

Appendix A.1
Of the
Evaluation of Lifestyle Modification and Cardiac
Rehabilitation in Medicare Beneficiaries*

Impact and Cost-Effectiveness of the Medicare Lifestyle
Modification Program Demonstration

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INTRODUCTION

Cardiovascular diseases, including high blood pressure, stroke, and coronary heart disease (CHD), impose enormous economic and health burdens worldwide, leading to illness, disability, lost productivity and premature death. In the U.S., total costs of coronary heart disease alone were estimated at \$156 billion for 2008 (Rosamond et al. 2008). Approximately one in five deaths annually in the United States is attributable to CHD, making it the leading cause of death each year (Rosamond et al. 2008). More than 451,000 people died of CHD in 2004, and an estimated 1.2 million new or recurrent heart attacks occur annually (Rosamond et al. 2008). The large majority (82%) of CHD deaths are in individuals aged 65 or older (Rosamond et al. 2008).

Although major advances in the treatment of cardiovascular disease have occurred in recent years, the success of prevention efforts aimed at changing individual behavioral risk factors has been mixed. For example, while rates of smoking among adults have decreased over the past four decades, other critical risk factors for cardiovascular disease, such as obesity and physical inactivity, remain serious problems. Lifestyle modification programs, including cardiac rehabilitation (CR) services, are interventions that target multiple risk factors and can serve to prevent, control, and potentially reverse cardiovascular disease. CR services are currently the only lifestyle modification program given national coverage by Medicare. Furthermore, in 1997, only 18% of Medicare beneficiaries hospitalized for CHD with a definite indication for CR and only 12% of those with a probable indication actually enrolled in CR (Suaya et al. 2007).

In an effort to assess lifestyle modification approaches for CHD, the Centers for Medicare & Medicaid Services (CMS) implemented the Lifestyle Modification Program Demonstration (LMPD) in 1999 under a congressional mandate. This payment demonstration was designed to test the feasibility and cost-effectiveness of providing either the Dr. Dean Ornish Program for Reversing Heart Disease® (Ornish) or the Mind/Body Medical Institute's Cardiac Wellness Program (M/BMI) (founded by Dr. Herbert Benson) for Medicare beneficiaries with coronary heart disease. The program enrolled 589 Medicare beneficiaries with at least one of four qualifying cardiac events: angina, acute myocardial infarction (AMI), cardiac artery bypass surgery (CABG), or percutaneous coronary intervention (PCI) (i.e., stent placement). Researchers at Brandeis University's Schneider Institutes for Health Policy performed a process and outcomes evaluation. Separate reports have examined the costs of lifestyle services (Lee et al., in press), selection effects in enrollment (Bhalotra et al. 2009), impact on behaviors (Razavi et al. 2009), impacts on cardiac risk factors (Stason et al. 2009), and utilization and mortality benefits of cardiac rehabilitation (Suaya et al. 2007, 2009).

The present study uses Medicare claims data in a matched-pair analysis to assess the impacts on cardiovascular events, mortality, costs, and the cost-effectiveness of the LMPD. The study uses an intention to treat analysis, despite drop-outs.

METHODS

Subject selection

Subjects were participants in the LMPD who were enrolled in fee-for-service Medicare and matched controls who were identified using Medicare claims data.

Lifestyle Modification Program Demonstration subjects. The demonstration encompassed 23 sites that provided the Ornish Program and 9 sites that provided the M/BMI program. A total of 589 participants entered the demonstration between June 1, 2000 and February 28, 2006, including 442 M/BMI program participants and 147 Ornish program participants. Specific inclusion and exclusion criteria for LMPD participants are described in detail in Stason et al. (2009). Exclusion criteria included certain high risk conditions related to heart disease, impaired cognitive function, and smoking (Ornish program only). Enrollment was authorized through another CMS contractor, the Delmarva Foundation for Medical Care (DFMC). DFMC is a not for profit health care quality improvement company. DFMC's quality monitoring responsibilities included enrollment legibility review to assure that the patient met the demonstration enrollment criteria as well as either the Ornish or MBMI enrollment criteria. After enrollment, DFMC then performed ongoing quality monitoring activities for each beneficiary to ensure that each site operated safely and followed the guidelines agreed with CMS. DFMC's statistics used slightly different criteria and, therefore, counted 593 enrollment cases, 4 more than reported here¹. Of the 589 participants based on Brandeis' criteria, 461 (78%) were enrolled in fee-for-service Medicare; of these, 324 were M/BMI program participants and 137 were Ornish program participants. Only data from this subset of LMPD participants and their matched controls were analyzed for this study, because Medicare claims data are not available for beneficiaries enrolled in health maintenance organizations (HMOs).

Control subjects. The evaluators developed an algorithm to identify matched controls from Medicare claims data for each LMPD participant. Matching was based on the premise that risk

¹ The 593 cases in the analysis by Rodgers et al. (2009) include 2 beneficiaries who re-enrolled after being discharged from the program for insufficient participation and 2 beneficiaries who disenrolled on the same day they had enrolled. Brandeis counted unduplicated patients who entered the program with an intent to continue beyond the first session. Section 4 of Rodgers et al. (2009) provides more detail on the 593 cases.

depends on the type of cardiac event that made a patient eligible for the demonstration, the time between that event and enrollment in the demonstration (or the start of follow-up), and other risk indicators (demographics and predicted Medicare costs). First, potential controls were identified using Medicare claims data for Medicare enrollees living within a 25-mile radius of a particular program site if the site was in an urban area, or within a 50-mile radius if the site was in a rural area. Potential controls who had ICD-9-CM diagnosis codes indicating coronary heart disease in this 12 month period, who had been in fee-for-service Medicare for the most recent 12 months and had Part B Medicare were classified by their most recent cardiac (i.e. “qualifying”) event as of their pseudo-enrollment date, as described below, into 4 clinical subgroups: acute myocardial infarction, (AMI) coronary artery bypass graft (CABG) surgery, percutaneous coronary intervention (PCI or stent) without CABG, or stable angina.

Potential controls within each clinical group were stratified into two subgroups depending on whether or not they had received CR within six months following their qualifying clinical event. Within clinical subgroups, potential controls were matched to participants on: 1) the time lag between the date of the qualifying event and enrollment in the LMPD or pseudo-enrollment (described below) as a potential control; 2) age; 3) gender; and 4) DxCG score, a continuous case-mix adjustment score based on the software chosen by CMS for risk adjustment in Medicare+Choice plans. We matched exactly by gender and qualifying event, as well as the time lag (to the nearest month) between the qualifying event and enrollment into LMPD or CR. For age and DxCG score, we defined an index where a difference of one decade of age was equivalent to one point (i.e. a 100% change) in DxCG score.

A “pseudo-enrollment date” was calculated for each control based on the interval (in whole months) between the date of the participant’s qualifying event and enrollment date, and was used to determine the start of each control’s follow-up period. We tried to find two “CR” and two “Non-CR” controls for each participant and succeeded for 421 (91%) of participants. We were unable to identify controls for the remaining 9% of participants because some demographic categories did not contain enough potential controls, or initial errors occurred in claims or matching. Altogether we found 898 non-CR controls and 897 CR controls and averaged 1.95 matches per participant. Weighting was used (weight=2) when there was only one control identified per participant in each control set.

Data sources

The primary data sources were Medicare’s National Claims History files, standard analytic files, and Medicare eligibility/denominator files for years 1998-2008. Medicare’s master enrollment database included information on date of birth, sex, date of death (where applicable), residence

zip code, Medicare entitlements over time and group health plan membership. In addition, CMS's payment file for the LMPD was used to sum the quarterly payments to sites for each LMPD participant. We analyzed one year of pre-enrollment and two to three follow-up years of claims data for each subject. To ensure that we analyzed only complete follow-up data for participants and controls, we limited the three years of data to the 339 participants who enrolled in the demonstration before September 1, 2005. Use of CR services was defined as Medicare reimbursement for at least one CR session within six months after the qualifying event.

