Cardiac Rehabilitation: New Emphasis on Metabolic Disease

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Key Points

- Changes in Medicare reimbursement guidelines, updating of program guidelines, expansion of the role of cardiac rehabilitation to all aspects of cardiac prevention, incorporation of the principles of exercise testing, and behavior change into clinic encounters have made cardiac rehabilitation more powerful and effective.
- Although much is known about how patients respond to and benefit from regular exercise and therapeutic lifestyle changes, more work is needed relative to improving long-term compliance to known beneficial lifestyle and medical therapies, improving referral rates of eligible patients to secondary prevention programs, and improving retention of patients who are referred to and begin participation in cardiac rehabilitation.
- Despite cardiac rehabilitation representing a Class 1A guideline therapy for most patients with cardiovascular disease, gender, age, and race discrepancies persist in terms of program access and utilization.
- Like other therapies available to patients with cardiovascular disease, cardiac rehabilitation has a bright future as a cost-effective strategy that improves mood, restores functional capacity, lessens or alleviates symptoms, and lowers the risk for and occurrence of subsequent clinical cardiovascular events, with all of the attendant social, economic, and medical benefits that ensue from its successes. The primary care physician who understands these principles can be an invaluable ally in this process.

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15.1 Introduction

Cardiac rehabilitation was developed in the mid-1970s as a mechanism by which to instruct and deliver exercise therapy to those having survived a recent acute coronary syndrome. Although the field of cardiac rehabilitation has a relatively short (40 years) history as evidence-based care for patients with cardiovascular disease, it continues to evolve. Changes in program scope have shifted the emphasis away from cardiac rehabilitation as a limited short-term intervention to one of a comprehensive secondary preventive strategy targeting the multiple medical, exercise, nutritional, and behavioral factors that place a patient at increased risk for a subsequent cardiac event. Consistent with this change in program scope, third-party payers such as Medicare now recognize the importance of a comprehensive secondary preventive approach to the cardiac patient. In fact, the national coverage policy from Medicare specifies that rehabilitation should not be solely an exercise program but rather a multidisciplinary one aimed at reducing subsequent cardiovascular disease risk through intensive risk factor management and institution of therapeutic lifestyle changes.

For the physician and allied health professional interested in the secondary prevention of cardiovascular disease, a good summary of the secondary prevention goals and treatment guidelines can be found in an American Heart Association/American College of Cardiology (AHA/ACC) statement on this topic [1] and other associated statements from the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) [2–5]. Table 15.1 provides a summary of these goals. In addition, the AACVPR also has been a long-standing proponent of a multidisciplinary program for cardiac rehabilitation, such that programs address the broad scope of cardiovascular disease and its related risk-related morbidities (diabetes, hypertension, dyslipidemias, metabolic syndrome, psychosocial stress, and smoking behavior) through both medical and multicomponent lifestyle interventions [6, 7]. In fact, both the ACC and the AACVPR, along

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Table 15.1 Summary of the American Heart Association/American College of Cardiology goals for secondary prevention in patients with coronary and other atherosclerotic vascular disease [1]

Risk factor or therapy	Goal
Smoking	Complete cessation. No exposure to environmental tobacco smoke
Blood pressure[a]	<140/90
Lipid management[a]	LDL cholesterol <100 mg/dL; if triglycerides are ≥200 mg/dL, then non-HDL cholesterol should be <130 mg/dL
Physical activity	30 min, 7 days/week (minimum 5 days/week)
Weight management	Body mass index: 18.5–24.9 kg/m^2 Waist circumference: men <40 in. and women <35 in.
Diabetes management	HemoglobinA_{1c} < 7% may be considered
Antiplatelet agents/ anticoagulants	See full paper for treatment recommendations [1]
Renin–angiotensin–aldosterone system blockers	See full paper for treatment recommendations [1]
Beta-adrenergic blockers	See full paper for treatment recommendations [1]
Influenza vaccination	Patients with cardiovascular disease should be vaccinated

[a]These guidelines (2011) have not incorporated the most recent hypertension [10] and lipid [11] guideline recommendations

with the American College of Sports Medicine, the American Hospital Association, and other organizations and individuals, were instrumental in providing the scientific evidence and opinion that led to the most recent changes in Medicare's national coverage policy [8, 9]. A summary of these changes is outlined in Table 15.2. As is evident, Medicare now expects rehabilitation programs to extend service beyond exercise only, by using an interdisciplinary team approach to promoting recovery from an acute cardiac event and reducing the risk of subsequent events.

