. Impact of major cardiovascular disease risk factors, particularly in combination, on 22-year mortality in women and men. *Arch Intern Med* 1998;158: 2007-2014.

10. Stamler J, Stamler R, Neaton JD, et al. Low risk-factor profile and long-term cardiovascular and noncardiovascular mortality and life expectancy: Findings for 5 large cohorts of young adult and middle-aged men and women. *JAMA* 1999;282:2012-2018.

11. Shepherd J, Cobbe SM, Ford I, et al. Prevention of coronary heart disease with Pravastatin in men with hypercholesterolemia. *N Engl J Med* 1995;333:1301-1307.

12. American College of Physicians. Guidelines for using serum cholesterol, high-density lipoprotein cholesterol, and triglyceride levels as screening tests for preventing coronary heart disease in adults. *Ann Intern Med* 1996;124:515-531.

13. The Tobacco Use and Dependence Clinical Practice Guideline Panel, Staff, and Consortium Representatives. A clinical practice guideline for treating tobacco use and dependence: A US Public Health Service report. *JAMA* 2000;283:3244-3254.

14. Sutton-Tyrrell K, Alcorn HG, Herzog H, Kelsey SF, Kuller LH. Morbidity, mortality, and antihypertensive treatment effects by extent of atherosclerosis in older adults with isolated systolic hypertension. *Stroke* 1995;26:1319-1324.

15. Burt VL, Cutler JA, Higgins M, et al. Trends in the prevalence, awareness, treatment, and control of hypertension in the adult US population: Data from the health examination surveys, 1960 to 1991. *Hypertension* 1995;26:60-69.

16. Sueta CA, Chowdhury M, Boccuzzi SJ, et al. Analysis of the degree of undertreatment of hyperlipidemia and congestive heart failure secondary to coronary artery disease. *Am J Cardiol* 1999;83:1303-1307.

17. Majumdar SR, Gurwitz JH, Soumerai SB. Undertreatment of hyperlipidemia in the secondary prevention of coronary artery disease. *J Gen Intern Med* 1999;14:711-717.

18. Kottke TE, Solberg LI, Brekke ML, et al. A controlled trial to integrate smoking cessation advice into primary care practice: Doctors Helping Smokers, Round III. *J Fam Pract* 1992;34:701-708.

19. Family Heart Study Group. Randomised controlled trial evaluating cardiovascular screening and intervention in general practice: Principal results of the British Family Heart Study. *BMJ* 1994;308: 313-320.

20. Imperial Cancer Research Fund OXCHECK Study Group. Effectiveness of health checks conducted by nurses in primary care: Results of the OXCHECK Study after one year. *BMJ* 1994;308:308-312.

21. Record NB, Harris DE, Record SS, et al. Mortality impact of an integrated community cardiovascular health program. *Am J Prev Med* 2000;19:30-38.

22. Rice VH. Nursing intervention and smoking cessation: A meta-analysis. *Heart Lung* 1999;28:438-454.

23. Hollis JF, Lichtenstein E, Vogt TM, Stevens VJ, Biglan A. Nurse-assisted counseling for smokers in primary care. *Ann Intern Med* 1993;118:521-525.

24. Tonnesen P, Mikkelsen K, Markholst C, et al. Nurse-conducted smoking cessation with minimal intervention in a lung clinic: A randomized controlled study. *Eur Respir J* 1996;9:2351-2355.

25. Pine DA, Madlon-Kay DJ, Sauser M. Effectiveness of a nurse-based intervention in a community practice on patients' dietary fat intake and total serum cholesterol level. *Arch Fam Med* 1997;6:129-134.

26. Brown AS, Cofer LA. Lipid management in a private cardiology practice (the Midwest Heart Experience). *Am J Cardiol* 2000;85:18A-22A.

27. Plehn JF, Davis BR, Sacks FM, et al, for The Care Investigators. Reduction of stroke incidence after myocardial infarction with pravastatin: The Cholesterol and Recurrent Events (CARE) study. *Circulation* 1999;99:216-223.