Primary outcomes

The primary outcomes for the study were time to first hospitalization and time to first cardiovascular hospitalization in the two or three years post-enrollment. In order to identify cardiovascular events, claims were classified by their principal diagnosis into cardiovascular or non-cardiovascular events. The cardiovascular classification was based on the hierarchical clinical categories number 16 (cardiac), 17 (cardiovascular), or 18 (peripheral vascular disease) used in the DxCG program for risk adjustment. If a patient was transferred from one hospital to another, only the initial admission was counted as a separate hospitalization. Participants who enrolled in the demonstration after August 31, 2005 were excluded from the analysis in the third year, as were as their CR controls and non-CR controls, since we were not able to observe medical events for them for a complete third year of follow-up.

Mortality rates were examined descriptively, as well as with analytical approaches using Cox regression and Kaplan-Meier survival curves. Among 2,256 subjects in the analysis, we obtained the survival information for 2,230, leaving 26 individuals unknown. We assumed that these 26 individuals were still alive at the end of the three years of follow-up. For those subjects who died beyond the time horizon of three years, their survival time is truncated to 1,095 days (3 years). As our approach to survival analysis excludes the possibility of surviving longer than three years, it understates actual survival and actual gains from reductions in risk of hospitalization or death. Nevertheless, it provides a consistent, data-driven measure of results.

Additional outcomes examined were number of hospitalizations of any type and number of hospitalizations for cardiovascular events by program type and by year.

Cost analysis

Costs were assessed from the point of view of the Medicare program for the pre-enrollment and follow-up periods and included amounts paid by Medicare for medical services beginning one year prior to enrollment (or the pseudo-enrollment date for controls) and ending two or three years after enrollment. For LMPD participants, total costs included the demonstration payments

made by CMS to the sites where lifestyle modification services were performed. Costs were analyzed by enrollment year, where the first follow-up year for each participant or control began the day of his or her enrollment or pseudo-enrollment. Costs prior to enrollment (termed pre-costs) were tallied as a covariate in the analysis, while costs after the enrollment date were an outcome measure. All patients were in fee-for-service Medicare at the time of the enrollment date. We examined Medicare claims for services covered at the start of demonstration (i.e., all except medications under Part D). Missing values for skilled nursing facilities (SNF), home health agency (HHA) and durable medical equipment (DME) expenditures were imputed as described below.

Imputation of missing values for skilled nursing facility (SNF) and home health agency (HHA) claims. Because of limitations in retrieving information from The CMS Data Extraction System (DESY) for early years, actual data for SNF and HHA were available only from 2004. We were not able to obtain full information for subjects who enrolled before January 1, 2005 for the costing analysis. Table 1 shows the missing pattern.

Table 1. Types of follow up data missing (denoted by check marks)

Enrollment year	Follow up year			
	Pre-enrollment	Year 1	Year 2	Year 3
Thru 2001	√	√	√	√
2002	√	√	√	
2003	√	√		
2004	√			

We imputed costs of SNF and HHA based on the costs on inpatient, outpatient, and physician visits in the same year. To generate these imputations, we fitted two regression models with available data on costs of SNF and HHA as dependent variables, respectively (transformed with the started log), and costs of inpatient, outpatients and physician visits as independent variables (log transformed). We then inverted the predicted values from the regression models for the observations with missing values (by exponentiating the predicted values subtracting on the started log scale and then subtracting 1). Imputed values were truncated to 0 if they were negative.

Imputation for DME. Because data on DME spending were not available and these claims represent only a small share of Medicare spending, we obtained the average annual spending per Medicare enrollee for DME up to 2004 from the CMS website. The average annual growth

rate of 7.5% for 1991-2004 was then applied to impute the annual expenditure on DME for 2005-2008.

Cost-effectiveness analysis

The framework for the cost-effectiveness analysis included net costs (in monetary terms) and net effectiveness measured as the gain in hospitalization-free years. The perspective was that of the Medicare program. Both costs and hospitalization-free years were discounted at the recommended rate of 3% per year (assuming that costs occurred at the midpoint of each year), and all results reflect constant 2007 prices. Price changes were adjusted using the medical care component of the Consumer Price Index compiled by the Bureau of Labor Statistics (website: <http://www.bls.gov/cpi/>, accessed September 10, 2008).

Multivariate analyses

Separate multivariate analyses were conducted for costs and for cardiovascular hospitalizations. Multivariate cost analyses were conducted using hierarchical linear modeling (HLM) with panel data, in which the dependent variable was total Medicare spending, as described earlier. Independent variables in HLM models included the one-year pre-enrollment Medicare costs, subject's qualifying event, gender, age (in years), program type (M/BMI program, Ornish program, CR, or non-CR group), and year of follow-up (1 or 2). Multivariate analyses of time to hospitalizations were conducted using survival analysis. Survival analyses examined time in days to any type of hospitalization after enrollment and time in days to hospitalization for a principal diagnosis of cardiovascular disease after enrollment as dependent variables. Independent variables in these proportional hazard models included program type (M/BMI program, Ornish program, CR or non-CR group), type of qualifying event, gender, and age (in years).

RESULTS

All the follow-up analyses were based on 461 participants (324 M/BMI and 137 Ornish), 897 CR controls (627 and 270 matched for M/BMI and Ornish, respectively) and 898 non-CR controls (626 and 272 matched for M/BMI and Ornish, respectively) for year zero, year one and year two. For year three, analyses were based on 339 participants (220 M/BMI and 119 Ornish, respectively), 656 CR controls (422 and 234 for M/BMI and Ornish, respectively), and 662 non-CR controls (426 and 236 for M/BMI and Ornish).

Descriptive findings on cardiovascular events

Number of hospitalizations. Tables 2 and 3 show the average number of hospitalizations of any type and the average number of hospitalizations for cardiovascular events by program type and

year. For the M/BMI group, the average number of hospitalizations for any reason was significantly lower than that of its matched CR and non-CR groups in all years, including baseline. M/BMI program participants also had significantly fewer hospitalizations for cardiovascular reasons in year zero and year 1, but not in the last two years of follow-up, compared to either matched control group. Given the pre-enrollment year differences, these findings suggest an inherent limitation in the matching process for M/BMI program enrollees based on claims data.

Table 2. Number of hospitalizations for M/BMI program participants and controls by year

Year	Non-CR controls	CR controls	M/BMI	Total
<u>A. Any hospitalization</u>				
Pre-enrollment year*	0.97	1.03	0.87	0.97
Year 1*	0.51	0.51	0.25	0.46
Year 2*	0.43	0.44	0.30	0.41
Year 3*	0.44	0.44	0.19	0.39
<u>B. Cardiovascular hospitalization</u>				
Pre-enrollment year*	0.79	0.85	0.72	0.80
Year 1*	0.24	0.22	0.09	0.20
Year 2 (NS)	0.18	0.19	0.11	0.17
Year 3 (NS)	0.17	0.16	0.09	0.15

*p<0.05; NS (not significant) denotes p>0.05 for comparison among groups; CR denotes cardiac rehabilitation; M/BMI denotes Mind/Body Medical Institute

Table 3. Number of hospitalizations for Ornish program participants and controls by year

Year	Non-CR controls	CR controls	Ornish	Total
<u>A. Any hospitalization</u>				
Pre-enrollment year (NS)	0.96	0.84	0.72	0.86
Year 1*	0.47	0.45	0.26	0.42
Year 2*	0.48	0.42	0.24	0.41
Year 3 (NS)	0.34	0.35	0.34	0.34
<u>B. Cardiovascular hospitalization</u>				
Pre-enrollment year (NS)	0.66	0.73	0.58	0.67
Year 1 (NS)	0.18	0.23	0.16	0.2
Year 2 (NS)	0.19	0.23	0.07	0.18
Year 3 (NS)	0.11	0.12	0.2	0.13

*p<0.05; NS (not significant) denotes p>0.05 for comparison among groups; CR denotes cardiac rehabilitation; M/BMI denotes Mind/Body Medical Institute

A different pattern was found for the Ornish group. For Ornish program participants, there were no statistically significant differences ($p < 0.05$) in hospitalizations for any reason and in hospitalizations for cardiovascular reasons when compared to controls, with two exceptions: In years 1 and 2 of follow-up, Ornish program participants had significantly fewer hospitalizations for any reasons than did the matched CR and non-CR groups.