In this chapter, we will provide information of use to practicing physicians who are considering referral to and interacting with a cardiac rehabilitation program. First, we will explore the utility and interpretation of the graded exercise tolerance test in the cardiac and noncardiac patients undergoing evaluation. Second, we will review the emerging role of cardiac rehabilitation in metabolic disorders. Third, we explore the structure of a cardiac prevention strategy, whether it be conducted within a clinic setting, in cardiac rehabilitation, or in a combination of the two, where the cardiac rehabilitation program communicates with the referring physician to address the needs and progress of the cardiac rehabilitation participant. Finally, we will provide some patient individual cases to illustrate these concepts.

Table 15.2 Summary of important changes in Medicare national coverage decision policy, 1982 to March 2006 and March 2006 to present [8, 9]

	1982 to March 2006	March 26, 2006 to present
Program components	Stipulated exercise only	Medical evaluation, risk factor modification, exercise, and education
Program duration	36 visits in 12 weeks	36 visits in 18 weeks (following review, up to 72 visits in 36 weeks)
ECG rhythm strips	Required	Clinician determined the need for ECG monitoring
Level of physician supervision	Proximal to exercise area	Hospital premises (within 250 yd for separate buildings on campus). Off-hospital campus then present and immediately available
"Incident to" physician	Unclear	Can vary based on the setting of the services provided; however, ordering physician, primary care physician, or program medical director should all suffice as long as there is documentation in the medical record of interactions between the physician and rehabilitation staff concerning patient status
Indications	STEMI, NSTEMI, CABG, stable angina	NTEMI, STEMI, CABG, angina, PTCA, coronary stenting, heart valve surgery, cardiac transplant, stable chronic systolic HF with LVEF ≤35% with NYHA class II-III symptoms, and optimal HF therapy for ≥6 wk

STEMI ST-segment elevation myocardial infarction, *NSTEMI* non-ST-segment elevation myocardial infarction, *CABG* coronary artery bypass graft surgery, *PTCA* percutaneous transluminal coronary angioplasty, *HF* heart failure, *LVEF* left ventricular ejection fraction, *NYHA* New York Heart Association

15.2 The Graded Exercise Test

In the primary care setting or in cardiac rehabilitation, a graded exercise test (GXT) might be obtained for risk stratification and prognostication, for diagnostic reasons (e.g., to test for residual ischemia in the setting of recurrent symptoms following an invasive therapeutic cardiovascular procedure), for therapeutic reasons (to develop an exercise prescription), or to quantify functional capacity—at baseline or in response to exercise training. It is important that the primary care provider be able to understand the reason for testing and the potential results obtained, so as to be able to adequately address the needs and status of the cardiac patient.

Reasons for obtaining a GXT in cardiac rehabilitation:

1. Diagnosis—evaluation of ischemia and symptoms following event or procedure
2. Prognosis—following a cardiac event

3. Exercise prescription—when entering a CR program
4. Evaluation of functional capacity—following exercise training for reinforcement

