

The Effect of a Cardiovascular Educational Intervention on Healthcare Utilization and Costs

Amar C. Nawathe, MD, MHA; Sherry A. Glied, PhD;
William S. Weintraub, MD; and Lori J. Mosca, MD, PhD

Cardiovascular disease (CVD) is the leading cause of morbidity, mortality, and health expenditures in the United States and globally.^{1,2} According to the Centers for Medicare & Medicaid Services,³ total US health expenditures in 2008 reached \$2.3 trillion, which translates to \$7681 per person or 16.2% of the nation's gross domestic product. For the same year, the American Heart Association⁴ estimated the cost of providing cardiovascular care at \$448.5 billion. The recent crisis in the US economy has led to an increased focus on healthcare expenditures, prevention of disease, and opportunities to contain costs.

Developing and testing primary prevention strategies that improve health outcomes and are cost-efficient is critical, yet few data have evaluated the potential effect of screening and educational interventions on utilization of healthcare resources. With the evolving US healthcare system, reduced reimbursements, and time constraints on physicians, it is important to explore the use of nontraditional personnel to provide aspects of preventive care that may be time-consuming for physicians (eg, lifestyle counseling). Cardiovascular disease prevention counseling by nonphysician healthcare providers such as nurses⁵ and registered dietitians^{6,7} has been shown to be cost-effective. The Family-Based Intervention Trial for Heart Health (FIT Heart)⁸ recently showed that a screening and lifestyle counseling intervention by health educators was associated with significant improvement in diet score and with beneficial effects on high-density lipoprotein cholesterol level compared with a control intervention (CIN), although both study groups reduced low-density lipoprotein level (the primary end point) to a similar degree following hospitalization of family members with CVD. The objectives of our study were to evaluate healthcare resource utilization and costs among FIT Heart participants following a CVD screening and educational special intervention (SI) versus a CIN during 1 year of follow-up.

METHODS

FIT Heart was a randomized controlled clinical trial that enrolled healthy family members of cardiac patients admitted to NewYork-Presbyterian Hospital and Columbia University Medical Center with a diagnosis of acute myocardial infarction, unstable angina, stable angina, or coronary or noncoronary atherosclerotic revascularization procedure

Objectives: To evaluate healthcare utilization and costs following a cardiovascular disease (CVD) screening and educational special intervention (SI) compared with a control intervention (CIN) at 1 year in the Family-Based Intervention Trial for Heart Health.

Study Design: Participants randomized to SI for screening and periodic lifestyle counseling were compared with participants randomized to CIN for resource utilization and associated costs at 1 year.

Methods: A total of 421 participants (67% women and 37% minorities) were healthy family members of hospitalized patients with CVD who had 1-year follow-up resource utilization data. Resource utilization was systematically measured using a standardized questionnaire in both study groups and was validated by medical records in a subsample. Outcomes included provider visits, diagnostic studies, laboratory assessment, medication use, behavioral program enrollment, emergency department (ED) visits, hospital admissions, and healthcare costs.

Results: At 1 year, there were significantly fewer overall provider visits ($P = .04$) and psychiatrist visits ($P = .03$) in SI versus CIN. There was a nonsignificant trend toward fewer ED visits, decreased hospital admissions, and shorter inpatient length of stay in SI versus CIN. Estimated healthcare expenditures for CIN exceeded those for SI by \$590 per participant. The cost of the 1-year intervention was \$95 per participant.

Conclusions: A 1-year standardized low-cost screening and educational intervention was associated with significantly fewer provider visits and with a nonsignificant trend toward reduced healthcare utilization for several parameters. The long-term effect on outcomes and costs deserves further study.

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In this article

Take-Away Points / p340

www.ajmc.com

Full text and PDF

Web exclusive

eAppendices A-D

**For author information and disclosures,
see end of text.**

Take-Away Points

With the increasing health and economic burden of cardiovascular disease, identifying cost-efficient primary prevention strategies is vital.