Time to hospitalization. By the end of the third year of follow-up, a higher percentage (82.1%) of M/BMI program participants had no hospitalization for cardiovascular reasons, compared to matched CR and non-CR controls (68.6% and 70.3%, respectively). The difference is statistically significant ($p < 0.05$). On average, M/BMI participants lived 983 days without any cardiovascular hospitalizations compared to 876 days and 875 days for CR control and Non-CR controls, respectively. This comparison indicates that M/BMI program extends the time until the first hospitalization by 107 days (0.292 years) compared to CR controls, and by 108 days (0.296 years) for non-CR controls.

The curves in Figure 1 showing survival until a cardiovascular (CV) hospitalization indicate that M/BMI program enrollees had a lower likelihood of hospitalization than did their CR and non-CR controls. The survival of M/BMI participants until hospitalization is significantly higher than that of both types of controls (Chi sq.=21.03, df=2, $p < 0.05$), while there is little difference between the survival curves for CR controls and non-CR controls.

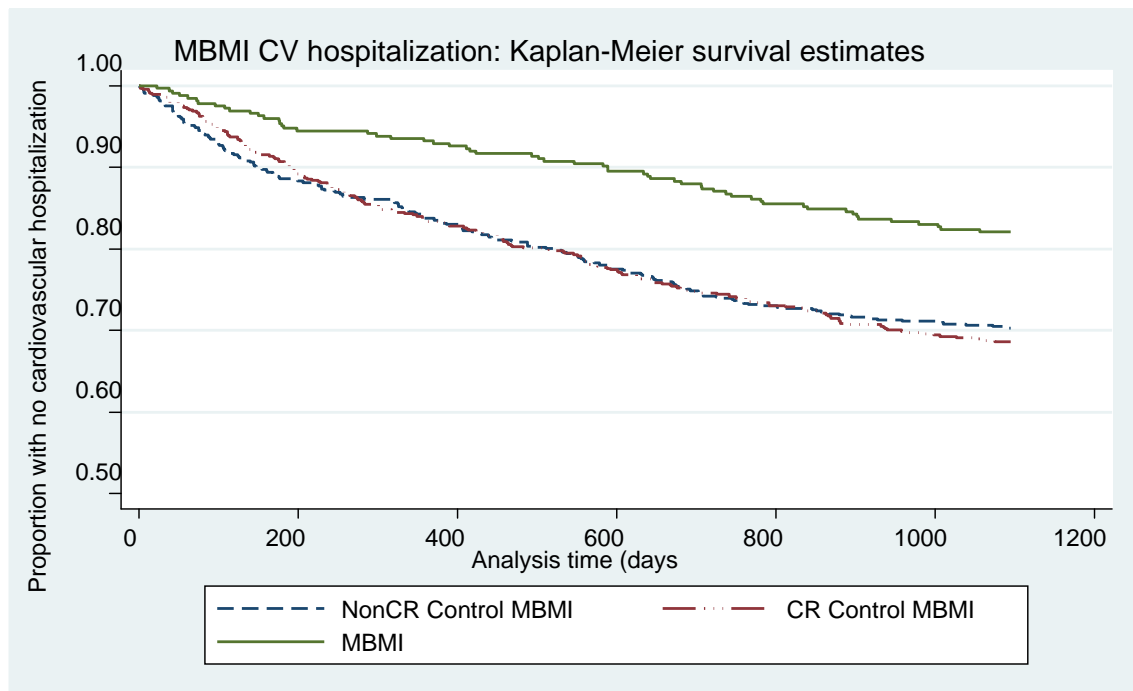


Figure 1. Survival until cardiovascular hospitalization for M/BMI program

By the end of the third year of follow-up, 67.9% of Ornish program participants had avoided a hospitalization for cardiovascular reasons, compared to 65.5% and 71.5% for matched CR control and non-CR controls. These differences were not statistically significant, however ($p > 0.05$). A typical Ornish program participant lived 922 days without cardiovascular hospitalization, saving 60 and 31 days (0.165 and 0.085 years) compared with 862 and 891 days for CR and non-CR controls respectively. Again, the difference was not significant ($p > 0.05$).

The survival curves in Figure 2 showed that while there is some difference between the Ornish program participants and matched controls, the difference is much smaller than that shown for the M/BMI group. Results for the Ornish program worsened after 900 days. The survival function of these three groups is not significant (Chi sq. = 2.04, df=2 $p > 0.05$).

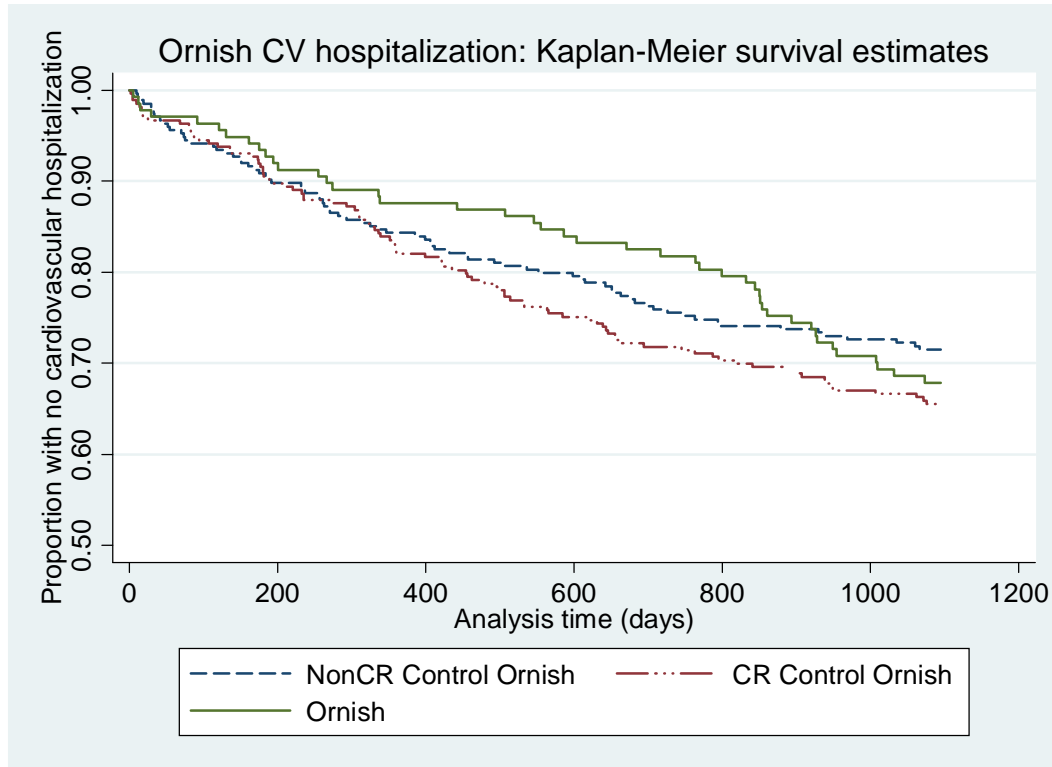


Figure 2. Survival until cardiovascular hospitalization for Ornish program

By the end of the third year, 64.2% of M/BMI program participants had not had any hospitalization, compared to 44.6% and 45.5% of the CR and non-CR control groups, respectively. The average number of days free of any hospitalization (with the censoring described above), is 861, 693 and 692 for M/BMI, CR controls and non-CR controls, respectively. The M/BMI program adds 169 hospital free days (0.463 years) compared to the CR controls and 168 hospital free days (0.460 years) compared to their non-CR controls. Similar to the results for cardiovascular hospitalizations, Figure 2 shows that the M/BMI program participants also fare

better than their matched controls on time to any hospitalization (Chisq = 38.22, df=2, $p < 0.05$).