15.2.1 The GXT for Diagnostic Purposes

In most settings, the primary reason for obtaining a graded exercise test (GXT), sometimes referred to as an exercise tolerance test (ETT), is to confirm or refute the diagnosis of functionally significant occlusive coronary artery disease when patients have symptoms suspicious for stable angina pectoris. The consensus guidelines and literature supporting this indication are thoroughly addressed in the periodically updated official guidelines of the American Heart Association and American College of Cardiology [12]. However, in the cardiac rehabilitation setting, only rarely is graded exercise testing performed for a de novo diagnosis of occlusive coronary artery disease. Rather, following an invasive procedure (percutaneous coronary intervention or coronary artery bypass grafting) for correction of occlusive disease, the cardiac patient might experience recurrent symptoms reminiscent or suggestive of angina. In such settings, it is reasonable to consider performing a graded exercise test with ECG monitoring in order to screen for exercise-induced ischemia. This may occur early in the setting of post-event rehabilitation and discharge, during a cardiac rehabilitation program (e.g., indicative of incomplete revascularization), or later in the patient's course after cardiac rehabilitation (e.g., restenosis following angioplasty or stenting). If ischemia is documented, the patient is most often referred for more extensive studies and perhaps a repeat revascularization procedure.

15.2.1.1 The Positive Exercise ECG Tracing

The diagnosis of functionally occlusive coronary artery disease is made on the basis of the exercise ECG. The following criteria are used to read the test as "positive" for such a condition. The criteria are designed to optimize the balance between sensitivity and specificity in a population with a relatively high prevalence of cardiovascular risk factors. The ST segments have to be depressed 0.1 mV compared with the PR interval for the same beat, with a configuration that is downsloping or flat at a point in the complex that is 0.08 ms from the conclusion of the QRS complex in a lead tracing with no baseline ST depression. Additionally, this configuration has to be consistent and evident in at least three successive complexes to avoid findings due to motion artifacts. The finding must be in at least one of the ten standard ECG leads other than III and aV_R. A lone finding in lead III is not considered to be valid; rather, it has to be accompanied by a similar finding in leads II or aV_F. In lead tracings with baseline ST depression, the tracing has to meet "double criteria" in order to be considered positive: the ST tracing has to be depressed further than baseline by an additional 0.2 mV. That is, if the tracing is already 0.05 mV below the resting PR interval, then to meet double criteria, the tracing has to be 0.25 mV below the PR interval (baseline) at 0.08 ms from the conclusion of the QRS complex.

There are several additional caveats. In order to reduce the prevalence of false-positive tests, the exercise ECG is "uninterpretable" if there are baseline ST changes due to left ventricular hypertrophy or left bundle branch block or if the subject is taking digitalis and related medications. A test is considered interpretable in the lateral precordial leads (V_4–V_6) and in the limb leads in the presence of a right bundle branch block.

Note that there is a high prevalence of false-positive tests in patients using exogenous estrogens. This is likely due to the fact that the chemical structure of estrogens resembles that of digitalis. Higher levels of endogenous estrogens are also likely the cause of the higher rate of false-positive testing in middle-aged women, although this has never been conclusively proven. Instead of obtaining a simple GXT, it might be prudent to proceed directly to a functional imaging study for diagnosis or exclusion of occlusive coronary artery disease in women on exogenous estrogen therapy, given the relatively higher rate of false-positive tests in this demographic, and since progression to functional imaging studies might be required anyway. Many of these considerations are summarized in an excellent text by Ellestad on the subject dealing with the interpretation of the exercise electrocardiogram [13].

Interpretations of the exercise ECG:

1. Criteria for positive test:
   (a) ST segments depressed 0.1 mV in the absence of baseline changes
      - Three successive beats
      - Flat or downsloping 0.08 ms from the completion of the QRS complex
      - Any one or more of the ten leads, excluding III and aV_R
   (b) Meets "double criteria" in the presence of baseline ST depression
2. Uninterpretable in the presence of:
   (a) LBBB, LVH with strain, and digitalis
3. High prevalence of false positives (i.e., use caution) in the presence of:
   (a) Exogenous estrogen used
   (b) LVH without strain
   (c) Middle-aged women