- A screening and periodic educational intervention by nonphysician health educators may be a low-cost strategy to improve lifestyle and to reduce the risk of cardiovascular disease.
- The intervention was associated with decreased provider visits and with a trend toward less utilization for other healthcare resource parameters.
- Reduced healthcare utilization associated with the preventive intervention resulted in decreased healthcare expenditures.

between January 2005 and June 2007 and conducted follow-up visits for 1 year between January 2006 and June 2008. This analysis includes all participants in FIT Heart who completed the baseline 1-hour structured counseling and 1-year resource utilization questionnaire (84% of the sample [206 in SI and 215 in CIN]). Details of the study design, follow-up rate, and main outcomes have been previously published.⁸

After standardized baseline evaluation, participants randomized to SI received immediate feedback regarding traditional CVD risk factors and lifestyle counseling for 1 year. CIN received general health messages only. Masters-level trained health educators with a minimum of 6 months of clinical experience and specific training in national CVD prevention guidelines delivered the intervention. The study was approved by the institutional review board of Columbia University Medical Center. Written informed consent was obtained from every participant in the study.

Healthcare resource utilization data during 1 year follow-up enrollment was collected using a standardized questionnaire completed by the participants at the end of the study year (eAppendix A available at www.ajmc.com). Utilization parameters collected were provider visits, cardiac diagnostic studies, blood laboratory assessment, medication use, behavioral program enrollment, emergency department (ED) visits, and hospital admissions. Provider visits included visits to family physicians, internists, obstetricians/gynecologists, cardiologists, nutritionists, psychiatrists, and others. Cardiac diagnostic studies included treadmill stress, stress echocardiography, nuclear stress, transthoracic echocardiography, diagnostic cardiac catheterization, carotid ultrasonography, coronary calcium imaging, Holter monitoring, and electrocardiography. Blood laboratory assessment included complete blood cell count, electrolytes, glucose, cholesterol, liver function tests, thyroid function tests, and high-sensitivity C-reactive protein. Medication use included prescription and over-the-counter drugs. Behavioral program data included enrollment in fitness programs, weight management programs, personal training sessions, and smoking cessation programs. Emergency department visit and hospital admission data included the

name of the hospital and the date and reason for the visit or admission. All variables analyzed were defined a priori except for the mean inpatient length of stay, which was a post hoc analysis.

Self-reported data were validated using medical records from primary care physicians (PCPs). Twenty-five participants (10%) from each study group were randomly selected. Each participant's

PCP was contacted by facsimile to request medical records for the 1-year study period, followed by subsequent reminders. The request included a copy of the medical record release form signed by the participant. A total of 31 medical records were received, 17 for SI (8%) and 14 for CIN (7%). There was no significant difference between self-report and medical record data in SI or CIN for provider visits, diagnostic studies, ED visits, or hospital admissions (eAppendix B available at www.ajmc.com).

Healthcare payer costs were calculated using estimated billed charges for resources utilized, including provider visits, cardiac diagnostic studies, ED visits, and hospital admissions. Reported medication use, laboratory assessment, and behavioral program enrollment were similar in both groups and were not included in the cost calculations. Our analysis proposed to study the differential healthcare costs between the 2 groups rather than the total societal costs of either study arm.

Hospital admission costs were calculated using 2007 Medicare diagnosis-related group price.^{9,10} For other resource utilization parameters, *Current Procedural Terminology (CPT)* codes from the American Medical Association¹¹ were assigned for each resource variable. Medicare reimbursement dollars for each CPT code were then identified for the New York area¹¹ and were multiplied by the units of services provided for that particular variable. For provider visits, the first visit by a participant to a particular provider was coded as an initial visit and subsequent visits to the same provider as follow-up visits. For severity-based multiple code levels, a middle-level code was selected uniformly across both study groups.

The cost structure of a health educator CVD prevention program based on FIT Heart in a nonresearch setting was estimated. Each participant received a baseline screening visit, with follow-up at 2, 4, and 6 weeks and at 6, 9, and 12 months, a total of 7 visits in a year. The mean durations for baseline office visits, follow-up office visits, and follow-up telephone contacts during our study were estimated at 60, 30, and 8 minutes, respectively.