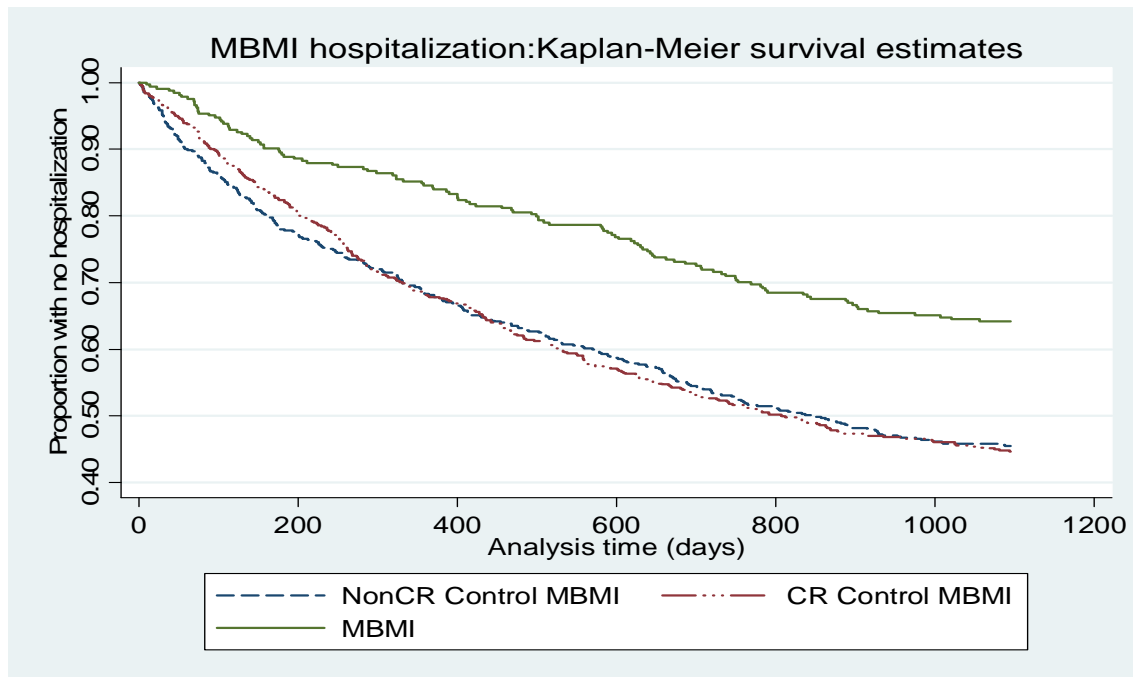


Figure 3. Survival until any hospitalization for M/BMI program

Finally, although the survival curve for the Ornish program participants appears better than that of matched controls, the difference is not significant (Chi sq.=4.6, df=2, $p=0.1003$).

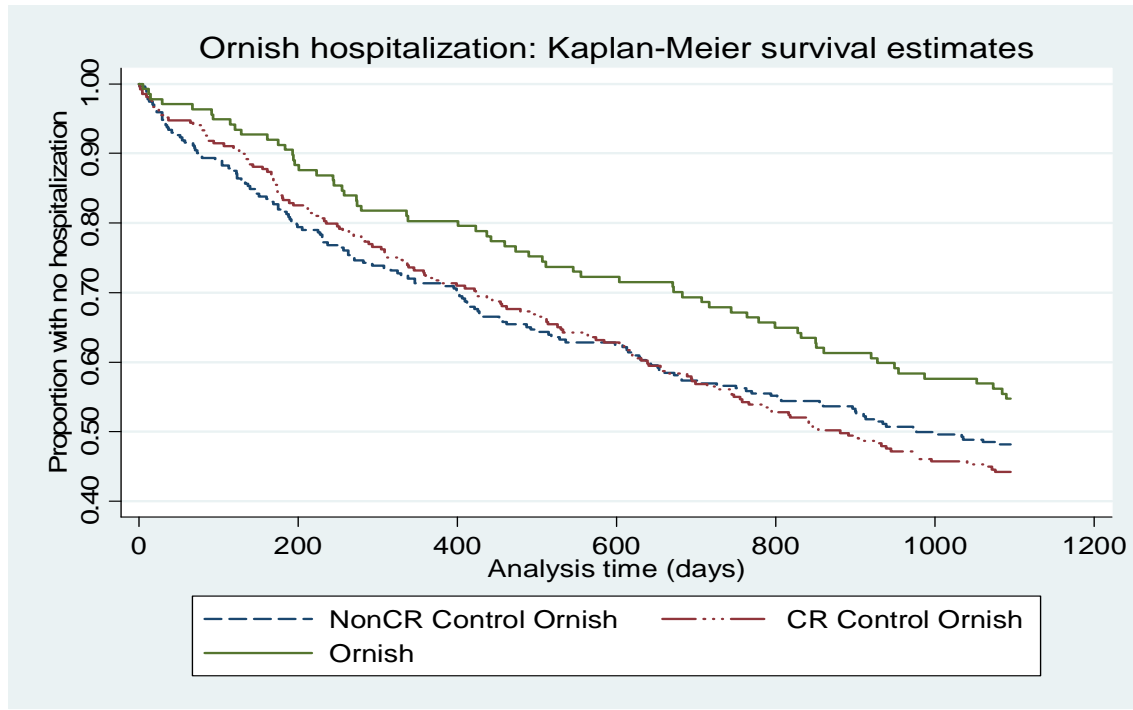


Figure 4. Survival until any hospitalization for Ornish program

Multivariate findings on time to any hospitalization and time to hospitalization for cardiovascular events

The tables in Annex 1 show the results of the proportional hazard models on time to any hospitalization and time to hospitalization for a primary diagnosis of cardiovascular disease for each LMPD group and matched controls. Results from M/BMI models indicated that older age was associated with an increase in the hazard of hospitalization at any given point in time, while having a qualifying event of cardiac artery bypass surgery were associated with a decrease in the hazard of any hospitalization at any given point in time. Participation in the M/BMI program was also associated with a decrease in the hazard of any hospitalization (hazard ratio of 0.544, $p < 0.05$) and of cardiovascular hospitalization (hazard ratio of 0.545, $p < 0.05$) at any given point in time. In Ornish models, older age was associated with an increase in the hazard of any hospitalization.

Program retention

Table 4 shows retention in each program. While both programs achieved high rates of completion of the intensive 3-month intervention period, only two thirds of participants completed the first year. The Ornish experienced further attrition in the second year, so that the M/BMI program had a higher rate of completion of 2 years. While follow-up data for the evaluation was based on all participants with available data, regardless of whether they continued to receive

demonstration services, attrition probably reduces the impact of the program, as participants who stop receiving program services are less likely to maintain the lifestyle changes.

Table 4. Enrollment and Completion Rates

Status	Ornish	M/BMI	Overall
	Program (n=147)	Program (n=442)	
Enrollment	100%	100%	100%
Completed Intensive 3-month Intervention Period	95%	82%	85%
Completed Intervention in Year 1	64%	66%	65%
Completed Follow up in Year 2	53%	64%	61%

Notation: M/BMI denotes Mind/Body Medical Institute

Descriptive findings on cost

Descriptive results compared Medicare payments for the two demonstration programs for three years from enrollment to payments on behalf of two different groups of matched controls. We also compared the groups on Medicare costs in the one year prior to enrollment. Average cost differences were calculated between M/BMI program and Ornish program enrollees and each of their two matched control groups.

The economic analysis of the demonstration hypothesized that patients would enter the demonstration before they had major initial or repeat cardiac procedures. Table 5 shows the qualifying events by LMPD enrollee group. This table shows that 64% of the 461 LMPD participants in this analysis had had a recent revascularization procedure (coronary artery bypass graft surgery or percutaneous coronary intervention (PCI) without CABG) and an additional 16% of patients had had a recent myocardial infraction (AMI). The table also shows that M/BMI program enrollees were more likely than Ornish program enrollees to have had a CABG as a qualifying event ($p < 0.05$). Similar results were also found when all 589 LMPD participants in the demonstration were examined.

Table 5. Qualifying event by LMPD program*

Qualifying Event	LMPD Program		Total
	Ornish (n=137)%	M/BMI (n=324) %	(n=461) %
Angina only	26.3	17.6	20.2
AMI	19.0	14.2	15.6
CABG	18.3	32.7	28.4
PCI or stent	36.5	35.5	35.8
Total %	100.0	100.0	100.0

*p<0.05 for differences between programs in distribution of events. Notation: LMPD denotes Lifestyle Modification Program Demonstration; M/BMI denotes Mind Body Medicine Institute; AMI denotes acute myocardial infarction; CABG denotes coronary artery bypass graft; PCI denotes percutaneous coronary intervention.

