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QUALITY IMPROVEMENT REPORT

Evaluation of a postdischarge coronary artery disease management program

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Abstract

Objectives: We conducted a demonstration project to assess the value of a nurse practitioner (NP) based coronary artery disease management (CAD-DM) program for patients with an acute coronary syndrome (ACS) or percutaneous coronary intervention.

Methods: Patients were recruited to attend three 1-h monthly visits. The intervention included assessment of clinical symptoms and guideline-based treatments; education regarding CAD/ACS; review of nutrition, exercise, and appropriate referrals; and recognition of significant symptoms and emergency response.

Results: Two hundred thirteen (84.5%) completed the program. Physician approval for patient participation was 99%. Average age was 63 ± 11 years, 70% were male, and 89% white. At baseline, 61% ($n = 133$) had one or more cardiopulmonary symptoms, which declined to 30% at 12 weeks, $p < .001$. Sixty-nine percent attended cardiac rehabilitation or an exercise consult. Compared to the initial assessment, an additional 20% were at low-density lipoprotein cholesterol < 70 mg/dL ($p = .04$), an additional 35% met exercise goals ($p < .0001$), and there was an improvement in the mental (baseline 49.7 vs. 12 weeks 53, $p = .0015$) and physical components (44 vs. 48, $p = .002$) of the SF-12 health survey.

Conclusion: This NP-based CAD-DM program was well received and participants demonstrated improvement in physical and mental health, and increased compliance with recommended lifestyle changes.

Introduction

Approximately 1.4 million hospitalizations occur annually for acute coronary syndromes (ACS), which include ST segment myocardial infarction (STEMI), non-STEMI (NSTEMI), and unstable angina (UA) (Roger et al., 2012). Despite advances in treatment and the availability of evidence-based guidelines for ACS management, there is a treatment paradox in which higher risk patients are less likely to receive secondary prevention measures (Motivala et al., 2011; Smith et al., 2006). Almost 20% of ACS patients are rehospitalized within 1 year of discharge, accounting for 60% of the direct costs related to managing ACS (Kolansky, 2009). Mensin et al. reported the mean per-patient cost of care in the first year following an ACS event, for labor age patients, was almost $23,000 per patient more than the first event itself (Kolansky, 2009; Menzin, Wygant, Hauch, Jackel, & Friedman, 2008; Shetty, Halpern, & McCollam, 2008).

Cost-effective secondary coronary artery disease prevention strategies continue to improve patient outcomes, reduce unnecessary healthcare expenditures, but evidence suggests that up to 26% of opportunities to provide guideline-recommended care are missed (Peterson et al., 2006). Thus, disease management programs have emerged as an avenue in which evidence-based care is provided to

a population defined by a common illness that requires significant self-care efforts (Clark, Hartling, Vandermeer, & McAlister, 2005; Faxon et al., 2004; Peterson, Albert, Amin, Patterson, & Fonarow, 2008; Turner et al., 2008).

Care provided by nurse practitioners (NPs) has a high satisfaction rate, clinical outcomes similar to physicians, and is cost effective (Bauer, 2010; Mattke, Seid, & Ma, 2007). NPs place a high value on prevention, emphasize active listening, and focus education and coaching on both their patients and families to promote self-care behaviors (Bauer, 2010; Budzi, Lurie, Singh, & Hooker, 2010; DiMatteo, 2004; Watts, Gee, & O'Day, 2009).

We hypothesized that patients with ACS or post-percutaneous coronary intervention (PCI) who attended an NP-based coronary artery disease management program (CAD-DM) postdischarge would demonstrate improved compliance with evidence-based self-care behaviors for risk factor reduction, display improvement in both physical and mental health, and express high satisfaction with their care.

Methods

Patients who were employed by one of two local large corporations, covered under the company-sponsored Blue Cross-Blue Shield (BC-BS) health insurance plan, and were discharged from a university hospital between 2001 and 2007 with a diagnosis of ACS or elective PCI were eligible for the CAD-DM program. Sponsorship for this program was provided by a grant from the University Disease Management Program that received funding from the two corporations and BC-BS. The goal of funding was to identify diseases with a high risk for readmission and design programs to improve care at the same or reduced cost.