All data were double entered and were analyzed using SAS version 9.1 (SAS Institute, Cary, NC). Arithmetic mean was used for each variable for comparison between the study

Table 1. Baseline Population Characteristics by Study Group Assignment*

Variable	SI			CIN		
	Included (n = 206)	Excluded (n = 42)	P	Included (n = 215)	Excluded (n = 34)	P
Demographics						
Age, y	49	46	.21	49	45	.11
Sex, %						
Male	33	40	.38	33	41	.31
Female	67	60		67	59	
Race/ethnicity, %						
White	63	74	.13	64	68	.65
Nonwhite	37	26		36	32	
Education, %						
≥Associate degree	37	37	>.99	39	47	.32
<Associate degree	63	63		61	53	
Health insurance, %						
Insured	85	81	.57	87	85	.84
Uninsured	15	19		13	15	
Laboratory Assessment						
Total cholesterol, mg/dL	203	202	.91	204	220	.03
Low-density lipoprotein cholesterol, mg/dL	121	123	.81	121	136	.01
High-density lipoprotein cholesterol, mg/dL	59	56	.34	60	58	.55
Triglycerides, mg/dL	113	125	.31	117	130	.29
Glucose, mg/dL	99	95	.16	100	97	.41
Glycosylated hemoglobin, %	5.5	5.4	.37	5.6	5.4	.48
Systolic blood pressure, mm Hg	126	129	.30	126	127	.80
Diastolic blood pressure, mm Hg	77	81	.05	77	78	.54

CIN indicates control intervention; SI, special intervention.

*Those who returned healthcare resource questionnaires were included in the analysis. Those who did not return healthcare resource questionnaires were excluded from the analysis. P values compare those included and excluded within each study group.

groups. *t* Test was used to compare the means of quantitative variables (provider visits, ED visits, and hospital days) between groups. χ^2 Test was used to compare categorical variables (all others) between groups. Linear regression analysis was used to control for age, sex, race/ethnicity, education, and health insurance status. Two-sided $\alpha < .05$ indicated statistical significance.

RESULTS

Baseline characteristics of participants in the study are given in **Table 1** by study group assignment and are listed according to 1-year respondent status to evaluate any selection bias in completion of resource utilization data. There were no significant differences between SI and CIN with respect to baseline demographics. In CIN, those individuals

who did not return their questionnaires and were therefore excluded from the analysis had significantly higher levels of total cholesterol and low-density lipoprotein cholesterol at baseline compared with those who returned their questionnaires. Similarly, there was a trend toward higher diastolic blood pressure among noncompleters versus completers of the questionnaire in SI.

Healthcare resource utilization reported by study participants during 1 year following enrollment is summarized in **Table 2** and **Table 3**. Table 2 gives total and mean numbers of provider visits and diagnostic studies by study group assignment, as well as initial and follow-up visits for each provider type. At 1 year, there were significantly more overall provider visits in CIN ($P = .04$), specifically psychiatrist visits ($P = .03$). There was no statistically significant difference for visits to PCPs, cardiologists, or nutritionists. On average, SI reported

■ **Table 2.** Provider Visits and Diagnostic Studies by Study Group Assignment at 1 Year

Variable	No.		Arithmetic Mean (95% Confidence Interval)		P
	SI (n = 206)	CIN (n = 215)	SI (n = 206)	CIN (n = 215)	
Provider Visits					
Total	578	843	2.81 (2.39 to 3.22)	3.92 (3.04 to 4.79)	.04
Primary care^a	444	523	2.16 (1.84 to 2.47)	2.43 (2.06 to 2.81)	.26
Initial	217	245			
Follow-up	227	278			
Cardiologist	78	85	0.38 (0.26 to 0.49)	0.40 (0.24 to 0.39)	.86
Initial	47	43			
Follow-up	31	42			
Psychiatrist	47	215	0.23 (0.05 to 0.40)	1.00 (0.37 to 1.63)	.03
Initial	11	21			
Follow-up	36	194			
Nutritionist	9	20	0.04 (0.04 to 0.83)	0.09 (−0.02 to 0.21)	.44
Initial	6	4			
Follow-up	3	16			
Diagnostic Studies					
Stress echocardiography	14	27	0.07 (0.03 to 0.10)	0.13 (0.08 to 0.17)	.046
Nuclear stress	13	17	0.06 (0.03 to 0.10)	0.07 (0.04 to 0.11)	.52
Treadmill stress	19	22	0.09 (0.05 to 0.13)	0.10 (0.06 to 0.14)	.73
Carotid ultrasonography	7	12	0.030 (0.005 to 0.090)	0.06 (0.03 to 0.09)	.28
Coronary calcium imaging	3	0	0.010 (−0.001 to 0.030)	0.00	—
Diagnostic cardiac catheterization	2	3	0.010 (−0.003 to 0.020)	0.010 (−0.001 to 0.030)	>.99
Transthoracic echocardiography	7	4	0.03 (0.01 to 0.05)	0.0200 (0.0005 to 0.0360)	.37
Holter monitoring	6	9	0.030 (0.006 to 0.050)	0.04 (0.02 to 0.08)	.48
Electrocardiography	71	83	0.34 (0.28 to 0.41)	0.38 (0.32 to 0.45)	.38
CIN indicates control intervention; SI, special intervention.					
^a Includes family medicine, internal medicine, and obstetrics/gynecology office visits.					