28. Ornish D, Scherwitz LW, Billings JH, et al. Intensive lifestyle changes for reversal of coronary heart disease [published correction appears in *JAMA* 1999;281:1380]. *JAMA* 1998;280:2001-2007.

29. Campbell NC, Ritchie LD, Thain J, et al. Secondary prevention in coronary heart disease: A randomized trial of nurse led clinics in primary care. *Heart* 1998;80:447-452.

30. Baillargeon JP, Lepage S, Larrivee L, Roy MA, Landry S, Maheux P. Intensive surveillance and treatment of dyslipidemia in the postinfarct patient: Evaluation of a nurse-oriented management approach. *Can J Cardiol* 2001;17:169-175.

31. Carlsson R, Lindberg G, Westin L, Israelsson B. Influence of coronary nursing management follow up on lifestyle after acute myocardial infarction. *Heart* 1997;77:256-259.

32. Taylor CB, Houston-Miller N, Killen JD, DeBusk RF. Smoking cessation after acute myocardial infarction: Effects of a nurse-managed intervention. *Ann Intern Med* 1990;113:118-123.

33. Arthur HM, Daniels C, McKelvie R, Hirsh J, Rush B. Effect of a preoperative intervention on preoperative and postoperative outcomes in low-risk patients awaiting elective coronary artery bypass graft surgery: A randomized, controlled trial. *Ann Intern Med* 2000;133:253-262.

34. Weinberger M, Kirkman MS, Samsa GP, et al. A nurse-coordinated intervention for primary care patients with non–insulin-dependent diabetes mellitus: Impact on glycemic control and health-related quality of life. *J Gen Intern Med* 1995;10:59-66.

35. Kirkman MS, Weinberger M, Landsman PB, et al. A telephone-delivered intervention for patients with NIDDM: Effect on coronary risk factors. *Diabetes Care* 1994;17:840-846.

36. Jolly K, Bradley F, Sharp S, et al. Randomised controlled trial of follow up care in general practice of patients with myocardial infarction and angina: Final results of the Southampton Heart Integrated Care Project (SHIP). *BMJ* 1999;318:706-711.

37. Feder G, Griffiths C, Eldridge S, Spence M. Effect of postal prompts to patients and general practitioners on the quality of primary care after a coronary event (POST): Randomised controlled trial. *BMJ* 1999;318:1522-1526.

38. LaBresh KA, Owen P, Alteri C, et al. Secondary prevention in a cardiology group practice and hospital setting after a heart-care initiative. *Am J Cardiol* 2000;85:23A-29A.

39. Wilkes S, Evans A. A cross-sectional study comparing the motivation for smoking cessation in apparently healthy patients who smoke to those who smoke and have ischaemic heart disease, hypertension or diabetes. *Fam Pract* 1999;16:608-610.

40. Rice VH, Fox DH, Lepczyk M, et al. A comparison of nursing interventions for smoking cessation in adults with cardiovascular health problems. *Heart Lung* 1994;23:473-486.

41. Jolly K, Bradley F, Sharp S, Smith H, Mant D. Follow-up care in general practice of patients with myocardial infarction or angina pectoris: Initial results of the SHIP trial: Southampton Heart Integrated Care Project. *Fam Pract* 1998;15:548-555.

42. Pheley AM, Terry P, Pietz L, et al. Evaluation of a nurse-based hypertension management program: Screening, management and outcomes. *J Cardiovasc Nurs* 1995;9:54-61.

43. Pine D, Sullivan S, Sauser M, David C. Effects of a systematic approach to tobacco cessation in a community-based practice. *Arch Fam Med* 1997;6:363-367.

44. Quereshi AI, Suri FK, Guterman LR, Hopkins LN. Ineffective secondary prevention in survivors of cardiovascular events in the U.S. population. *Arch Intern Med* 2001;161:1621-1628.