RELATIONSHIP BETWEEN SESSIONS ATTENDED AND OUTCOMES

IN OUTPATIENT CARDIAC REHABILITATION

By Kristin Miller

We recommend acceptance of this thesis in partial fulfillment of the candidate's requirements for the degree of Master of Science in Clinical Exercise Physiology.

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RELATIONSHIP BETWEEN SESSIONS ATTENDED AND OUTCOMES IN OUTPATIENT CARDIAC REHABILITATION

A Manuscript Style Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Clinical Exercise Physiology

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ABSTRACT

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Background – Patients with heart disease benefit from attending exercise and educational-based cardiac rehabilitation programs. The purpose of this study is to determine if the number of cardiac rehabilitation sessions attended or length of program enrollment affects patient outcomes.
Methods – The data consisted of 14,666 patient records with entry and discharge data from the Wisconsin Cardiac Rehabilitation Outcomes Registry (WiCORE). The magnitude of the change scores of cardiac rehabilitation components were analyzed for patients attending 1-12, 13-24, and 25-36 sessions, as well as for patients enrolled in a cardiac rehabilitation program for 1-60, 60-90, and greater than 90 days.
Results – Change scores of 14 different cardiac rehabilitation components were analyzed and included weight, waist circumference, body mass index, systolic blood pressure, diastolic blood pressure, total cholesterol, high-density lipoprotein, low-density lipoprotein, triglycerides, SF-36 physical component, SF-36 mental component, minutes per day of exercise, days per week of exercise, and volume of exercise. Patients who attended a greater number of sessions or were enrolled in cardiac rehabilitation longer improved the most, with variations in magnitude of change.
Conclusions – Although some of the changes in each component were significantly different ($p<.05$) between the groups of patients, the actual differences were small. However, if a patient is striving to improve his or her health, he or she should attend the maximum number of sessions or continue cardiac rehabilitation for the longest period of time that he or she can.

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INTRODUCTION

Cardiac rehabilitation is a comprehensive program of exercise, education, and behavioral modification for patients with heart disease. It is typically hospital-based and run by a team of healthcare professionals, including doctors, nurses, exercise physiologists, dieticians, and therapists. Patients eligible for cardiac rehabilitation include those who have had a myocardial infarction (MI), percutaneous transluminal coronary intervention, coronary artery by-pass surgery, cardiac valve surgery, a heart transplant, or individuals experiencing stable angina.

Recent studies have documented the benefits of cardiac rehabilitation. In some studies, mortality is often used as the outcome because it is easy to measure (8). Suaya et al. (7) compared mortality rates between patients who attended cardiac rehabilitation and patients who did not attend. Those who attended and averaged 24 sessions had a 21-34% increase in survival 5 years after being hospitalized. A similar study compared patients who attended the full 36 sessions to patients who attended 24, 12, and 1 session(s) (3). The basis for comparison was whether or not the patients had an MI or died four years after they were admitted into the hospital. Those who attended 36 sessions had a 14% lower risk of death and 12% lower risk of MI than those who attended 24 sessions, a 22% lower risk of death and 23% lower risk of MI than those who attended 12 sessions, and a 47% lower risk of death and 31% lower risk of MI than those who attended only 1 session.

In addition to mortality, there are other ways to measure and compare patient outcomes. Sanderson et al. (5) described four domains that comprise the core components of cardiac rehabilitation: behavioral, clinical, health, and service. The behavioral domain measures the willingness and ability for the patient to make lifestyle changes. These measures are gathered through questionnaires and also through observations of the patient and his/her behaviors. Secondary prevention strategies, such as adhering to prescribed medication, are also included. The clinical domain consists of medical record documentation that is recorded regularly during the cardiac rehabilitation process. This may include exercise capacity, lipid values, blood pressure values, and weight. The health domain includes morbidity, mortality, health status, and health-related quality of life. This domain includes outcomes that are "patient-centered", as the viewpoint of the patient is the most important factor. Lastly, the service domain evaluates programs and their effectiveness. Program structure and services are determined as well as patient satisfaction. Through analysis of information from these four domains, the effectiveness of cardiac rehabilitation may be determined.

In order to compare and measure outcomes, patient data must be recorded and organized in a way to be able to perform statistical analyses. A database used throughout the state of Wisconsin is the Wisconsin Cardiac Rehabilitation Outcomes Registry, also known as WiCORE. Nearly 70 cardiac rehabilitation programs in Wisconsin utilize WiCORE to record, track, and analyze patient information. This online database has many tools for documenting and recording different kinds of data. The four main groups of information are demographic data, program entry data, program discharge data, and follow-up data. The demographic data consists of the patients' personal information,

admitting diagnosis, comorbid conditions, previous events or history, and other clinical information. The program entry data consists of baseline data upon admission to cardiac rehabilitation, including such factors as weight, waist circumference, blood pressure, lipid values, medications, tobacco use status, and current exercise behaviors. Programs also have the ability to enter scores of various behavioral and psychosocial screening tools. For example, the Short Form Health Survey, or SF-36, is composed of a variety of health-related questions pertaining to eight key components. Vitality, emotional role functioning, social role functioning, and mental health are related to the mental component summary, the SF-36 MCS. Physical functioning, bodily pain, general health perceptions, and physical role functioning are related to the physical component summary, the SF-36 PCS. The answers to this questionnaire are translated into a number and that is the score entered into the program entry data.

When patients finish cardiac rehabilitation, information is entered into the program as discharge data. This consists of similar data to that at program entry. Also included in the discharge data are the program completion status, the duration of the program and number of sessions completed, the services that were provided, and any events or admissions into the hospital.