Table 6 shows average Medicare payments by group in the pre-enrollment year and the three follow-up years. This analysis found that the average Medicare payment in year zero (the year prior to enrollment) for M/BMI program participants was \$22,368, lower than the pre-enrollment expenditures for CR controls, but higher than that for non-CR controls matched to M/BMI program participants. The difference was not statistically significant, however (F=1.96, df(1)=2, df(2)=1605, p>0.05). Average expenditures for Ornish program participants in the year prior to enrollment were \$15,137, higher than both that for CR and non-CR controls matched to Ornish program participants, but these differences were also not statistically significant (F=0.46, df(1)=2, df(2)=682, p>0.05). These results indicate that the matching process was reasonably successful and that patients entered the demonstration after they had already incurred substantial costs to Medicare, as did both groups of controls. However, during year zero, M/BMI program participants had \$7,231 higher costs than Ornish program participants (t=3.28 p <0.05), perhaps due to the higher proportion of recent CABGs among M/BMI participants. The potential for cost savings lies in the possibility of preventing repeat procedures and events and their associated ambulatory costs.

Table 6. Average Medicare payments per beneficiary by program and year*

Year	Non-CR Controls	CR Controls	Lifestyle
<u>A. M/BMI Comparison</u>			
Pre-enrollment (NS)	\$21,559	\$23,930	\$22,368
Year 1 (NS)	\$8,933	\$8,519	\$9,471
Year 2 (NS)	\$7,534	\$8,709	\$7,639
Year 3*	\$8,521	\$9,013	\$5,683
<u>B. Ornish Comparison</u>			
Pre-enrollment (NS)	\$13,329	\$14,303	\$15,137
Year 1 (NS)	\$6,062	\$7,499	\$9,634
Year 2 (NS)	\$7,784	\$7,922	\$4,475
Year 3 (NS)	\$6,900	\$6,396	\$6,499

*p<0.05; NS denotes p>0.05.

Notation: M/BMI denotes Mind Body Medical Institute; CR denotes cardiac rehabilitation.

For each of the three years of follow-up, average spending in all programs was substantially lower than spending in year zero. We first performed a cost analysis on claims for LMPD participants and their matched controls for their first year after enrollment into the demonstration. Individuals' costs varied substantially from one participant or control subject to another. M/BMI program participants had *higher* costs during this year (*after* including Medicare payments for the intervention) of \$952 and \$538 compared to those receiving and not receiving CR. The difference was not statistically significant (F=0.40, df(1)=2, df(2)= 1605, p>0.05). Similar to M/BMI program participants, Ornish program participants had higher costs than CR and non-CR controls, of approximately \$2,136 and \$3,572, respectively. The difference was not statistically significant (F=2.92, df(1)=2, df(2)=682, p>0.05). A major factor in the higher costs for intervention subjects was Medicare's payments to demonstration sites, which averaged \$3,991 per participant (including those who did not complete the program), \$3,801 for M/BMI participants and \$4,441 for Ornish participants. For the 376 fee-for-service participants who completed the program, Medicare's average payment was higher, about \$4,494. Individuals' costs varied substantially, however, from one participant or control subject to another.

In the second year of follow-up, the Ornish program enrollees had substantially lower costs than the matched CR and non-CR controls (\$3,446 and \$3,309 lower, respectively, F=2.24, df(1)=2, df(2)=682, p >0.05). Year-two costs for M/BMI program enrollees were slightly higher than those

of the matched non-CR controls (\$105 higher), and lower than CR controls (\$1,070 lower). These differences were not statistically significant ($F=1.09$, $df(1)=2$, $df(2)=1605$ $p>0.05$), however.

After excluding enrollees who enrolled in the program later than Aug 31 2005, the investigators examined the costs for those who had complete year 3 claims data (339 participants). Here, M/BMI program participants showed statistically significant lower costs than their controls (\$3,330 and \$ 2,838 lower than CR and non-CR controls, respectively, ($F=3.06$, $df(1)=2$, $df(2)=1085$, $p<0.05$), while Ornish enrollees incurred slightly higher costs, of \$103, than CR controls and slightly lower costs, \$400 lower, than non-CR controls. This difference was not significant ($F=0.12$, $df(1)=2$, $df(2)=592$, $p>0.05$), however.

Over all three years of follow-up, without controlling for year zero costs and other factors, the M/BMI program saved \$3,448 and \$2,195 compared with CR controls and non-CR controls. Similarly, expenditures for the Ornish program enrollees were \$1,207 and \$137 lower than those of their CR and non-CR counterparts, respectively.

Multivariate findings on cost

Even though there were no statistically significant differences in pre-enrollment costs for both the M/BMI and Ornish programs when compared with their controls, the magnitudes of the cost differences may be important. In the multivariate analyses of total spending, investigators controlled for pre-enrollment costs by including it as a covariate, along with other independent variables thought to influence costs. Tables 2.1 to 2.4 in Annex 2 show the results of the HLM analyses, while Table 2.5 provides definitions of variables reported in Tables 2.1 to 2.4. The tables suggest that over three years, the M/BMI program could save the Medicare program \$2,315 per participant, compared with non-CR controls, ranging from a savings of \$6,083 to a cost of \$1,452 per person and the M/BMI program could save \$2,710 per participant when compared with matched CR controls. However, the results of M/BMI analyses were not statistically significant ($p>0.05$). Spending in the Ornish program was \$857 less than spending for non-CR controls and \$1,535 less than that for CR controls. However, similar to the findings for the M/BMI program, the differences were not statistically significant ($p>0.05$). In other words these findings suggest a trend toward cost savings for both programs, but due to the small estimated savings and the small sample size, the findings could be just random variation. In summary, neither program produced cost savings, nor was more costly, compared to matched CR and non-CR controls, over the three years of follow-up.

Mortality analysis

During 3 years of follow-up, 2.7% of M/BMI participants died, compared to 10.2% and 10.4% in the non-CR and CR control groups, respectively. Figure 5 shows a reduced mortality rate in the M/BMI program. The difference of the survival function is significant (Chi sq. = 19.01, df =2, p <0.05). While the mortality results are statistically significant, they may reflect case-mix differences between the LMPD groups and controls that cannot be ascertained from claims data. The LMPD demonstrated a referral proclivity toward more active patients, excluded high risk patients and current smokers (Ornish program only), and these characteristics could not be identified when selecting controls.

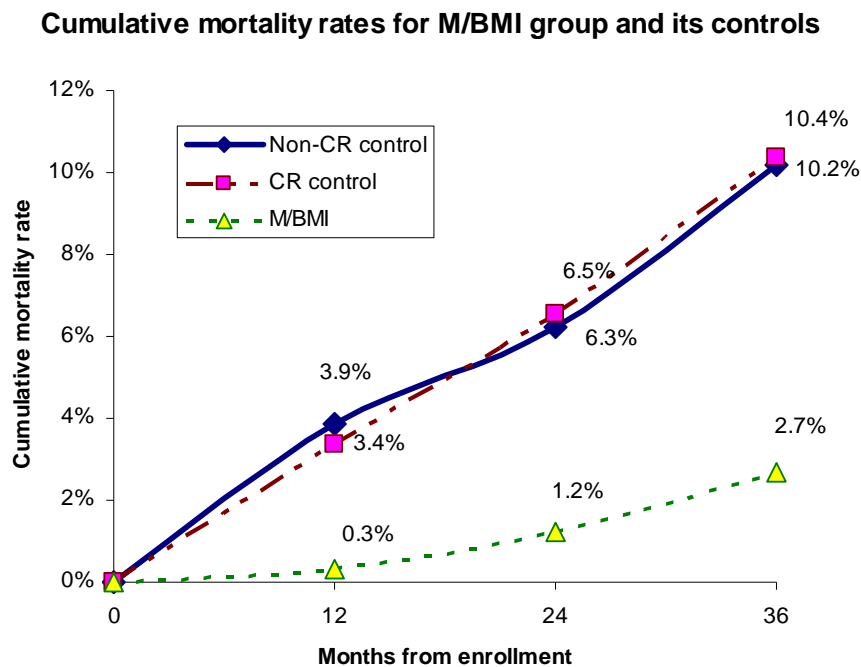


Figure 5. Mortality for M/BMI program versus controls

Figure 6 displays mortality in the Ornish program. Unlike the M/BMI program, the Ornish group does not show consistent nor significant differences in mortality among groups. In the first year of follow up, Ornish group had the highest mortality rate of 4.4% compared with its non-CR and CR control group. Cumulative mortality rate in the Ornish group grew less rapidly in year 2 and 3. The difference among groups is not significant.