After obtaining physician approval, patients were contacted by a trained research assistant to determine eligibility and interest in participating in the program. The program was described to the patient as an effort on the part of the cardiovascular care team to help the primary care physician and cardiologist improve their care, particularly in light of the short length of hospital stay. Patients were made aware that it was entirely voluntary, the cost would be assumed by their employer, and the objectives of the program were to facilitate understanding of the disease process, proper medication use, and lifestyle modifications to reduce the likelihood of a future event. At the time of the first visit, written informed consent was obtained for participation and follow-up as approved by the University of Michigan Institutional Review Board.

The goals of the program were to (a) see patients within 2 weeks of hospital discharge, (b) assess the initiation or compliance with evidence-based secondary coronary prevention treatments prescribed at discharge, and (c) assess cardiovascular symptoms and risk factors with emphasis on lifestyle modification. The program consisted of three 1-h visits with an experienced cardiovascular NP over a 12-week period. Patients were seen for a baseline visit with return appointments 1 and 3 months from the initial visit. If needed, the NP would see patients, between these visits, for continuation of care. Every patient received individualized education by the NP at each visit, based on risk factors, knowledge deficits, and patient requests. Spouse and family participation was highly encouraged (DiMatteo, 2004).

A summary of the program is presented in Figure 1. At the initial visit, a comprehensive cardiovascular risk assessment included blood pressure, heart rate, weight, waist circumference, height, physical exam, electrocardiogram, fasting lipid panel, and basic metabolic profile. Quality of life (QoL) was assessed using the SF-12 Heath Survey (SF-12) (Ware, Koskinski, & Keller, 1999), depression was assessed by the Patient Health Questionnaire (PHQ-9) questionnaire (McManus, Pipkin, & Whooley, 2005), and coronary artery disease and coronary risk factor knowledge by way of a nonvalidated 22-item questionnaire developed by the NP. Questions centered around cardiovascular risk factors, appropriate response to acute chest pain, lipid, blood pressure, and exercise goals, foods low in saturated fat/cholesterol, and impact of smoking, obesity, and diabetes to heart disease. Scoring was expressed as a percentile of correct answers. A Likert scale of 1–10 was used to assess patient's readiness to change in the areas of diet, exercise, stress management, and smoking, which was adopted from the modified works of Prochaska et al. (Prochaska, DiClemente, & Norcross, 1992). At the conclusion of each visit, patients were asked to rate (Likert scale) their confidence to adequately manage their coronary artery disease.

Statistical analysis

All continuous variables are presented as mean ± 1 standard deviation and categorical variables are presented as frequencies and percentages. Paired *t*-tests were used for continuous variables from baseline to the end of the 12-week program. McNemar's chi-square and exact tests were used for changes in proportions of categorical variables. All analyses were performed using SAS V9.1.

Results

A total of 674 patients were screened for eligibility. Approximately half (n = 353, 52.4%) declined participation or did not respond, 38 (5.6%) patients were