2.81 visits per individual to healthcare providers overall compared with 3.92 visits per individual for CIN. For psychiatrist visits, SI reported a mean of 0.23 visits per individual compared with 1.00 visit per individual in CIN. Because many women use their obstetricians/gynecologists for primary care, we categorized them as PCPs, in addition to family physicians and internists.

Control intervention reported more use of stress echocardiography compared with SI ($P = .046$) (Table 2). The use of other diagnostic studies was similar in both study groups, as was laboratory workup and fitness program enrollment. There was no significant increase in the use of cholesterol-lowering medications in either group, as previously reported.⁸

Emergency department and hospital use by study participants is summarized in Table 3. For ED visits, SI reported 0.16 visits per individual compared with 0.18 visits per individual

in CIN. Special intervention reported 0.05 ED visits per individual for a cardiac reason compared with 0.07 visits per individual for CIN. Special intervention reported 16 hospital admissions overall and 3 for a cardiac reason compared with 25 and 7 hospital admissions, respectively, in CIN. Chest pain, presyncope, and palpitations were cardiac reasons identified by study participants for ED visits and for hospital admissions. Special intervention reported 0.22 hospital days per individual overall and 0.02 hospital days per individual for a cardiac reason compared with 0.45 and 0.08 hospital days, respectively, in CIN. Special intervention had mean hospital length of stay of 2.9 days overall and 1.3 days for a cardiac reason compared with 3.9 and 2.4 days, respectively, for CIN.

Healthcare payer costs based on estimated billed charges during the study years are given in Table 4. Except for transthoracic echocardiography, the costs for all other variables

■ **Table 3.** Emergency Department Visits and Hospitalizations by Study Group Assignment at 1 Year

Variable	SI (n = 206)	CIN (n = 215)	P
Mean Emergency Department Visits (Total Visits)			
Overall	0.16 (32)	0.18 (39)	.51
Cardiac	0.05 (10)	0.07 (15)	.36
Hospitalizations			
Hospital admissions			
Overall	16	25	.31
Cardiac	3	7	.34
Mean hospital days (total days)			
Overall	0.22 (47)	0.45 (98)	.12
Cardiac	0.02 (4)	0.08 (17)	.30
Mean length of stay, d			
Overall	2.9	3.9	.22
Cardiac	1.3	2.4	.45

CIN indicates control intervention; SI, special intervention.

are consistently higher for CIN compared with SI. The estimated costs per participant were \$1077 for SI compared with \$1668 for CIN.

The cost of the health educator–based CVD prevention program was estimated at \$95 per participant per year based on the FIT Heart model.⁸ Estimated costs were based on a baseline office visit, 2 office follow-up visits, and 4 telephone contacts, accounting for 2.5 contact hours per participant per year. Annual work hours for a health educator working 8 hours a day, 5 days a week, and 48 weeks a year were estimated at 1920 hours. We used the mean values of the following: health educator annual base salary of \$40,000 plus \$12,000 benefits (30% of the annual salary), fingerstick cholesterol measurement costs estimated at \$13 per test (with each patient receiving 2 tests per year), \$329 for control tests, \$1000 for marketing and educational materials, federal Clinical Laboratory Improvement Amendments certificate of waiver of \$150 for 2 years (\$75 per year), blood pressure machine for \$75, weighing machine for \$70, and nonelastic body-measuring tape for \$10. We excluded office space value from our calculations given wide variation among different geographic settings and the limited additional office space required for the program. We also estimated the cost of receiving 1 hour of structured counseling with a health educator without follow-up (aimed at identifying individuals at risk of CVD to briefly educate them) at \$41 per person. It should be noted that most of the cost variables are fixed. Therefore, the number of program participants will affect the cost per

person (eAppendix C and eAppendix D available at www.ajmc.com).