15.2.2 The GXT for Prognostic Purposes

15.2.2.1 Cardiorespiratory Fitness

Cardiorespiratory fitness, as measured by a graded exercise tolerance test, provides strong and independent prognostic information about overall—and especially cardiovascular—morbidity and mortality. Cardiorespiratory fitness is a valid prognostic indicator in apparently healthy individuals; in at-risk individuals with diabetes mellitus, metabolic syndrome, and hypertension; and in patients with cardiovascular disease, such as those presenting to cardiac rehabilitation programs [14–20]. However, despite the profoundly important prognostic information provided by simple clinical assessments of fitness, they are, unfortunately, rarely used in the clinic setting and often ignored in the exercise testing laboratory. There appears to be an undue emphasis—both on the part of the cardiac specialist and primary care physician—on the exercise ECG for the diagnostic interpretation just discussed. Tables 15.3 and 15.4 indicate, for women and men, the expected fitness level in METS; 1 MET is the "metabolic equivalent" or energy utilized by a person at rest (approximated by 3.5 mL O_2/kg/min or 1 kcal/kg/min). Due to its increasingly recognized value, testing laboratories should report the fitness classification on clinical GXT reports. This can be used as a valuable marker to follow longitudinally the changes in risk stratification in individuals in cardiac rehabilitation programs.

15.2.2.2 The Exercise ECG for Prognostic Purposes

There is a rich literature from the 1980s regarding the use of the exercise ECG—specifically, the time during the GXT at which it becomes abnormal—and the prognostic implications of this in clinical decision-making. In one set of investigations, it was observed that, after myocardial infarction, a sub-maximal test can be used to determine medium- and long-term risk of recurrent ischemic events and cardiovascular death. Additionally, GXT information can be used to determine the likelihood of left main and three-vessel coronary artery disease (sometimes referred to as "surgical disease").

In a publication during this period, the Duke Treadmill Score was developed and subsequently reached broad popularity for prognostic purposes [18]. It was observed that a limited GXT performed within the first several weeks following a myocardial infarction could assist in determining whether follow-up testing was indicated in order to identify patients who would benefit most from coronary artery bypass grafting (CABG). If the exercise ECG of a GXT was positive or symptoms developed before a HR of 120 beats per minute (bpm) was achieved, this indicated a 22% likelihood of the patient having three-vessel occlusive coronary disease or 8% of having left main coronary artery disease [22]. This would prompt further studies in the coronary catheterization laboratory with the anticipation that the patient will require CABG. Soon, these criteria were found to be relevant for all individuals suspected of having occlusive coronary artery disease [23]. Unfortunately, with the ready availability of invasive diagnostic and therapeutic catheterization laboratories at many institutions, this practice has fallen out of favor, and the GXT is rarely used today as a prognostic test when developing a therapeutic plan.

Table 15.3 Cardiorespiratory fitness classifications for women (METS) [21]

Age (year)	Low	Below average	Average	Above average	High
20–29	≤8.0	8.0–9.9	10.0–12.4	12.5–13.9	≥14.0
30–39	≤7.7	7.8–9.6	9.7–11.9	12.0–13.6	≥13.7
40–49	≤7.1	7.2–9.0	9.1–11.6	11.7–13.0	≥13.1
50–65	≤6.0	6.2–8.2	8.3–10.5	10.6–11.9	≥12.0

Table 15.4 Cardiorespiratory fitness classifications for men (METS) [21]

Age (year)	Low	Below average	Average	Above average	High
20–29	≤10.9	11.0–12.5	12.6–14.8	14.9–16.2	≥16.3
30–39	≤9.7	9.8–11.3	11.4–13.6	13.7–14.8	≥14.9
40–49	≤8.6	8.7–10.2	10.3–12.5	12.6–13.6	≥13.7
50–59	≤7.1	7.2–9.0	9.1–11.3	11.4–12.5	≥12.6
60–69	≤6.0	6.1–7.6	7.7–10.2	10.3–11.3	≥11.4

15.2.3 The Use of the GXT for Therapeutic Purposes: Modifying the Exercise Prescription

The GXT can also be used to follow a patient's progress and to adjust exercise training intensity. It is for this purpose that the Center for Medicare and Medicaid Services (CMS) recognizes the need to reimburse for a GXT both prior to and following an approved period (36 sessions) of cardiac rehabilitation. The principles underlying this practice in the coronary patient are summarized in Fig. 15.1.