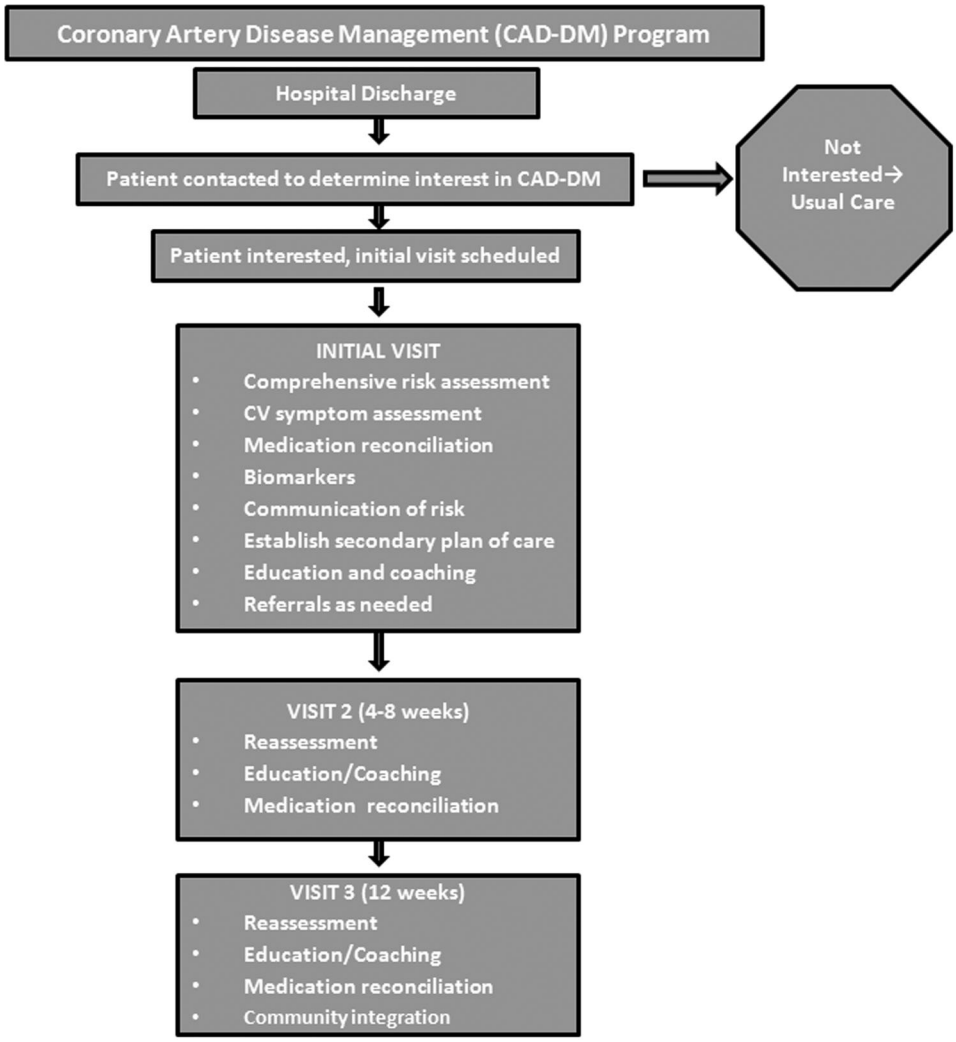

Figure 1 The CAD-DM process flow for patients who participated.

ineligible, and 31 (4.6%) patients agreed to participate but did not attend the initial visit. Of the remaining 252 patients who attended the first visit, 22 (8.7%) did not return despite NP recommendation, 13 (5%) were seen more than once but dropped out before the third visit, 1 (0.4%) died of a cardiac event, and 3 (1.2%) had missing data. The final analysis included the 213 patients (33.4% of the eligible patients) who completed the program. The mean number of days from discharge to initial visit was 36.4 ± 28.4 days (median 30 days). Patients were asked to report their readiness to change habits in diet, exercise, and stress management. Results at baseline and 12 weeks indicated a motivated group with a score greater than 8 (1 = *not thinking of changing* and 10 = *very ready to change*) in all three categories.

Baseline characteristics of the participants are described in Table 1. Mean age was 63 ± 11 years. The study cohort was composed of predominantly Caucasian males who were married and well educated, and with a family income less than $75,000. Ninety-three percent of participants had an ACS of which 59% had UA, 19% an NSTEMI, and 15% a STEMI, and 4% an elective PCI (Table 2). Over 90% of those with an ACS underwent a PCI, of which over 90% received stents. Prior to the index event, 63% of patient's had hypertension, 30.5% had diabetes, 55% had chronic obstructive pulmonary disease, 34% had preexisting coronary heart disease, and 36% had previous coronary revascularization (Table 2).

The drug therapies at the initial visit and 12 weeks are presented in Table 3. The high use of evidence-based medications at initial visit reflects the discharge planning process that required the discharging physician to document reasons why they did not recommend guideline-based therapies.