Cumulative mortality rates for Ornish group and its controls

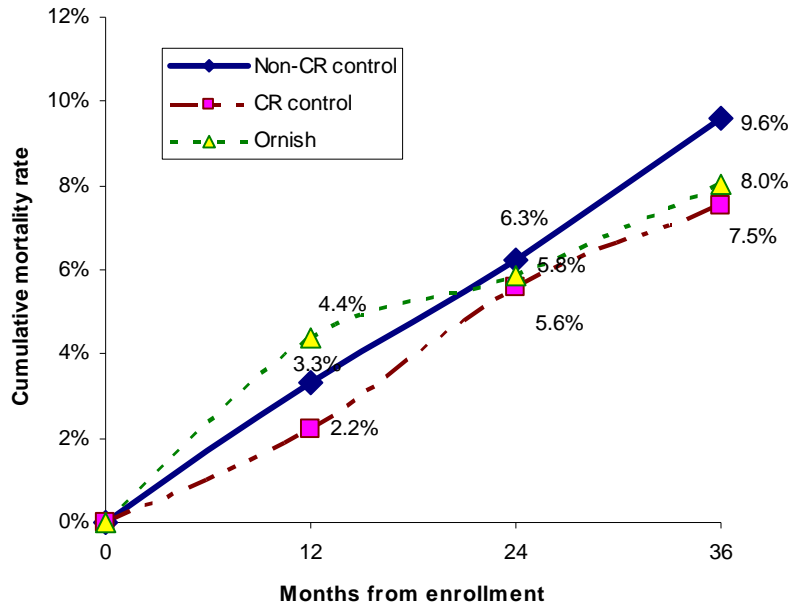


Figure 6. Mortality for Ornish program versus controls

Results of Cox regression models. Consistent with the results from the survival curve, the Cox model for the M/BMI program showed that after controlling for the individual's gender, qualifying event, and age at enrollment, the M/BMI program was able to reduce the death hazard among the participants compared with the non-CR control group. The results also indicate that beneficiaries having qualifying events of angina, CABG, and PCI or stent were less likely to die than those having an AMI; females were more likely to live longer; and the older an individual was at enrollment, the higher his or her hazard of dying during the three years of follow-up. However, in the Ornish program, two variables showing the significant impact on the death hazard were female and the age at enrollment. Their impacts are consistent to those in the M/BMI program. The Ornish program was not associated with a significant change in the death hazard.

Cost effectiveness analysis for M/BMI group

We conducted a cost-effectiveness analysis for M/BMI program. The results showed under the typical scenario, M/BMI program had dominant effects, saving the costs and lives simultaneously. Even under the worst scenario, M/BMI program is still cost-effective, using the threshold of gross domestic product (GDP) per capita in US in 2007 of \$45,800. It costs \$34,987 and \$23,695 to save a life, compared with non-CR and CR controls.

Cost-effectiveness findings

As the M/BMI program showed favorable improvement for medical outcomes, we conducted a cost effectiveness analysis (CEA) based on costing and outcome analysis for the M/BMI program. The costs were reported as net costs between intervention program and the reference group over 3 years, expressed in inflation and discounting-adjusted 2007 dollars. The benefit was reported as saved hospitalization-free years for cardiovascular hospitalization or any hospitalization. The CEA results are organized by two scenarios—the typical case and the worst case. The typical case, shown in the upper portion of Table 7, was defined as the participant with average net costs, compared with reference groups. The worst case, shown in the lower portion of that table, was defined as the participant at the upper bound of the 95% confidence interval of the net costs.

The analysis showed the dominantly favorable effects of M/BMI for the typical case scenario, with net savings for implementing the M/BMI program, and longer hospital-free years, when compared with either CR or non-CR controls. Our typical (most likely) estimate suggest better outcomes and a trend toward cost savings, while the worst case estimate suggests better outcomes at zero net cost, giving a cost-effectiveness ratio of zero.

Table 7. Cost effectiveness analyses for M/BMI program under two scenarios

Reference group	Net cost (in 2007 US\$)	Reduction in 3-year mortality	C/E ratio (cost per life saved)
<u>Typical scenario</u>			
Non-CR	-775	7.5%	Dominant
CR	-1,583	7.7%	Dominant
<u>Worst scenario</u>			
Non-CR	2,617	7.5%	34,987
CR	1,815	7.7%	23,695

Notation: CR denotes cardiac rehabilitation; M/BMI denotes Mind Body Medical Institute

Even under the worst case, the M/BMI program is highly cost-effective, as a participant whose life is saved may expect 7 to 10 years of discounted life expectancy.

The Ornish program, however, is not cost effective even under the typical case, much less under the worst case. That is because the Ornish program presents no evidence of favorable benefits on mortality. If a program is not effective, it cannot be cost-effective.

DISCUSSION AND CONCLUSIONS

Altogether, these findings suggest that lifestyle modification may be beneficial for older Americans by several measures. The M/BMI program seems to be associated with improved mortality; follow-up costs were somewhat lower (although not significantly so), and the times to the first hospitalization and the first cardiac hospitalization were longer compared with matched controls who received either traditional cardiac rehabilitation or no cardiac rehabilitation.

Several limitations of this study need to be noted. First, the matching of lifestyle program participants to controls was limited to factors available in claims data. Hence, matching could be performed on variables age, gender, race, cardiac diagnosis, and the presence of certain comorbidities but did not include parameters such as the severities of cardiac disease or comorbid conditions, levels of cardiac risk factors, or lifestyle-related behaviors. For example, the Ornish program only accepted participants if they were non-smokers, and, since smoking history could not be identified in matching CR or non-CR controls, these groups clearly differed on this risk factor. These factors could be important, as shown in the papers on selection effects on enrollment (Bhalotra et al., 2009) and on CR utilization (Suaya et al., 2007). Data from a mailed survey in demonstration participants and controls, in fact, indicated differences in baseline characteristics, with lifestyle participants being better educated, more likely to be homeowners, more likely to live with their spouses, and less likely to be a current or former smoker, and less likely to be currently or previously hypertensive.

Second, the demonstration had specific inclusion and exclusion criteria for participants, as described in Stason et al. (2009), with exclusion criteria for certain high risk conditions related to heart disease and impaired cognitive function. As the matching process was based on claims data, it could not incorporate all of these clinical factors.

Third, matches for patients with stable angina were identified by recent hospitalizations for this diagnosis while such a hospitalization was not required for demonstration participants. Hence, there may be differences between participants and controls both in terms of pre-enrollment costs for hospitalizations and, possibly, in the severity of the underlying heart disease. These participants represented a sixth of M/BMI enrollees and a quarter of Ornish enrollees.

A fourth limitation was the relatively small sample size of participants in the demonstration. The demonstration targeted 1,800 participants per program but enrolled only 461 participants who were available for analysis including 324 in the M/BMI program and 137 in the Ornish program.

Data from enrollees in HMOs could not be analyzed because of the absence of claims data showing hospitalizations and costs. These numbers compare to Brandeis' power analysis that indicated the need for at least 600 participants.

Despite these caveats, this evaluation has a number of strengths. It provides an example of a comparative-effectiveness analysis that examines two lifestyle programs with different intensities and different costs and compares these with each other and with two control groups—CR participants and non-CR participants. The analysis of claims data allowed both costs and outcomes to be evaluated. Other strengths were the study's ability to examine costs and outcomes over multiple years of follow-up while using two statistical approaches to assessing effects on outcomes--time to events and hospitalization rates.