Lastly, follow-up data also can be entered into the WiCORE database. This information is obtained from 6-12 months after program entry and includes the same information that was recorded at entry and discharge.

METHODS

The purpose of this study was to determine if the number of cardiac rehabilitation sessions attended or the length of rehabilitation enrollment affects patient outcomes. Data was analyzed through use of the WiCORE database. Change scores for various outcomes were calculated by comparing discharge data to baseline data. Comparisons were made between those patients who attend 1-12, 13-24, and 25-36 sessions, as well as those enrolled for 1-60, 60-90, and greater than 90 days. This determines if the magnitude of the improvement is correlated to the length of time spent in cardiac rehabilitation. Approval from the University of Wisconsin – La Crosse Institutional Review Board for the protection of human subjects was received followed by a data use agreement with the Wisconsin Society for Cardiovascular and Pulmonary Health and Rehabilitation (WISCPHR) to allow access to patient data from the Wisconsin Cardiac Rehabilitation Outcomes Registry.

RESULTS

Demographic information for the subjects whose records were analyzed is presented in Tables 1 and 2. Only subjects who had complete data for a given variable at baseline and discharge were included in the analysis. Patients attending more sessions or a greater number of days were generally older, weighed more, and had a higher BMI compared to those who attended fewer sessions or had a shorter program duration.

Table 1. Descriptive characteristics of subjects subdivided by number of sessions attended (N=14,016).

# of Sessions	Age (years)	Height (inches)	Weight (pounds)	BMI (kg/m^2)
1 to 12 (n=2332)	63.3 ± 11.79[c]	67.9 ± 3.92	195.2 ± 41.07[c]	28.6 ± 7.92[c]
13 to 24 (n=6250)	64.9 ± 11.44[c]	67.6 ± 4.05	195.4 ± 43.07[c]	28.8 ± 8.34[c]
25 to 36 (n=5434)	67.5 ± 10.91[ab]	67.4 ± 4.11	197.8 ± 45.15[ab]	29.5 ± 8.64[ab]

[a] = significantly different ($p<.05$) than 1 to 12 sessions
[b] = significantly different ($p<.05$) than 13 to 24 sessions
[c] = significantly different ($p<.05$) than 25 to 36 sessions

Table 2. Descriptive characteristics of subjects subdivided by length of program enrollment (N=14,173).

# of Days	Age (years)	Height (inches)	Weight (pounds)	BMI (kg/m^2)
1 to 60 (n=6942)	64.7 ± 11.52[bc]	67.8 ± 3.99	195.0 ± 42.17[bc]	28.5 ± 8.25[bc]
61 to 90 (n=4177)	66.2 ± 11.25[a]	67.5 ± 4.04	196.2 ± 43.60[ac]	29.2 ± 8.20[a]
>90 (n=3054)	67.0 ± 11.14[a]	67.2 ± 4.20	199.6 ± 46.44[ab]	29.7 ± 9.05[a]

[a] = significantly different ($p<.05$) than 1 to 60 days
[b] = significantly different ($p<.05$) than 61 to 90 days
[c] = significantly different ($p<.05$) than >90 days

Changes in the 14 outcome variables subdivided by the number of sessions patients attended and length of time they were in the program are presented in Tables 3 and 4, respectively. The general trends in the data were very similar when looking at

sessions attended and program length, with only subtle differences. Because of the large sample size in each group, many small differences in the means were statistically significant.

Body Composition

There was a general decrease in body weight, waist circumference, and BMI as the number of sessions attended and program length increased. The more sessions patients attended and the longer patients were enrolled in a program, the larger the decreases. The changes for these variables were small and averaged less than 1%, however.

Blood Pressure

There was virtually no change in SBP or DBP regardless of how the data was subdivided. Small decreases of less than 2 mmHg occurred in each group, but were insignificant and not dependent on number of sessions attended or days of enrollment.

Blood Lipids

Relatively large decreases in total cholesterol, LDL, and triglycerides occurred in all subgroups. The more sessions patients attended and the longer they were enrolled in a program, the greater the decreases. Only small, subtle increases in HDL occurred for each group.

SF-36

Similar increases occurred for the SF-36 mental component and physical component summaries. The mental and physical component scores generally increased with an increase in number of sessions attended or number of days enrolled in program.

Exercise

Patients attending any number of cardiac rehabilitation sessions had a significant improvement in their total volume of exercise. This was attributed to a combination of an increase in the number of days per week patients exercised as well as the number of minutes per day they exercised. Patients significantly increased the number of minutes per day of exercise with an increase in number of sessions attended or days enrolled in program. Number of days increased by approximately 3 days per week and minutes per day increased an average of 25 minutes per day across all groups.

Tobacco Use

Table 5 displays the percentage of patients who were smoking at the time of program entry and program discharge. Approximately 12-16% of patients were smoking at program entry compared to 5-7% at program discharge. There was no correlation with number of sessions attended or days enrolled in program, but 50-60% of smokers quit by the time they finished cardiac rehabilitation.