Table 1 Demographics

Variable	Number (%)
Age	63 ± 11.0 years
Gender	
Male	149 (70)
Female	64 (30)
Ethnicity	
Caucasian	190 (89.2)
African American	13 (6.1)
Other	10 (4.7)
Marital status	
Married	162 (76)
Divorced	26 (12)
Single	13 (6)
Widowed	11 (5)
Education	
High school	41 (19.2)
Some college/associate	75 (35.2)
Bachelor's degree	35 (16.4)
Graduate degree	58 (27.2)
Income	
Less than $50K	91 (42.7)
$50K–$74,999	37 (17.4)
$75K or more	53 (24.9)

Table 2 Clinical indication for CAD-DM and past history

	Number (%)
Acute coronary syndrome	% PCI
STEMI[a]	31 (14.5) 94%
NSTEMI[a]	41 (19.2) 87%
Unstable angina	126 (59.1) 92%
Elective PCI	9 (4.2)
Past history	
Carotid artery disease	19 (9)
Chronic renal insufficiency	12 (6)
COPD[a]	117 (55)
Coronary heart disease	72 (34)
CABG[a]	22 (11)
Percutaneous coronary intervention	33 (19)
Both (CABG + PCI)	11 (5.5)
Diabetes	56 (30.5)
Hypertension	134 (63)
Peripheral vascular occlusive disease	9 (4)
Stroke	3 (1)

STEMI, ST segment elevation myocardial infarction; NSTEMI, non-ST segment elevation myocardial infarction; PCI, percutaneous coronary intervention; COPD, chronic obstructive pulmonary disease; CABG, coronary artery bypass grafting.

Coronary risk factors

All patients were provided education and counseling on cardiovascular risk factors including: smoking, blood pressure, lipids, exercise, weight, diabetes, and stress per the American Heart Association/American College of Cardiology (AHA/ACC) guidelines. Initial and 12-week values for coronary risk variables are summarized in Table 3. The number of patients not at blood pressure goal decreased over the course of the program from 17.8% to 15.0% ($p < .001$). The NP referred 167 of the 213 (78%) patients to a certified dietitian of whom 69% attended at least one session with an average of 2.13 sessions per patient. Referrals were made based on the NP assessment of need and patient expressed desire to meet with a dietician. Mean weight loss in the obese cohort (body mass index [BMI] > 30 kg/m^2) was 4.6 ± 8.2 lbs (range 13.5 lb gain to 33.0 lb loss). At baseline, 47.9% of patients fell into the obese category, which decreased to 43.2% at 12 weeks, $p = .02$. Smoking cessation was emphasized at each visit and three of the 15 (7%) smokers quit by 12 weeks. The remaining 12 smokers who did not stop self-reported a lack of confidence to change this behavior.

The mean lipid parameters at baseline reflected the use of lipid lowering agents (Table 3). At the initial visit, 93% of subjects were taking statins and some were on combined lipid-lowering therapy (5% ezetamibe, 1.9% gemfibrozil, 3% niacin, and 1.4% fenofibrate). All therapies were continued. There were significant improvements in non-high-density lipoprotein cholesterol (non-HDL-C), low-density lipoprotein cholesterol (LDL-C), and triglycerides and a modest but nonsignificant increase in HDL-C ($p = .30$). At their initial visit, 81% of patients were at the non-HDL-C goal of <130 mg/dL, which increased at the 12-week visit to 89%, $p = .0009$. The percent of patients reaching the LDL-C treatment goal of less than 100 mg/dL also increased from 83% to 89% ($p = .047$) over the course of the program. During the study period, we modified the LDL-C goal for the ACS patients to

Table 3 Medication, lipids, and biomarkers

	Initial	12 Weeks	*p*-Value
Medications			
Aspirin	99.1%	97.7%	.08
Ace-inhibitor/ARB	66.7%	64.8%	.45
Beta-blockers	87.3%	86.4%	.62
Statins	93.0%	94.4%	.41
Omega 3 fatty acids	12.2%	60.6%	<.0001
Lipids			
Non-HDL-C (mg/dL)	107.3 ± 2.1	98.8 ± 25.8	.003
HDL-C (mg/dL)	42.8 ± 2.1	44.1 ± 14.4	.30
LDL-C (mg/dL)	80.2 ± 4.2	74.9 ± 20.4	.03
Triglycerides (mg/dL)	137.0 ± 10.6	121.5 ± 66.5	.04
Body habitus			
Weight (lbs)	197.9 ± 40.9	194.9 ± 39.1	.49
BMI* > 30 kg/m^2	47.9%	43.2%	.02

ARB, angiotensin receptor blocker; non-HDL-C, non-high-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; BMI, body mass index; lbs, pounds.