While the findings appear to suggest that more intensive lifestyle modification programs are clinically effective, their additional costs and difficulties in achieving enrollment targets reduce their advantages compared to traditional cardiac rehabilitation. Moreover, limitations in matching may cause the benefits of these programs to be overstated and raise uncertainties about their value for the Medicare program compared to traditional cardiac rehabilitation.

Another component of this evaluation found that cardiac rehabilitation is significantly effective and cost-effective but is underutilized by beneficiaries (Suaya et al., 2009). In 2006, the Centers for Medicare & Medicaid expanded eligibility for CR services and further expansions are under consideration.² These findings speak to the importance of increasing enrollment in cardiac rehabilitation programs.

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² In March 2006, Medicare included intensive CR programs, such as the Ornish and M/BMI programs, as acceptable CR programs for beneficiaries eligible for the CR benefit. In addition, the proposed rule on "Payment and Coverage Improvements" (CMS, 2009) describes an expansion of the Medicare cardiac rehabilitation benefit to include specific payment provisions for intensive cardiac rehabilitation, like the Ornish and M/BMI programs, which may be provided for up to six 1-hour sessions per day for up to 72 sessions over 18 weeks.

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REFERENCES

Bhalotra SM, Razavi SM, Shepard DS, Strickler GK, Ritter G, Stason WB. Perspectives on Lifestyle Modification from a Beneficiary Survey, Part 1: Factors affecting enrolment in the Medicare Lifestyle Modification Program. Unpublished report submitted to the Centers for Medicare & Medicaid Services, 2009.

Bureau of Labor Statistics. Medical care services, U.S. city average, not seasonally adjusted Series CUUR0000SAM2. Web: <http://data.bls.gov/PDQ/servlet/SurveyOutputServlet>, 2008. Accessed September 10, 2008.

Centers for Medicare & Medicaid Services. Payment and coverage improvements. Federal Register 2009; 74(132) 33606-10, July 13.

Lee AJ, Shepard DS. Costs of cardiac rehabilitation and enhanced lifestyle modification programs. *Journal of Cardiopulmonary Rehabilitation and Prevention* 2009; In press.

Razavi SM, Shepard DS, Bhalotra SM, Strickler GK, Ritter G, Stason WB. Perspectives on Lifestyle Modification from a Beneficiary Survey, Part 2: Effectiveness of Lifestyle Modification Programs in Changing Behaviors of Elders. Unpublished report submitted to the Centers for Medicare & Medicaid Services, 2009.

Rodgers R, Pu H, Oetgen WJ. Medicare Lifestyle Modification Program Demonstration, 10/99 – 7/08: Delmarva Foundation for Medical Care Final Report. Report submitted to the Centers for Medicare & Medicaid Services, March 31, 2009.

Rosamond W, Flegal K, Furie K, Go A, Greenlund K, Haase N, Hailpern SM, et al.; American Heart Association Statistics Committee and Stroke Statistics Subcommittee 2008. Heart disease and stroke statistics--2008 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation* 1174 e25-146.

Stason WB, Shepard DS, Fournier S, Ritter G, Strickler GK, Bhalotra SM, Suaya JA. Effects of the Medicare Lifestyle Modification Program Demonstration on Cardiac Risk and Quality of Life. Unpublished report submitted to the Centers for Medicare & Medicaid Services, 2009.

Suaya JA, Shepard DS, Normand SL, Ades PA, Prottas J, Stason WB. Use of cardiac rehabilitation by Medicare beneficiaries after myocardial infarction or coronary bypass surgery. *Circulation* 2007; 116:15: 1653-62.

Suaya JA, Stason WB, Ades PA, Normand SL, Shepard DS. Cardiac rehabilitation and survival in older coronary patients. *Journal of the American College of Cardiology* 2009; 54:25-33.

ANNEX 1. REGRESSION RESULTS FOR SURVIVAL ANALYSES

Table 1.1. Cox model for M/BMI program on cardiovascular hospitalization

Variable	Hazard Ratio	Coefficient	Standard of Error	z	P>z	95% Confidence Interval	
						Lower	Upper
mbmicgrp	1.054	0.053	0.107	0.52	0.602	0.864	1.286
Mbmi	0.545	-0.607	0.082	-4.04	0.000	0.406	0.731
qualANG	0.943	-0.059	0.151	-0.37	0.714	0.689	1.291
qualCAB	0.656	-0.422	0.098	-2.83	0.005	0.490	0.879
qualSTE	0.931	-0.071	0.130	-0.51	0.610	0.708	1.225
Female	1.099	0.095	0.109	0.96	0.338	0.906	1.334
Enrollment	1.019	0.019	0.008	2.25	0.025	1.002	1.036

Table 1.2. Cox model for Ornish program on cardiovascular hospitalization

Variable	Hazard Ratio	Coefficient	Standard of Error	z	P>z	95% Confidence Interval	
						Lower	Upper
ornicgrp	1.237	0.213	0.190	1.39	0.165	0.916	1.670
Ornish	1.091	0.087	0.206	0.46	0.645	0.754	1.579
qualANG	1.062	0.060	0.222	0.29	0.775	0.704	1.600
qualCAB	0.791	-0.234	0.192	-0.96	0.335	0.492	1.273
qualSTE	1.238	0.213	0.239	1.11	0.269	0.848	1.807
Female	0.795	-0.230	0.119	-1.54	0.124	0.593	1.065
enrollment	1.004	0.004	0.013	0.34	0.737	0.980	1.030

Table 1.3. Cox model for M/BMI program on any hospitalization

Variable	Hazard		Standard		z	P>z	95% Confidence Interval	
	Ratio	Coefficient	Error				Lower	Upper
mbmicgrp	1.011	0.011	0.077		0.15	0.882	0.871	1.175
Mbmi	0.544	-0.609	0.059		-5.65	0.000	0.441	0.672
qualANG	0.988	-0.012	0.120		-0.10	0.920	0.779	1.253
qualCAB	0.694	-0.365	0.078		-3.24	0.001	0.557	0.866
qualSTE	0.923	-0.080	0.099		-0.75	0.453	0.749	1.138
Female	1.114	0.108	0.083		1.46	0.145	0.963	1.289
enrollage	1.022	0.022	0.006		3.52	0.000	1.010	1.035

Table 1.4. Cox model for Ornish program on any hospitalization

Variable	Hazard		Standard		z	P>z	95% Confidence Interval	
	Ratio	Coefficient	of Error				Lower	Upper
ornicgrp	1.052	0.051	0.124		0.44	0.663	0.836	1.325
Ornish	0.774	-0.256	0.118		-1.68	0.093	0.574	1.044
qualANG	0.931	-0.072	0.149		-0.45	0.653	0.681	1.273
qualCAB	0.967	-0.033	0.165		-0.20	0.845	0.692	1.352
qualSTE	0.881	-0.126	0.132		-0.84	0.398	0.658	1.181
female	0.983	-0.018	0.111		-0.16	0.876	0.788	1.225
enrollage	1.026	0.026	0.010		2.62	0.009	1.007	1.047

Table 1.5. Cox regression on mortality model for M/BMI program

Variable	Hazard Ratio	Coef.	Std. Err.	z	P>z	95% Confidence Interval		Definition of variables
						Lower	Upper	
						mbmicgrp	0.941	
Mbmi	0.231	-1.464	0.087	-3.90	0.000	0.111	0.483	M/BMI group
qualANG	0.804	-0.218	0.215	-0.82	0.414	0.476	1.357	Qualifying event was angina
qualCAB	0.513	-0.668	0.128	-2.68	0.007	0.315	0.836	Qualifying event was CABG
qualSTE	0.607	-0.500	0.145	-2.09	0.037	0.379	0.970	Qualifying event was PTCA
Female	0.691	-0.369	0.134	-1.91	0.057	0.473	1.011	Female gender
Enrollage	1.113	0.107	0.017	7.22	0.000	1.081	1.146	Age at enrollment