It is a basic principle of exercise physiology that there is a linear relation between heart rate and workload from rest to the ventilatory threshold when the oxygen demands precipitated by the exercise workload exceeds the oxygen supply to working muscles. After a period of exercise training, there occur three observable physiologic responses characterizing the "training effect." These three responses are illustrated in Fig. 15.1: (1) resting bradycardia, where the resting heart rate is lower following exercise training; (2) a training bradycardia, a relative bradycardia at each successive workload to HR maximum; (3) an increase in maximum workload (measured as time to exhaustion in a given exercise protocol or as peak

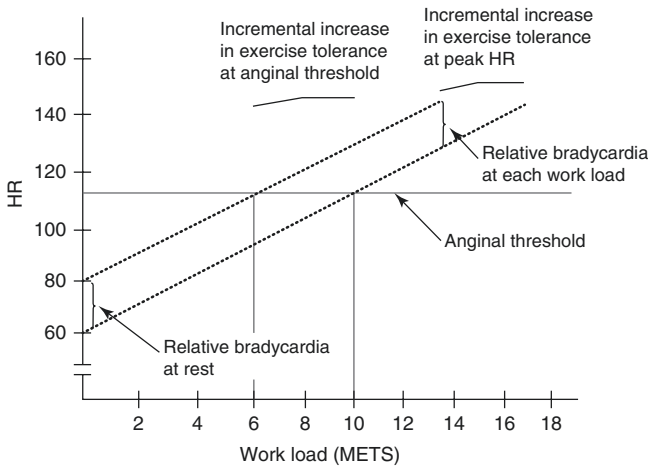

Fig. 15.1 The principles underlying graded exercise testing in the cardiac patient. For a full discussion of the principles, please see the text. The graphic depicts the linear response of heart rate (HR) to increasing workloads in metabolic equivalents (METs, multiples of resting energy expenditure) before and following an exercise training program (shown by the *dotted lines* where the pre-program line is higher and to the left of the post-program line). The three components of an exercise "training effect" are evident: decrease in resting heart rate (training bradycardia), a relative bradycardia at each workload, and an increase in maximum work tolerance. When angina from a fixed lesion reproducibly occurs at a heart rate of 115 bpm, there is a similar increase in workload (from 6 to 8 METs) before the onset of angina, resulting in an effective increase in asymptomatic work tolerance with exercise training for the cardiac patient having stable exercise-induced angina

VO_2 with indirect calorimetry using a metabolic cart). This physiology is particularly pertinent for individuals with occlusive coronary artery disease and angina pectoris. With a fixed lesion, the angina threshold (HR at which angina occurs) is reproducible and corresponds to a given level of work (workload). In the figure, before and following exercise training, the angina threshold is approximately 115 bpm. The maximum workload at the angina threshold is 6 METS prior to training, but 10 METs following; this represents a 66% increase in exercise tolerance following exercise training.

It should be noted that these responses are specific to the muscles undergoing exercise training, and, therefore, careful attention should be given to the exercise prescription and the muscle groups that will be commonly used in the activities of daily living when the angina threshold is likely to be exceeded. For example, if a patient works in a job that requires primarily upper body work, then consideration should be given to exercise training primarily the upper body during the cardiac rehabilitation period in order to provide the greatest increase in exercise tolerance in the work setting.

Thus, graded exercise testing is a useful clinical tool with prognostic, diagnostic, and therapeutic uses. Careful attention to the use of this tool in the cardiac rehabilitation program can increase the utility of program components to modify risk for subsequent events.

15.3 Cardiac Rehabilitation: Expanding Applications to Metabolic Disease

The increasing prevalence of overweight and obesity has contributed to a diabetes epidemic in the USA. In response to this growing health concern, the AHA issued a scientific statement regarding the role of exercise training in type 2 diabetes to reduce cardiovascular risk [24]. Because diabetes is a strong risk factor for initial and subsequent cardiovascular events, exercise training should be employed in both the primary and secondary prevention settings. In individuals with diabetes, exercise training improves glycemic control, reduces body fat and body mass index, reduces hypoglycemic medication requirement, and improves exercise capacity. Moreover, exercise has favorable effects on other cardiovascular risk factors in diabetic individuals, including hypertension and hyperlipidemia [25, 26].