<70 mg/dL as recommended in the guidelines. The number of patients at LDL-C goal of <70 mg/dL increased by about 20% (baseline 37% vs. 45% at 12 weeks, $p = .04$). Fasting blood sugars (FBSs) were tracked only in the 56 diabetics (36% of cohort). The mean FBS at baseline was 145 ± 53 mg/dL and at 12 weeks 133 ± 62 mg/dL, $p = .12$.

Exercise

A total of 200 patients (94%) were referred to cardiac rehabilitation and 128 (64%) completed the program. One hundred thirty-three (66%) were referred by the NP and 67 (34%) by a physician prior to the patient entering the CAD-DM program. Seventy-two (36%) patients declined cardiac rehab. The major reasons included work schedule (38.8%), distance from program location or desire for a home exercise program (13.8%), and not interested (9.7%). The NP referred 38 (53%) of patients who declined cardiac rehabilitation for a 1-h consult, with an exercise specialist, to provide a personalized home exercise program and 30 (79%) attended. Patients reporting sedentary habits decreased from 55% at initial visit to 15% at 12 weeks, $p < .0001$. Patients reporting optimal exercising levels increased by threefold from 17% at baseline to 51% at 12 weeks, $p < .0001$.

Cardiovascular symptoms

Cardiovascular symptoms at the initial and 12-week visit are summarized in Figure 2. Approximately 10% of patients had classic angina (defining characteristics for ischemia) at baseline, which was reduced to 8% at 12 weeks ($p = .25$). A significant number of patients had a decrease in nonanginal chest discomfort (defining characteristics for nonischemia) at the completion of the program (17% vs. 7%, $p = .0002$). A similar reduction was found for atypical chest discomfort (defining characteristics indeterminate for ischemia or nonischemia) (12% vs. 7%, $p = .04$) and dyspnea (21%–9%, $p < .0001$). Further, there was a twofold increase in patients free of symptoms after 12 weeks (28%–59%, $p < .0001$) despite no change in medication.

Quality of life

The self-perceived QoL of patients was assessed at initial and 12-week visits by the SF-12 questionnaire on a scale of 0–100 (designed to have national norm mean 50.0 ± 10). The average mental component score (adult population mean 52.4) at the initial visit was 50 ± 11 and increased significantly to 53 ± 9 ($p = .002$) at 12 weeks (Figure 3). The average physical component score (adult mean 50.8) increased from 44 ± 11 to 48 ± 10 ($p = .002$).

Knowledge and satisfaction

The 22 question knowledge assessment was given at baseline and study completion. Patients' knowledge of coronary artery disease and risk factors increased from an average score of 72% ± 17% to 78% ± 15% ($p < .0001$). Patient satisfaction scores were available from 135 (63%) patients. Of these, satisfaction was rated high. On a 10-point scale satisfaction averaged 9.4 ± 1.6, with 96% of patients rating the program as 8 or greater.

Discussion

We hypothesized that an NP-based CAD-DM program, provided postdischarge to patients with an ACS or PCI, would result in improved compliance with evidence-based therapies for risk factor reduction, improve patients' physical and mental health, and result in high satisfaction. Our results support that the 12-week NP-based CAD-DM program is a viable and feasible means to reach these goals. It was well accepted by physicians and participating patients. While the CAD-DM program was intended to determine whether improved care and outcome could be provided at the same or reduced cost, these cost variables are beyond the scope of this report.

Patient participation was approved by over 99% of 1200 internal medicine and family practice faculty who are employees in an academic practice setting. Patients were highly satisfied with the program and 85% completed the program having attended at least three sessions including week 12. Participants were highly motivated to modify their behavior relative to diet, exercise, and stress management based on self-reported readiness to change, which are reflected in the results.

Improvement was found in the self-perception of physical and mental health as measured by the SF-12. Each of these is likely related to the decrease in cardiovascular and noncardiac symptoms and improved fitness facilitated by cardiac rehab and exercise consultations. It is reasonable to speculate that the high degree of compliance with lifestyle change and decrease in symptoms would result in improved outcomes and less use of healthcare resources. Telephone calls to the NP during work hours were infrequent but the opportunity may have helped relieve anxiety. Whether the improved knowledge, confidence, and decrease in noncardiac chest symptoms will result in fewer emergency room visits and/or hospitalizations will need to be assessed.