Table 1.6. Cox regression model on mortality for Ornish program

Variable	Haz. Ratio	Coef.	Std. Err.	z	P>z	95% Confidence Interval		Definition of variables
						Lower	Upper	
						Ornicgrp	0.742	
Ornish	0.841	-0.173	0.303	-0.48	0.631	0.416	1.702	Ornish group
qualANG	1.655	0.504	0.659	1.27	0.206	0.758	3.611	Qualifying event was angina
qualCAB	0.985	-0.015	0.456	-0.03	0.975	0.398	2.439	Qualifying event was CABG
qualSTE	0.732	-0.312	0.314	-0.73	0.466	0.316	1.695	Qualifying event was PTCA
Female	0.481	-0.732	0.162	-2.17	0.030	0.248	0.932	Female gender
Enrollage	1.060	0.058	0.025	2.44	0.015	1.012	1.111	Age at enrollment

ANNEX 2. REGRESSION RESULTS FOR TOTAL AMOUNT OF MEDICARE SPENDING

Table 2.1. Regression for M/BMI program with non-CR controls as reference group

Total Cost	Coefficient	Standard Error	z	P>z	95% Confidence Interval	
					Lower	Upper
pretotcost	0.111	0.014	8.060	0.000	0.084	0.138
mbmicrgrp	-674	846	-1	0	-2332	983
Mbmi	466	1031	0	1	-1555	2487
year2	-1528	846	-2	0	-3186	129
year3	-36	954	0	1	-1906	1834
mbmicrgrp~2	1588	1195	1	0	-753	3930
mbmicrgrp~3	829	1330	1	1	-1778	3437
mbmiyear2	-432	1458	0	1	-3290	2425
mbmiyear3	-3282	1622	-2	0	-6460	-103
qualANG	764	1138	1	1	-1465	2994
qualCAB	-3619	1017	-4	0	-5613	-1624
qualSTE	-493	984	-1	1	-2423	1436
Female	-3747	7665	0	1	-18771	11276
femaleage~70	5391	7743	1	0	-9785	20567
femaleage~75	4592	7738	1	1	-10573	19757
femaleage7~0	3357	7776	0	1	-11884	18598
femaleageg~0	3038	7898	0	1	-12442	18518
age65to70	-3350	5507	-1	1	-14144	7444
age70to75	-2758	5498	-1	1	-13534	8017
age75to80	-480	5518	0	1	-11295	10335
Agegt80	-673	5581	0	1	-11611	10266
_cons	9816	5567	2	0	-1096	20728
Test	-2315	1922	-1	0	-6083	1452

Table 2.2. Regression for Ornish program with non-CR controls as reference group

Total Cost	Coefficient	Standard Error	z	P>z	95% Confidence Interval	
					Lower	Upper
pretotcost	0.116	0.022	5.180	0.000	0.072	0.160
ornicrgrp	1323	1187	1	0	-1004	3651
Ornish	3362	1455	2	0	512	6213
year2	1538	1191	1	0	-796	3873
year3	721	1246	1	1	-1721	3163
ornicrgrpy~2	-1299	1679	-1	0	-4590	1991
ornicrgrpy~3	-1993	1741	-1	0	-5406	1420
ornishyear2	-6882	2056	-3	0	-10912	-2852
ornishyear3	-4062	2133	-2	0	-8242	118
qualANG	3049	1357	2	0	390	5708
qualCAB	-1449	1522	-1	0	-4431	1533
qualSTE	1440	1258	1	0	-1026	3905
Female	1001	7218	0	1	-13147	15148
femaleage~70	-1905	7355	0	1	-16321	12511
femaleage~75	-2440	7401	0	1	-16947	12066
femaleage7~0	1632	7400	0	1	-12873	16136
femaleageg~0	-839	8177	0	1	-16866	15187
age65to70	3118	5155	1	1	-6986	13223
age70to75	4731	5156	1	0	-5375	14836
age75to80	2307	5172	0	1	-7829	12444
agegt80	4382	5326	1	0	-6057	14821
_cons	136	5256	0	1	-10165	10436
Test	-857	2585	0	1	-5923	4210

Table 2.3. Regression for M/BMI program with CR controls as reference group

Total Cost	Coefficient	Standard Error	z	P>z	95% Confidence Interval	
					Lower	Upper
pretotcost	0.111	0.014	8.060	0.000	0.084	0.138
mbminoncrgrp	674	846	1	0	-983	2332
Mbmi	1141	1032	1	0	-883	3164
year2	60	848	0	1	-1602	1723
year3	793	957	1	0	-1083	2670
mbminoncrg~2	-1588	1195	-1	0	-3930	753
mbminoncrg~3	-829	1330	-1	1	-3437	1778
mbmiyear2	-2021	1459	-1	0	-4881	840
mbmiyear3	-4111	1624	-3	0	-7294	-928
qualANG	764	1138	1	1	-1465	2994
qualCAB	-3619	1017	-4	0	-5613	-1624
qualSTE	-493	984	-1	1	-2423	1436
Female	-3747	7665	0	1	-18771	11276
femaleage~70	5391	7743	1	0	-9785	20567
femaleage~75	4592	7738	1	1	-10573	19757
femaleage7~0	3357	7776	0	1	-11884	18598
femaleageg~0	3038	7898	0	1	-12442	18518
age65to70	-3350	5507	-1	1	-14144	7444
age70to75	-2758	5498	-1	1	-13534	8017
age75to80	-480	5518	0	1	-11295	10335
agegt80	-673	5581	0	1	-11611	10266
_cons	9142	5568	2	0	-1771	20055
Test	-2710	1927	-1	0	-6487	1066

Table 2.4. Regression for Ornish program with CR controls as reference group

Total Cost	Coefficient	Standard Error	z	P>z	95% Confidence Interval	
					Lower	Upper
pretotcost	0.116	0.022	5.180	0.000	0.072	0.160
orninoncrgrp	-1323	1187	-1	0	-3651	1004
Ornish	2039	1454	1	0	-811	4889
year2	239	1191	0	1	-2096	2573
year3	-1272	1246	-1	0	-3713	1169
orninoncrg~2	1299	1679	1	0	-1991	4590
orninoncrg~3	1993	1741	1	0	-1420	5406
ornishyear2	-5582	2056	-3	0	-9613	-1552
ornishyear3	-2069	2133	-1	0	-6249	2111
qualANG	3049	1357	2	0	390	5708
qualCAB	-1449	1522	-1	0	-4431	1533
qualSTE	1440	1258	1	0	-1026	3905
Female	1001	7218	0	1	-13147	15148
femaleage~70	-1905	7355	0	1	-16321	12511
femaleage~75	-2440	7401	0	1	-16947	12066
femaleage7~0	1632	7400	0	1	-12873	16136
femaleageg~0	-839	8177	0	1	-16866	15187
age65to70	3118	5155	1	1	-6986	13223
age70to75	4731	5156	1	0	-5375	14836
age75to80	2307	5172	0	1	-7829	12444
agegt80	4382	5326	1	0	-6057	14821
_cons	1459	5257	0	1	-8844	11762
Test	-1535	2582	-1	1	-6595	3526

Table 2.5. Definitions of variables in Tables 2.1 to 2.4

Variable/Test	Definition
pretotcost	Yearly cost before enrollment
mbmicgrp	CR group for MBMI program
Mbmi	MBMI participant
year2	Dummy variable for Year 2
year3	Dummy variable for Year 3
mbmicgrp~2	Interaction term of CR group with year 2
mbmicgrp~3	Interaction term of CR group with year 3
mbmiyear2	Interaction term of MBMI with year 2
mbmiyear3	Interaction term of MBMI with Year 3
qualANG	Qualifying event was angina
qualCAB	Qualifying event was CABG
qualSTE	Qualifying event was PTCA
Female	Female gender
femaleage~70	Interaction term of female and age 65 to 70
femaleage~75	Interaction term of female and age 70 to 75
femaleage7~0	Interaction term of female and age 75 to 80
femaleageg~0	Interaction term of female and age 80 or older
age65to70	Age 65 to 70
age70to75	Age 70 and 75
age75to80	Age 75 to 80
agegt80	Age 80 or older
_cons	Constant
Test	Cost difference compared with reference group