The growing obesity epidemic has also increased the prevalence of the metabolic syndrome. The metabolic syndrome, characterized by systemic insulin resistance, is generally defined as the presence of any three of the following traits [27]: (1) abdominal obesity, defined as a waist circumference in men ≥102 cm (40 in) and in women ≥88 cm (35 in); (2) serum triglycerides ≥150 mg/dL or drug treatment for elevated triglycerides; (3) serum high-density lipoprotein (HDL) cholesterol <40 mg/dL in men and <50 mg/dL in women or drug treatment for low HDL cholesterol; (4) blood pressure ≥130/85 mmHg or drug treatment for elevated blood pressure; and (5) fasting plasma glucose (FPG) ≥100 mg/dL or drug treatment for elevated blood glucose. A recent study estimated that nearly 35% of all US adults and 50% of those 60 years or older have the metabolic syndrome [28]. Importantly, the metabolic syndrome significantly increases risk for cardiovascular events and death [29], so interventions targeting this condition will have major impact on population health. Because numerous studies demonstrate the beneficial effects of exercise training on the individual components of the metabolic syndrome [30], exercise prescriptions should be considered in every individual who presents with the metabolic syndrome.

The ability of individuals with diabetes or metabolic syndrome to participate in formal exercise programs may be limited due to access to facilities or lack of insurance coverage. However, evidence demonstrates a benefit of home-based exercise programs in combination with ongoing physical activity counseling by health-care providers [31], underscoring the importance of continued exercise-related discussions at each patient visit. Cardiac rehabilitation for those with cardiac disease and metabolic syndrome or diabetes mellitus is even more imperative than in those without these comorbid conditions.

15.4 Cardiac Care in the Outpatient Setting: Behavioral and Therapeutic Strategies

The assessment of global cardiovascular risk at baseline and in response to therapy is an important issue to assess during cardiac rehabilitation. Many cardiac rehabilitation programs assess the patient before and after a period of cardiac rehabilitation using established modifiable markers of cardiovascular risk, including each component of the lipid profile, blood pressure, metabolic syndrome, diabetes mellitus, central adiposity, cigarette smoking, depression, social support, and others. The goal is to modify the risk in order to prevent downstream cardiovascular morbidity and mortality. Although much is accomplished in the setting of the cardiac rehabilitation program itself, much can also be accomplished in the clinic-based visits with physicians and mid-level providers to reinforce messages from the cardiac rehabilitation program, to titrate and optimize medical therapy, and to further refine risk modification strategies when cardiac rehabilitation is completed. For lifestyle modification to be successful in the clinic setting, the provider must base the approach upon a behavioral construct that to the clinician makes sense and is one that can readily be employed. Many consider the standard stages of change behavioral change construct [32] to be the most useful. This is discussed below.

15.4.1 Assessment of Risk in the Cardiac Rehabilitation Setting

It is critical to assess modifiable cardiovascular risk factors prior to, and following, a course of cardiac rehabilitation. First, such an assessment can focus the attention of the patient and the CR staff on targeted areas of particular interest during the rehabilitation period. Follow-up assessments can demonstrate significant improvement when patients are compliant with prescribed therapeutic and lifestyle modifications. Second, such information can be shared as objective evidence of success to referring providers, thus becoming a reinforcing strategy for participant recruitment. Two case examples demonstrating these principles are presented later. Third, the CR staff can use these data to assess the effectiveness of the program, and, in general, ineffective strategies can be modified and adapted to be more efficacious or abandoned if found to have no utility.

We have used the format illustrated in the case examples to collect relevant data on individual participants. Such data are shared with the referring health-care provider and can become part of the medical record of the individual. In addition, data are collected in a longitudinal database for subsequent program-wide assessments, as previously discussed.