DISCUSSION

A structured screening and lifestyle intervention for CVD prevention by nonphysician health educators was associated with reduced healthcare provider visits in SI compared with CIN at 1 year. There was a nonsignificant trend toward decreased healthcare utilization associated with SI for several parameters and no evidence of any significant increase in utilization. We estimated the cost of the screening and 1-year educational intervention at \$95 per person per year.

The influence of general health counseling on healthcare utilization and on associated costs has been studied primarily in traditional settings¹²⁻¹⁷; however, data on interventions using nonphysician and nonnursing interventions are limited. In a randomized controlled trial¹² conducted among all general practices in Ebeltoft, Denmark, an intervention group received health screenings to identify lifestyle-related medical conditions, including vision, hearing, CVD risk score, cardiovascular and pulmonary performance, and endocrine, liver, and kidney function. Thomsen and colleagues¹² reported overall similar hospital admissions and ED visits for the intervention group compared with a control group, with a trend toward decreased hospital use in the latter years of the 8-year study for the

Table 4. Estimated Billed Charges for Healthcare Resource Utilization Outside of the Study by Study Group Assignment at 1 Year^a

Variable	Estimated Billed Charge, \$	
	SI (n = 206)	CIN (n = 215)
Provider Visits		
Primary care	31,954	37,604
Cardiologist	10,008	10,588
Psychiatrist	5838	24,626
Nutritionist	274	577
Subtotal	48,074	73,395
Diagnostic Studies		
Stress echocardiography	3426	6607
Nuclear stress	3719	4863
Treadmill stress	2458	2846
Carotid ultrasonography	939	1609
Coronary calcium imaging	—	—
Diagnostic cardiac catheterization	3885	5827
Transthoracic echocardiography	1691	966
Holter monitoring	1062	1592
Electrocardiography	2008	2347
Subtotal	19,188	26,657
Emergency Department Visits^b		
Overall	2110	2571
Cardiac	659	989
Hospitalizations		
Overall	152,589	255,977
Cardiac	36,909	124,002
Total Estimated Billed Charges		
Overall	221,961	358,600
Per individual	1077	1668

CIN indicates control intervention; SI, special intervention.
^aAdmissions data are based on Medicare diagnosis-related groups. All other data are based on American Medical Association *Current Procedural Terminology* codes.
^bEmergency department physician charges only.

intervention group. The South-East London Screening Study,¹³ another longitudinal randomized controlled trial of multiphasic health screening in 2 large group practices in south London, reported similar hospital use in intervention and control groups. In our study, we did not find statistically significant differences in ED and hospital use at 1 year. However, we observed a nonsignificant trend toward decreased hospital admissions, hospital days, and mean inpatient length of stay in SI compared with CIN at 1 year. The overall health expenditure difference observed between our study groups was primarily driven by hospital costs, possibly due to several factors, such as patient acuity and the expen-

sive nature of inpatient care. However, identifying these factors was beyond the scope of our study.

For outpatient primary care visits, Thomsen and colleagues¹⁴ reported increased daytime outpatient contacts in the first year of their 8-year study, followed by a gradual decline over subsequent years. The South-East London Screening Study¹³ and the Multiphasic Check-up Evaluation Study¹⁵⁻¹⁷ found similar outpatient visits in their study and control groups over 9 and 7 years, respectively. Our study found a significant reduction in provider visits in SI compared with CIN at 1 year.

We found similar use for other utilization parameters. With only 11 participants in SI and 21 participants in CIN visiting a psychiatrist, the difference observed at a subgroup level for psychiatrist visits was largely due to outliers observed in CIN, with 1 participant making 52 visits in the study year. The difference observed with stress echocardiography use is possibly due to chance.