Blood pressure, lipid parameters, exercise frequency, and BMI status were all positively affected, including the

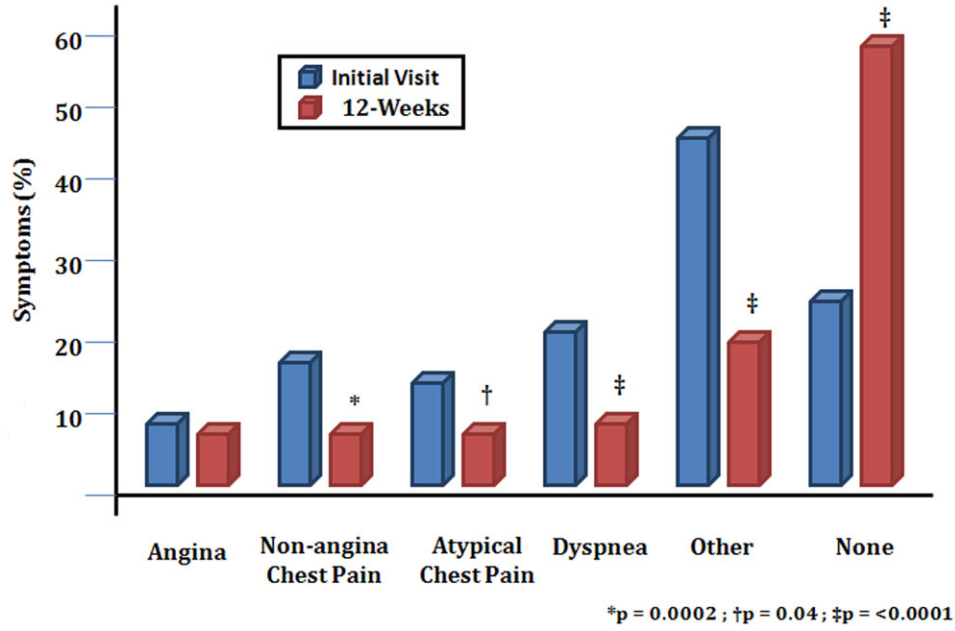

Figure 2 Cardiovascular symptoms expressed by participants at baseline and 12 weeks.

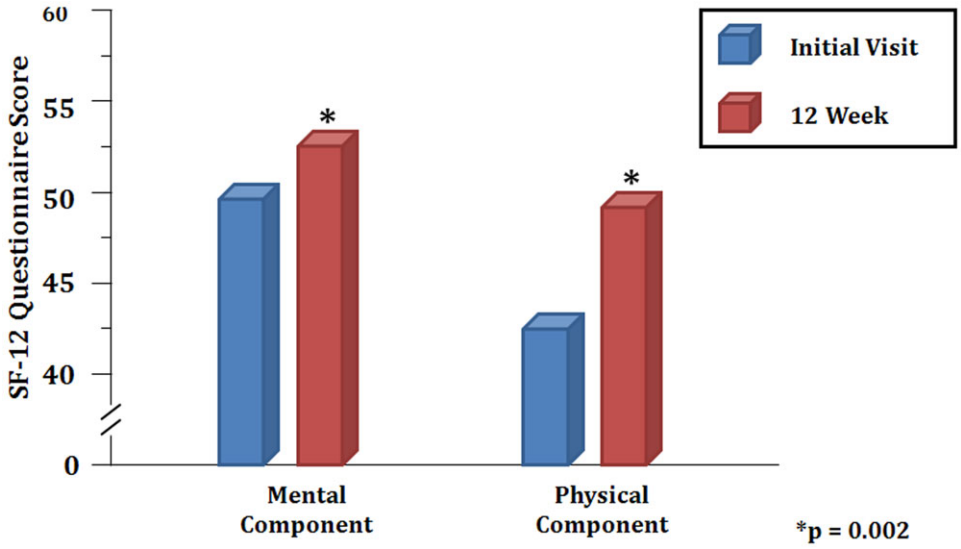

Figure 3 SF-12 Questionnaire: Mental and Physical Assessments. SPF-12 mental and physical component scores at baseline and 12 weeks.