Table 3. Changes Based on Number of Sessions Attended

Weight (pounds)				
# of Sessions	n	Pre	Post	Δ
1 to 12	2332	195.1 ± 40.95	194.0 ± 40.39	-1.1[bc]
13 to 24	6250	195.5 ± 43.09	193.6 ± 42.05	-1.9[ac]
25 to 36	5434	197.9 ± 45.06	195.5 ± 43.62	-2.3[ab]
Waist Circumference (inches)				
# of Sessions	n	Pre	Post	Δ
1 to 12	888	40.3 ± 5.16	39.8 ± 5.14	-0.4[bc]
13 to 24	2802	40.7 ± 5.64	40.0 ± 5.47	-0.7[ac]
25 to 36	2289	41.4 ± 5.93	40.4 ± 5.63	-0.9[ab]
BMI (kg/m^2)				
# of Sessions	n	Pre	Post	Δ
1 to 12	2280	29.7 ± 5.59	29.5 ± 5.51	-0.2[bc]
13 to 24	6129	30.1 ± 5.95	29.8 ± 5.79	-0.3[a]
25 to 36	5299	30.6 ± 6.43	30.3 ± 6.23	-0.3[a]

SBP (mmHg)				
# of Sessions	n	Pre	Post	Δ
1 to 12	2354	120.1 ± 16.14	118.3 ± 14.28	-1.8[c]
13 to 24	6354	118.8 ± 16.46	118.0 ± 14.39	-0.8
25 to 36	5455	119.7 ± 17.30	119.0 ± 14.95	-0.7[a]
DBP (mmHg)				
# of Sessions	n	Pre	Post	Δ
1 to 12	2347	69.2 ± 9.62	67.8 ± 9.10	-1.4[b]
13 to 24	6346	67.9 ± 9.60	67.3 ± 9.11	-0.6[a]
25 to 36	5448	67.3 ± 9.79	66.5 ± 9.18	-0.8
Total Cholesterol (mg/dL)				
# of Sessions	n	Pre	Post	Δ
1 to 12	1258	168.6 ± 42.75	158.4 ± 42.24	-10.2[bc]
13 to 24	3129	172.4 ± 45.19	154.7 ± 39.90	-17.7[a]
25 to 36	2754	166.9 ± 45.15	148.9 ± 37.29	-18.0[a]
HDL (mg/dL)				
# of Sessions	n	Pre	Post	Δ
1 to 12	1247	42.3 ± 13.45	42.4 ± 13.04	0.1
13 to 24	3116	42.1 ± 12.89	42.2 ± 12.93	0.1
25 to 36	2750	42.4 ± 13.24	42.9 ± 13.31	0.4
LDL (mg/dL)				
# of Sessions	n	Pre	Post	Δ
1 to 12	1227	98.5 ± 36.69	90.0 ± 34.87	-8.5[bc]
13 to 24	3061	100.7 ± 38.14	86.3 ± 33.78	-14.5[a]
25 to 36	2704	96.2 ± 38.04	80.6 ± 31.30	-15.6[a]
Triglycerides (mg/dL)				
# of Sessions	n	Pre	Post	Δ
1 to 12	1239	139.6 ± 91.49	130.6 ± 84.18	-9.1[c]
13 to 24	3104	148.2 ± 93.03	133.9 ± 77.12	-14.4
25 to 36	2739	146.2 ± 96.07	131.2 ± 74.57	-15.1[a]
SF36 - Physical Component Summary				
# of Sessions	n	Pre	Post	Δ
1 to 12	758	44.9 ± 11.95	48.3 ± 10.10	3.5[c]
13 to 24	2910	43.6 ± 12.28	48.0 ± 11.92	4.4[c]
25 to 36	2607	39.8 ±11.66	45.6 ± 11.36	5.8[ab]
SF36 - Mental Component Summary				
# of Sessions	n	Pre	Post	Δ
1 to 12	755	51.8 ± 10.94	54.7 ± 9.96	2.9[c]
13 to 24	2913	51.0 ± 11.02	54.5 ± 10.28	3.5[c]
25 to 36	2601	49.8 ± 11.20	54.1 ± 10.00	4.3[ab]
Minutes of Exercise (minutes/day)				

# of Sessions	n	Pre	Post	Δ
1 to 12	2070	17.9 ± 20.24	38.4 ± 12.93	20.5[bc]
13 to 24	5578	12.7 ± 17.73	38.7 ± 12.35	25.9[ac]
25 to 36	4888	10.2 ± 15.90	40.0 ± 12.37	29.8[ab]
Days of Exercise (days/week)				
# of Sessions	n	Pre	Post	Δ
1 to 12	2267	2.5 ± 2.69	4.9 ± 1.73	2.4[bc]
13 to 24	6094	1.8 ± 2.46	4.8 ± 1.61	3.0[a]
25 to 36	5213	1.6 ± 2.34	4.5 ± 1.53	2.9[a]
Volume of Exercise (minutes/week)				
# of Sessions	n	Pre	Post	Δ
1 to 12	2136	84.4 ± 108.97	193.2 ± 103.74	108.7[bc]
13 to 24	5715	56.3 ± 90.11	187.2 ± 93.74	130.9[a]
25 to 36	4979	43.3 ± 76.09	178.6 ± 87.54	135.2[a]

[a] = significantly different ($p<.05$) than 1 to 12 sessions
[b] = significantly different ($p<.05$) than 13 to 24 sessions
[c] = significantly different ($p<.05$) than 25 to 36 sessions

Table 4. Changes Based on Number of Days Enrolled in Program

Weight (pounds)				
# of Days	n	Pre	Post	Δ
1 to 60	6942	194.9 ± 42.17	193.3 ± 41.22	-1.6[c]
61 to 90	4177	196.5 ± 43.64	194.6 ± 42.51	-1.9[c]
>90	3054	199.5 ± 46.23	196.8 ± 44.80	-2.6[ab]
Waist Circumference (inches)				
# of Days	n	Pre	Post	Δ
1 to 60	3064	40.5 ± 5.49	39.9 ± 5.35	-0.6[bc]
61 to 90	1715	41.1 ± 5.82	40.3 ± 5.58	-0.8[ac]
>90	1247	41.4 ± 5.99	40.4 ± 5.68	-1.1[ab]
BMI (kg/m^2)				
# of Days	n	Pre	Post	Δ
1 to 60	6787	29.8 ± 5.76	29.6 ± 5.61	-0.2[c]
61 to 90	4096	30.3 ± 6.15	30.0 ± 5.97	-0.3[c]
>90	2972	31.0 ± 6.63	30.6 ± 6.46	-0.4[ab]
SBP (mmHg)				
# of Days	n	Pre	Post	Δ
1 to 60	7034	119.2 ± 16.37	118.2 ± 14.30	-1.0
61 to 90	4202	119.4 ± 16.85	118.5 ± 14.74	-0.9
>90	3086	119.6 ± 17.32	119.1 ± 14.90	-0.6