To explain the initial rise in reported outpatient visits in their study, Thomsen and colleagues¹⁴ suggested that barriers to general practitioner visits were reduced following the offer of health discussions. Previous trials¹²⁻¹⁷ provided screening or counseling visits at baseline, with subsequent study contacts at annual or longer intervals. In contrast, SI herein included multiple office and telephone contacts with the health educators in 1 year. It is possible that SI participants might have substituted health educator visits for physician care, despite that the intervention encouraged adherence to follow-up with physicians regarding abnormal test results. We reported previously in this population¹⁸ that racial/ethnic minorities with elevated CVD risk factors may have delayed medical follow-up compared with white subjects (possibly due to lack of access to a physician) and that nonwhite individuals were more likely to return to our study prevention counselors for follow-up rather than consult an outside physician. Reduced visits to physicians may have been related to lesser utilization of some parameters such as stress echocardiography, but we were unable to study this directly.

With the clinical and economic burden of CVD worldwide, there is need to identify cost-efficient CVD prevention strategies.¹⁹ A longitudinal epidemiologic study⁵ in Norsjö,

Sweden, reported nurse-based counseling for cholesterol reduction and CVD prevention to be cost-effective. Field and colleagues²⁰ in the OXCHECK trial, a nurse-based intervention, reported that lipid-lowering drugs represented a large proportion of CVD costs and suggested that protocols limiting the use of drugs might improve cost-effectiveness. Less than 20% of our study population used lipid-lowering prescription medications with nonsignificant change at 1 year.⁸ Prior randomized controlled trials^{5,12-17,20} utilized nurses or physicians as counselors for educational interventions. The use of health educators, as in our study, may represent a less expensive viable option.

The following limitations should be noted. Our resource utilization data were collected by self-report and may not be completely accurate. However, our results did not show any significant differential reporting between study groups. The nonsignificant trend toward less overreporting for provider visits in SI compared with CIN may tend to overestimate costs in the latter. A small subset of participants in FIT Heart who did not return the resource utilization questionnaire were excluded from the analysis (14% in CIN and 17% in SI), which may limit generalizability of our results. However, baseline characteristics of responders and nonresponders were similar on almost all characteristics measured, suggesting that the effect was unlikely to be substantial, and loss to follow-up was not differential to study group assignment. Baseline healthcare resource utilization patterns were unknown for SI and CIN participants. However, randomization resulted in equal distribution of CVD risk factors for both groups. Our analysis of healthcare costs did not capture indirect costs such as missed wages for time spent in follow-up visits for SI or for more provider visits in CIN. Because the study duration was only 1 year, we were unable to identify study intervention effects on long-term healthcare utilization and costs. Most of our participants were insured and were not at high risk for CVD, which may limit generalizability of results. Finally, we did not conduct a cost-effectiveness analysis because there was no significant difference between groups in the primary outcome of low-density lipoprotein cholesterol level.

FIT Heart, a screening and lifestyle counseling initiative for CVD prevention by nonphysician health educators, was associated with improved measures such as dietary score and exercise habits in SI versus CIN.⁸ Our analysis suggests that the study intervention did not increase subsequent healthcare utilization and costs at 1 year and that some parameters of resource utilization were significantly reduced in SI compared with CIN. The effect of reduced provider visits on long-term health outcomes deserves further study. Our data suggest that a hospital-based CVD screening and education program

targeted to family members of hospitalized cardiac patients may be a low-cost approach to identify individuals at risk of CVD, improve lifestyle, and reduce healthcare utilization up to 1 year.

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Author Affiliations: From the Department of Medicine (ACN, LJM) and the School of Public Health (SAG), Columbia University, New York, NY; the Christiana Care Health System (WSW), Newark, DE; and the Preventive Cardiology Program (LJM), NewYork-Presbyterian Hospital, New York, NY.

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Address correspondence to: Lori J. Mosca, MD, PhD, Department of Medicine, Columbia University Medical Center, 601 W 168th St, Ste 43, New York, NY 10032. E-mail: ljm10@columbia.edu.

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