percent of hypertensive patients achieving blood pressure goal and on-target lipid values. Considering the minimal changes in medication regimens, the improvement in risk factors appears to be related to improved lifestyle and medication compliance. Patients reported increased compliance with statin therapy, implementation of a low fat, low cholesterol diet, and increase in exercise. Low HDL-C is predictive of future coronary artery disease events in patients with prior ACS and at the time of this study was recommended as a target for treatment (Davidson & Rosenson, 2009). HDL-C trended upwards but not significantly. Niacin was recommended to one third of the patients, but most often was refused or stopped because of side effects. Cardiac rehabilitation following an ACS and PCI reduces the risk of future events and mortality and is strongly recommended by

guidelines (Hammill, Curtis, Schulman, & Whellan, 2010; Motivala et al., 2011). Yet the rate of cardiac rehab referral is only about 20% and there is a significant 50% drop-off (10%–12% participate) from referral to enrollment (Boyden, Rubenfire, & Franklin, 2010). Similarly, of the 133 patients referred to cardiac rehab by the NP, only 71 (53%) completed the program. Sixty-two (47%) patients dropped out for various reasons, the majority because of work schedules or distance from the rehab center. Thirty-eight (52%) of the dropouts were referred to an exercise specialist for development of a home program, of which 30 attended.

The majority of our patients at initial visit were already taking established AHA/ACC evidence-based secondary prevention medications in large part because of quality improvement activities in our institution (Eagle et al., 2004). Many studies describe a decline in medication compliance over time, but this was not the case in our study. In fact, persistence of combined pharmacotherapy regimens of aspirin, beta-blockers, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, and statins remained through the completion of the program. There was a significant increase in use of omega 3 fatty acids (12.2% vs. 60.6%). Given that this supplement was not typically prescribed at hospital discharge, this was an expected finding. Finally, the adherence with evidence-based drugs in our program is similar to other NP-based care program and thought to be related to the vigilance in education, monitoring for adverse effects, modifying doses as needed, and stressing of the value of medication compliance (McPherson, Swenson, Pine, & Leimer, 2002; Raftery, Guiqing, Murchie, Campbell, & Ritchie, 2005; Vale et al., 2003).

Limitations

There are several limitations to this report. We recognize that the population served is fairly specific (white males, well educated, who have a job, with an income less than $75,000 per year), which limits generalizability. The physician acceptance and improvement found in each of the metrics evaluated may not be generalizable in nonacademic or private practice settings. We have no ability to assess the degree to which participation and benefits can be attributed to program sponsorship by the employer and/or insurance carrier. While the program was well received, less than 50% participated, which may improve with a more timely entry rather than median 30 days from discharge. Barriers to timely patient entry into the program included delayed hospital discharge reporting to our research assistant, delayed approval by the primary care physician, and delayed patient response to the initial phone call to determine interest. Lastly, we recognize that those who chose to participate in the CAD-DM program may be a more motivated group and may not be representative of the entire post-ACS population.

Conclusion

The NP-based model for coronary care and coronary risk factor modification in stable coronary disease has been shown to be effective and cost effective compared to the medical model (McPherson et al., 2002; Murchie, Campbell, Ritchie, Simpson, & Thain, 2003; Raftery et al., 2005; Vale et al., 2003). Our results extend those observations to the postdischarge ACS and PCI patients. This project demonstrated marked reduction in symptoms and acceptance of lifestyle change and medication compliance. Patient and physicians were highly satisfied with the care and the outcomes. The care was patient centered and achieved a high level of guideline-based goals for secondary prevention.

The NP disease management model postdischarge provides much-needed transitional care and is a complimentary approach to the medical model. Among the unique characteristics of the cardiovascular NP practice pattern includes longer time allotment for listening to patient and significant others concerns, improved availability to patients and family members, emphasis on education, and liberal referral to supportive services.

Based upon the evidence of secondary prevention program results in stable coronary artery disease, it is likely that postdischarge CAD-DM programs will lead to improved outcomes and less use of healthcare resources (Clark et al., 2005; Delaney, Murchi, Lee, Ritchie, & Campbell, 2007; Ma et al., 2009; McPherson et al., 2002; Murchie et al., 2003; Raftery et al., 2005; Vale et al., 2003). The true measure of benefit of the postdischarge ACS and PCI program will require a randomized controlled trial comparing NP disease management to conventional care.

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