DBP (mmHg)				
# of Days	n	Pre	Post	Δ
1 to 60	7021	68.3 ± 9.67	67.4 ± 9.11	-0.9
61 to 90	4194	67.7 ± 9.63	67.0 ± 9.19	-0.7
>90	3085	67.1 ± 9.83	66.3 ± 9.12	-0.9
Total Cholesterol (mg/dL)				
# of Days	n	Pre	Post	Δ
1 to 60	3429	171.0 ± 44.05	156.9 ± 40.71	-14.1[bc]
61 to 90	2072	169.4 ± 45.23	150.8 ± 38.45	-18.5[a]
>90	1716	167.0 ± 45.49	148.2 ± 37.19	-18.9[a]
HDL (mg/dL)				
# of Days	n	Pre	Post	Δ
1 to 60	3416	42.3 ± 13.31	42.2 ± 13.16	-0.1[bc]
61 to 90	2067	41.8 ± 12.81	42.3 ± 12.94	0.5[a]
>90	1706	42.8 ± 13.17	43.4 ± 13.20	0.6[a]
LDL (mg/dL)				
# of Days	n	Pre	Post	Δ
1 to 60	3358	100.2 ± 37.43	88.5 ± 34.41	-11.7[bc]
61 to 90	2032	98.4 ± 38.13	82.7 ± 31.81	-15.7[a]
>90	1677	95.5 ± 38.16	79.5 ± 31.19	-16.0[a]
Triglycerides (mg/dL)				
# of Days	n	Pre	Post	Δ
1 to 60	3393	142.9 ± 87.85	132.9 ± 78.26	-10.0[bc]
61 to 90	2062	148.0 ± 100.23	131.6 ± 77.14	-16.4[a]
>90	1703	149.3 ± 97.41	131.3 ± 75.40	-18.0[a]
SF36 - Physical Component Summary				
# of Days	n	Pre	Post	Δ
1 to 60	3091	44.1 ± 12.40	48.4 ± 11.75	4.4[b]
61 to 90	1985	40.9 ± 11.64	46.5 ± 11.24	5.7[a]
>90	1275	39.7 ± 11.53	44.4 ± 10.99	4.7
SF36 - Mental Component Summary				
# of Days	n	Pre	Post	Δ
1 to 60	3093	51.4 ± 10.98	54.9 ± 10.19	3.4
61 to 90	1985	50.0 ± 11.13	54.0 ± 9.90	4.0
>90	1267	49.6 ± 11.32	53.8 ± 10.23	4.1
Minutes of Exercise (minutes/day)				
# of Days	n	Pre	Post	Δ
1 to 60	6175	14.6 ± 18.93	39.1 ± 12.49	24.5[bc]
61 to 90	3754	11.3 ± 16.69	39.1 ± 12.50	27.9[ac]
>90	2746	9.9 ± 15.48	39.4 ± 12.36	29.5[ab]

Days of Exercise (days/week)

# of Days	n	Pre	Post	Δ
1 to 60	6759	2.0 ± 2.55	4.9 ± 1.58	2.9[c]
61 to 90	4032	1.7 ± 2.44	4.6 ± 1.59	2.9[c]
>90	2940	1.5 ± 2.28	4.2 ± 1.60	2.7[ab]

Volume of Exercise (minutes/week)

# of Days	n	Pre	Post	Δ
1 to 60	6308	66.7 ± 98.63	194.7 ± 96.36	128.1[b]
61 to 90	3848	48.9 ± 82.70	182.1 ± 91.45	133.2[ac]
>90	2818	41.0 ± 73.79	165.9 ± 85.89	124.9[b]

[a] = significantly different (p<.05) than 1 to 60 days
[b] = significantly different (p<.05) than 61 to 90 days
[c] = significantly different (p<.05) than >90 days

Table 5. Changes in Tobacco Use Status Based on Number of Sessions Attended and Number of Days Enrolled in Program

# of Sessions	% of Patients Who Smoke		**% of Smokers Who Quit**
	PRE	**POST**	
1 to 12	16.4	7.0	57.3
13 to 24	14.6	6.4	56.2
25 to 36	12.5	5.3	57.6
# of Days	% of Patients Who Smoke		**% of Smokers Who Quit**
	PRE	**POST**	
1 to 60	14.5	5.7	60.7
60 to 90	13.4	5.9	56.0
>90	14.2	7.2	49.3

DISCUSSION

The results generally showed improvement in outcomes with increasing number of sessions or days enrolled in cardiac rehabilitation. Many of the changes were statistically significant between the groups of patients attending 1-12, 13-24, and 25-36 sessions, as well as those attending 1-60, 61-90, and greater than 90 days. However, these changes were not all clinically significant due to how small the changes actually were.

Patients attending more sessions or attending for a longer period of time lost about one pound more than those attending the minimum number of sessions or days. This small weight loss resulted in only a slight decrease in BMI. Similarly, for waist circumference, patients lost less than an inch more with attending a greater number of sessions or days compared to those who attended fewer sessions or days. A study by Maines et al. (4) observed similar results where patients lowered their BMI by only 1%. Ades et al. (1) also concluded that large changes in body composition are unlikely during standard cardiac rehabilitation. However, during high-calorie-expenditure exercise, they found that patients were able to double weight loss, fat mass loss, and waist circumference reduction compared to those participating in standard cardiac rehabilitation exercise. The type and intensity of exercise that patients perform greatly affects the magnitude of changes in body composition. The small changes in body composition observed in this study were likely due to the fact that participants were only expending 800-1000 kcal/week. In the study by Ades et al. (1), subjects were expending 3000 to 3500 kcal/week, which most likely resulted in greater body composition changes.

Changes in blood pressure were small and insignificant. Baseline blood pressure values for all groups averaged approximately 119/68, thus large changes were neither necessary nor likely. The fact that most patients were already within an acceptable blood pressure range and their values did not change much may have been due to the high percentage of patients on blood pressure medication at program entry. As displayed in Tables A-2 and A-3, about 80-90% of patients were on a beta blocker and 50-60% of patients were on an ACE inhibitor at program entry and program discharge. Changes in blood pressure are more likely to be changed by medication and exercise than just exercise alone. After a cardiac event, it is common for patients to be put on a variety of medications that affect the workload on the heart. The reason so many patients were on a blood pressure medication at program entry was likely due to the fact that they were started on the medication after their event, but before they started cardiac rehabilitation.

An improvement in blood lipids was one of the greatest changes seen with patients attending cardiac rehabilitation. Patients lowered total cholesterol, increased HDL, lowered LDL, and lowered triglycerides with increasing number of sessions or days of cardiac rehabilitation. Not all changes were significantly different from one another, but the results did show a steady trend in bringing lipid levels to the appropriate values with increasing number of sessions attended or days enrolled in cardiac rehabilitation. Around 93% of patients were on a lipid medication at program entry and program discharge, as displayed in Table A-1. Although dosage changes of medication were not included in the database, it can be concluded that attending cardiac

rehabilitation has a strong effect on improving blood lipids. However, the exact reason for these changes remains unclear.

Patients showed an improvement in their mental and physical states based on the increasing scores for the SF-36 mental and physical component summaries. On average, the physical and mental component scores increased by 11% and 7%, respectively. These results were similar to other studies, such as those by Maines et al. (4). Mental health, similar to the mental component summary of this study, increased 7%. Well-being and functional status, comparable to the physical component summary used in this study, increased 13% and 18%, respectively. These results show that the interventions of cardiac rehabilitation can improve the mental and physical distress of experiencing a cardiac event. Also, when patients attend more cardiac rehabilitation sessions, it is likely that they are feeling more comfortable with themselves both mentally and physically.

Attending cardiac rehabilitation had a positive effect on the volume of exercise patients were doing from baseline to discharge. This was the result of a combination of days per week and minutes per day of exercise. Patients increased total volume of exercise by an average of 127 minutes per week and were performing three times as much exercise at discharge compared to baseline. Hopefully, patients would continue this trend after leaving the phase II supervised setting.

Lastly, this study analyzed tobacco use status and showed that about 50-60% of patients using tobacco at program entry quit by the time they finished cardiac rehabilitation (Table 5). This is a relatively large number of patients who were able to change their lifestyle and improve their health by quitting tobacco use. There was not a trend of the number of patients that quit with increasing number of sessions or days of

enrollment. However, simply attending cardiac rehabilitation, which may include counseling or tobacco cessation interventions, had a positive effect on helping patients quit.

Patients attend cardiac rehabilitation for a relatively short amount of time, but attending any number of sessions or days showed to have a positive effect on virtually all outcomes. The magnitude of some of these changes in outcomes was shown to be small. However, even these short-term changes may lead to long-term benefits, such as a decreased mortality or risk of an MI. As mentioned previously, Hammill et al. (3) found that fewer deaths and MI's occurred in patients who attended a greater number of cardiac rehabilitation sessions. Similarly, Suaya et al. (6) observed that patients attending cardiac rehabilitation and averaged 24 sessions had a 21-34% increase in survival compared to those who did not attend. Therefore, it can be reasonably concluded that if a patient is striving to improve his or her health and extend longevity, he or she should attend the maximum number of sessions or continue cardiac rehabilitation for the longest period of time possible.

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APPENDIX A

MEDICATION USE CHANGES

Table A. Medication use changes.

1 - Percentage of people on lipid lowering medication

	# of Sessions	Pre	Post	Δ	**# of Days**	Pre	Post	Δ
Total Cholesterol	1 to 12	92.6	93.0	*0.4*	1 to 60	93.1	93.7	*0.6*
	13 to 24	92.9	94.5	*1.6*	61 to 90	92.6	94.4	*1.8*
	25 to 36	93.5	94.4	*0.9*	>90	93.5	93.1	*-0.4*
HDL	1 to 12	92.5	92.9	*0.4*	1 to 60	93.1	93.8	*0.7*
	13 to 24	92.9	93.6	*0.7*	61 to 90	92.7	94.4	*1.7*
	25 to 36	93.4	94.4	*1.0*	>90	93.4	93.2	*-0.2*
LDL	1 to 12	92.6	93.0	*0.4*	1 to 60	93.1	93.7	*0.6*
	13 to 24	93.0	93.7	*0.7*	61 to 90	92.7	94.6	*1.9*
	25 to 36	93.4	94.4	*1.0*	>90	93.4	93.2	*-0.2*
Triglycerides	1 to 12	92.7	93.1	*0.4*	1 to 60	93.2	93.8	*0.6*
	13 to 24	92.9	93.6	*0.7*	61 to 90	92.6	94.4	*1.8*
	25 to 36	93.3	94.4	*1.1*	>90	93.3	93.1	*-0.2*

2 - Percentage of people on beta-blockers

	# of Sessions	Pre	Post	Δ	**# of Days**	Pre	Post	Δ
SBP	1 to 12	85.3	85.6	*0.3*	1 to 60	86.5	86.8	*0.3*
	13 to 24	87.0	87.0	*0.0*	61 to 90	87.4	87.6	*0.2*
	25 to 36	88.6	88.4	*-0.2*	>90	89.0	87.9	*-1.1*
DBP	1 to 12	85.3	85.6	*0.3*	1 to 60	86.5	86.9	*0.4*
	13 to 24	87.0	87.0	*0.0*	61 to 90	87.4	87.6	*0.2*
	25 to 36	88.6	88.4	*-0.2*	>90	89.0	87.9	*-1.1*

3 - Percentage of people on ACE inhibitors

	# of Sessions	Pre	Post	Δ	**# of Days**	Pre	Post	Δ
SBP	1 to 12	54.3	54.2	*-0.1*	1 to 60	53.5	53.4	*-0.1*
	13 to 24	54.2	54.7	*0.5*	61 to 90	56.0	57.1	*1.1*
	25 to 36	57.3	58.4	*1.1*	>90	59.0	60.4	*1.4*
DBP	1 to 12	54.2	54.2	*0.0*	1 to 60	53.4	53.4	*0.0*
	13 to 24	54.2	54.7	*0.5*	61 to 90	55.9	57.1	*1.2*
	25 to 36	57.2	58.3	*1.1*	>90	59.0	60.4	*1.4*

APPENDIX B

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Cardiac Rehabilitation

Cardiac rehabilitation is a program for patients who have or are at risk for cardiovascular disease. This may include patients who have had coronary bypass surgery, angioplasty, a myocardial infarction, stable angina, or other heart-related events. Cardiac rehabilitation programs provide medically trained staff to supervise patients and assist in improving their physical and mental health. Medicare coverage allows phase II outpatient cardiac rehabilitation patients to attend 36 sessions. These visits typically occur three times a week over a 12-week time period. A physician or cardiologist usually refers a patient to cardiac rehabilitation if he or she thinks the patient would benefit from it. With referral, a recommended 36 sessions is also implied, but not required of the patient. It is ultimately the patient's decision whether or not to attend all of the sessions. As a result, outcomes in cardiac rehabilitation may vary greatly due to the number of sessions patients attend. Not only will the number of sessions be different among cardiac patients, but the type of program they attend may also vary. The program may be exercise-based, educational-based, or a combination of the two. Outcomes in cardiac rehabilitation are very dependent on the number of sessions as well as the type of program attended.

Outcomes

Outcomes can be evaluated in a variety of ways. A simple way to determine outcomes is to measure mortality among patients (8). Suaya et al. (6) used this idea to

analyze 601,099 cardiac rehabilitation users and nonusers, ages 65 and older. The users and non-users were paired up based upon sex, race, type of cardiac event, age, and Medicare/Medicaid dual eligibility. Mortality of the patient was accounted for if it occurred within 5 years of the discharge date. Those who attended cardiac rehabilitation averaged 24 sessions and had a 21-34% increase in survival compared to those who did not attend cardiac rehabilitation. Oldridge et al. (5) analyzed the effects of cardiac rehabilitation on all-cause death, cardiovascular mortality, and recurrent myocardial infarction. The data included 4,347 patients from 10 randomized clinical trials; 2,202 patients were randomly assigned to comprehensive cardiac rehabilitation and 2,145 were delegated as the control subjects. Two or more of the following were required: presence of chest pain, elevation of enzyme levels, and electrocardiogram changes representing an acute myocardial infarction. The results showed that patients enrolled in cardiac rehabilitation had a reduction of 24% for all-cause death and 25% for cardiovascular mortality. A similar study involving 4,554 patients observed a 20% reduction in overall mortality with those attending exercise-based cardiac rehabilitation compared to the control group who did not attend (4).

Another study went into further detail comparing patients who attended the full 36 sessions to patients who attended 24, 12, and 1 session(s) (2). The sample used in this study was 30,161 elderly patients who attended at least one cardiac rehabilitation session, starting between the years 2000 and 2005. The basis for comparison was whether or not the patients had an MI or passed away four years after their first cardiac rehabilitation session. Those who attended 36 sessions had a 14% lower risk of death and 12% lower risk of MI than those who attended 24 sessions, a 22% lower risk of death and 23% lower

risk of MI than those who attended 12 sessions, and a 47% lower risk of death and 31% lower risk of MI than those who attended only 1 session. Although this method shows overall effectiveness of attending cardiac rehabilitation sessions, specific goals may instead need to be addressed to demonstrate true outcomes in cardiac rehabilitation (8).

Core Components

Cardiac rehabilitation programs are not all the same. Some are solely exercise-based, while others incorporate education and counseling. These differences may have a significant effect on how beneficial cardiac rehabilitation is and the outcomes produced. It is recommended that rehabilitation should include 10 core components necessary to improve cardiovascular risk reduction, encourage healthy behaviors, reduce disability, and promote an active lifestyle (1,9).

Patient Assessment

An initial assessment records the patient's health history. Current or past cardiovascular events and issues are noted as well as surgical procedures. The patient should also have a physical examination of heart rate, blood pressure, auscultation of the heart and lungs, inspection for edema, post-cardiovascular procedure wound sites, and cognitive function. A resting 12-lead electrocardiogram is obtained and rhythm is recorded. During assessment is also when goals and strategies are planned for risk reduction.

Nutritional Counseling

A vital component of a patient returning to better health is to educate and counsel the patient on nutrition. Total daily caloric intake and eating habits are assessed. This includes consumption of fruit and vegetables, whole grains, fish, number of meals and

snacks, frequency of eating out, and alcohol consumption. Goals are then set and the patient is educated on how to attain them. Depending on the patient, he/she may need counseling on weight, hypertension, diabetes, heart failure, kidney disease, or other comorbidities.

Weight Management

A patient's weight, height, and waist circumference are measured at entry into cardiac rehabilitation. This information can lead to a before and after body mass index (BMI). Patients are educated on what BMI and waist circumference is appropriate for them and how this can be achieved. A healthy BMI range is 18.5-24.9 kg/m^2 and waist circumference should be <40 inches for men and <35 inches for women.

Blood Pressure Management

Resting blood pressure should first be taken a few different times to obtain an accurate measurement. This should be taken lying, seated, and standing to rule out orthostatic hypotension. It is important to take into consideration any medication a patient is on when managing blood pressure. Prescription and non-prescription drugs may have a significant effect on one's blood pressure, whether or not that is its purpose. Communication with the patient's physician is key when discussing making changes to a current medications. Besides changing medications, there are other lifestyle modifications that may have some bearing on blood pressure. This includes physical activity and exercise, weight management, and smoking. Consumption of fruits and vegetables, dairy, sodium, and alcohol also affects blood pressure. Depending on the patient, goals are set to maintain or improve blood pressure.

Lipid Management

Fasting measures of total cholesterol, high-density lipoprotein, low-density lipoprotein, and triglycerides are obtained at the start of cardiac rehabilitation. Current medications may also be analyzed if they have any affect on the patient's lipid levels. The patient is educated on nutrition and ways to obtain healthier levels of high-density lipoprotein, low-density lipoprotein, and triglycerides. Short-term and long-term goals are placed to obtain these levels.

Diabetes Management

Presence or absence of diabetes is first confirmed in the patient. If the patient is diabetic, history of heart disease, vascular disease, problems with eyes, kidneys, or feet, and neuropathy is recorded. Signs and symptoms of hypoglycemia or hyperglycemia of the individual patient are noted. Before beginning exercise, fasting plasma glucose is obtained to determine if the patient is safe to exercise. The patient and staff should be able to recognize signs or symptoms of either hyperglycemia or hypoglycemia and the plan of action if this should occur. Patients are educated on how to monitor themselves if they exercise outside of cardiac rehabilitation. They may also be referred to a registered dietician for medical nutrition therapy.

Tobacco Cessation

A patient's smoking status should first be established: never smoked, former smoker, or current smoker. Quitting use of tobacco has been shown to be a difficult process for many people. Patients must express a readiness to change, otherwise tobacco cessation may not be successful. The next step is to proceed with the "5 A's": Ask, Advise, Assess, Assist, and Arrange. Smokers may need education and counseling, but it

is also very important they have social support around them. A quit date should be set and strategies will be prepared.

Psychosocial Management

Psychological distress of the patient must first be identified. This may include clinically significant levels of the following: depression, anxiety, anger or hostility, social isolation, marital/family distress, sexual dysfunction/adjustment, or substance abuse. Any current medications to control these psychological issues must be recorded. Individual or small-group education and counseling classes may be organized for those adjusting to heart disease, stress management, or health-related lifestyle changes. Nearly 20% to 45% of patients who experience a myocardial infarction become depressed. Depression is a risk factor for mortality; therefore, it is very important to help patients manage their psychological distress.

Physical Activity Counseling

A patient's current physical activity level is first assessed. Also, the domestic, occupational, and recreational needs are also determined. Activities for the patient will be dependent on age, gender, and daily life, which may include driving, sexual activity, sports, gardening, and household tasks. The patients are then counseled and encouraged to aim for 30-60 minutes per day of moderate-intensity activity on most, if not all, days of the week.

Exercise Training

The patient may need to perform an exercise test to assess heart rate and rhythm, signs, symptoms, ST-segment changes, hemodynamics, perceived exertion, and exercise capacity. Results of this assessment correlate to risk stratification based on the guidelines

by the American Heart Association and The American Association of Cardiovascular and Pulmonary Rehabilitation and the American Heart Association (1). Aerobic and resistance training exercises are prescribed to the patient based on his or her evaluation.

Created by the American Association of Cardiovascular and Pulmonary Rehabilitation, American College of Cardiology, and American Heart Association (9), the following is a useful tool for tracking the essential goals of secondary prevention in cardiac rehabilitation.

American Association of Cardiovascular and Pulmonary Rehabilitation, American College of Cardiology, and American Heart Association Cardiac Rehabilitation/Secondary Prevention Program Performance Measurement Set Data Collection Flow Sheet (ideally collected prospectively)

Patient name or code: Birth date:

Gender: ☐M ☐F Date of event(s):

Diagnosis: ☐MI ☐CABG ☐Angina ☐Valve repair or replacement ☐PCI ☐Transplantation ☐CHF

Race/ethnicity: ☐African American ☐Asian American ☐Native American ☐Nonwhite Hispanic ☐White ☐Other

Risk category ☐Low ☐Moderate ☐High

	Target Goal	Initial Assessment	Intervention Plan and Communication	Reassessment Prior to Completion of Program	Changes in Intervention Plan and Communication
Date					
Tobacco use	Complete cessation of tobacco use	☐ Never ☐ Recent (quit less 6 months ago) ☐ Current	*Complete only if current or recent tobacco use* ☐ Individual education and counseling *or* ☐ Referral to a tobacco cessation program *and* ☐ Healthcare provider notified	☐ Abstaining ☐ Smoking	*Complete only if still smoking* ☐ Individual education and counseling *or* ☐ Referral to a tobacco cessation program *and* ☐ Healthcare provider notified
Blood pressure control	<140/90 mm Hg or <130/80 mm Hg if patient has diabetes or chronic kidney disease	☐ Patient with diagnosis of treated or untreated hypertension ☐ Not hypertensive	*Complete only if patient has a diagnosis of hypertension:* Education completed: ☐ Target BP goal ☐ Medication compliance ☐ Lifestyle modification	☐ Intermittent monitoring of BP during CR	☐ Policy in place concerning communication with health care providers, including thresholds for communication
Lipid control	For CVD and CVD equivalents: LDL-C <100 mg/dL if triglycerides are >*200* mg/dL, non-HDL-C should be <130mg/dL	☐ Optimal control ☐ Suboptimal control	*Applies to all patients with CVD:* Education completed: ☐ Target lipid goals ☐ Medication compliance ☐ Lifestyle modification	*Complete only if suboptimal control on initial assessment:* ☐ Patient encouraged to contact healthcare provider about reassessment of lipid control	☐ Policy is in place to communicate with healthcare providers as needed
Physical activity habits	30+ min, minimum 5 d/wk	☐ Optimal habits ☐ Suboptimal habits	☐ Education completed concerning optimal physical activity habits *Complete only if habits are suboptimal* ☐ Intervention plan developed with the patient	☐ Optimal habits ☐ Suboptimal habits	*Complete only if habits remain suboptimal* ☐ An intervention plan is developed with the patient ☐ Healthcare provider notified
Weight management	Body mass index: 18.5 to 24.9 kg/m^2 *and* Waist circumference: men <40 in. women <35 in.	☐ At target ☐ Above target	*Applies to all patients* ☐ Education completed concerning target goals, diet, behavior change, regular physical activity *or* ☐ Referral to a weight management program *and* ☐ Healthcare provider notified if above target	☐ At target ☐ Above target	*Complete only if remains above target* ☐ Additional education completed for target goals, diet, behavior change, exercise *or* ☐ Referral to a weight management program *and* ☐ Healthcare provider notified

	Target Goal	Initial Assessment	Intervention Plan and Communication	Reassessment Prior to Completion of Program	Changes in Intervention Plan and Communication
Presence or absence of DM or IFG (fasting blood glucose – 110–125 mg/dL)	HbA_{1c} <7%	☐ Diagnosis of DM or IFG present ☐ Diagnosis of DM or IFG absent	*Complete only if DM is present:* ☐ Documentation that patient has attended skill training and medical nutrition therapy session *or* ☐ Referral to skill training and medical nutrition therapy session *or* ☐ Intervention plan recommended which includes: target goals for HbA_{1c}, medical nutrition counseling, and skill training *Complete only if IFG is present:* ☐ Education is completed concerning the importance of weight management and physical activity	*Complete only if DM or IFG is present:* ☐ Attendance at appropriate education or skill training session	☐ A policy is in place concerning communication with appropriate health care professionals including thresholds for notification
Presence or absence of depression	Assessment of presence or absence of depression using a valid and reliable screening tool	☐ Patient screened for depression ☐ Patient not screened for depression	*Complete only if screening tool indicates possible depression:* ☐ Results discussed with patient *and* ☐ Healthcare provider notified	☐ Patient re-screened for depression ☐ Patient not re-screened for depression	*Complete only if screening tool indicates possible depression:* ☐ Results discussed with patient *and* ☐ Healthcare provider notified
Exercise capacity	Assessment of symptom-limited exercise tolerance and development of an individualized exercise prescription	☐ Assessment and exercise prescription completed ☐ Assessment and exercise prescription not completed	☐ Exercise prescription communicated to the patient and healthcare provider	☐ Re-assessment and exercise prescription completed ☐ Re-assessment and exercise prescription not completed	☐ Revised exercise prescription communicated to the patient and healthcare provider
Use of preventive medications	Adherence to prescribed preventive medications	☐ Patient has been prescribed preventive medications by his or her healthcare provider(s)	☐ Individual education and counseling about the importance of adherence to appropriate preventive medications *or* ☐ Group education and counseling about the importance of adherence to appropriate preventive medications	☐ Individual or group education completed	☐ Patient is encouraged to discuss questions or concerns about prescribed preventive medications with his or her healthcare providers

Without these components, cardiac rehabilitation may be excluding the opportunity to improve the quality of life of cardiac patients. Maines et al. (3) studied 591 patients before and after completing cardiac rehabilitation. These patients were admitted to cardiac rehabilitation due to 45% having an acute myocardial infarction, 30% having a coronary artery bypass graft, or 25% with percutaneous transluminal coronary angioplasty for an acute ischemic syndrome. Since cholesterol medication can have a

considerable affect on lipid levels, patients on lipid-lowering medications were excluded. All patients began cardiac rehabilitation 3-8 weeks after their cardiac event, and attended all 36 sessions. On average, the following improvements in core components were shown: exercise capacity (+33%), percent body fat (-6%), body mass index (-1%), high-density lipoprotein (+5%), total cholesterol (-6%), triglycerides (-9%), anxiety score (-39%), depression score (-35%), somatization score (-37%), and quality of life parameters (+14%).

More than 13 million Americans have documented coronary artery disease, and this continues to increase every day. Cardiovascular disease has held its position as the number one cause of death in the United States. If these patients attend cardiac rehabilitation, they can significantly improve their health and quality of life. Numerous variables and components can influence how beneficial cardiac rehabilitation is, but it has been clearly shown that attending more sessions results in better outcomes. Physical exercise is a key component of cardiac rehabilitation, but it is also important for the patient to understand and manage all other components of his or her health.

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