15.4.2 Assessment and Modification of Risk in the Clinic Setting

As noted, a clinic visit, with either a member of the CR team or the referring physician, is an important ancillary component of cardiac rehabilitation. It is important to incorporate smoking, inactivity, and poor eating habits into a behavior change strategy. There are at least four steps to a successful intervention when trying to achieve behavioral change: (1) bringing attention to the behavior, (2) discussion of the behavior with the individual, (3) developing an effective strategy with the patient for changing behavior, and (4) following up with the progress of the strategy at the next encounter. It is clear, however, that such approaches take time and the pressures of current medical practice require that strategies to address behavior change in the outpatient setting be both effective and time-efficient.

Steps in successful clinic-based behavior change strategies:

1. Bring attention to the behavior—surveying
2. Discussion of importance of changing the behavior
3. Agreeing on plan and contracting
4. Follow-up

15.4.2.1 Bringing Attention to the Behavior

There are several methods to bring a particular behavior to the attention of a patient. When this comes from the physician, the individual becomes aware that the physician believes in its importance. For example, measuring a weight or waist circumference or asking about eating and physical activity behaviors are important components of drawing the patient's attention to the issue; it also stresses that the health-care provider believes the issue is important enough to seek and record this information. Short surveys administered about eating and physical activity behaviors, administered in the waiting room while the individual is waiting to see the caregiver, also provide an effective strategy for collecting this information. It is essential, however, in order for this strategy to be effective, that the information subsequently be addressed and referenced during the clinic encounter with the physician. Such data should also become part of the medical record, preferably in the clinic visit note.

15.4.2.2 Discussion of the Behavior in the Clinic with the Patient

It is important, once the data are collected on a given behavior, to discuss the behavior with patients during the clinic encounter. That being said, it is clear, that not all behaviors of interest can be effectively addressed in each

clinic visit. That is, it may be particularly ineffective to mention as a parting comment during a clinic encounter that the individual "should lose weight, eat better, and get more regular exercise." Although better than not acknowledging the problem at all, the absence of a detailed, if brief, discussion of important behavioral issues will rarely lead to significant or long-term behavior change. Rather, the provider must spend some time explaining the importance of the behavior at issue. Addressing *one* of the potentially four important cardiovascular behaviors in *each* visit is an efficient and effective means to promoting behavior change. In the prevention setting, the important behaviors that should be addressed are smoking, poor nutrition choices, lack of sufficient physical activity, and type A behavior (high mental stress levels due to excessive external demands as perceived by the individual). How does one choose which behavior to address in a given clinic visit?

Choosing Which Risk Factor to Address: The Transtheoretical Model of Behavioral Change

The transtheoretical model of behavior change (pre-contemplation, to contemplation, to planning, to action, to maintenance and reinforcement) is a common approach to instituting behavior change in the clinic setting. It can also be used to decide which behavior of several that could best be chosen should be addressed in any given encounter. For example, should an individual be a smoker, have a poor diet, excessive job-related stress, and be physically inactive, one might ask which behavior might be best to address first. One approach might be to assess in which stage of pre-contemplation, contemplation, or planning the individual is in, by prompting with questions such as "Have you considered stopping smoking?" or "Have you made plans to stop smoking within the next several months?" Depending upon this survey of prospective behaviors, it might make sense first to address those behaviors to which the individual is willing or even eager to direct their attention. For example, in a patient that responds to such queries with "I enjoy smoking and do not wish to consider stopping at the present, but I do want to consider changing my diet and getting more exercise," it does not make sense to address first the smoking issue ahead of diet and exercise issues.

15.4.2.3 A Series of Clinic Visits Become a Program for Behavior Change

Given time constraints and limitations on the amount of information any one individual can absorb in one visit, it makes sense to address only one behavior in each visit and attempt to move the behavior change along the transtheoretical model spectrum in each clinic encounter. This typically may take from 5 to 15 min. Thus, in reality, *a series of clinic visits becomes a program of behavior change*, and, for example, it may take up to 16 sequential clinic visits to address and promote effective behavior change in each of 4 distinct behaviors.

Developing a Behavior Change Plan

As noted, developing a behavior change plan is an essential step in the process of promoting lifestyle changes in the clinic setting. This may take as little as 5 min and as much as 15 min. Addressing the need to increase physical activity, for example, the clinician might probe the individual's lifestyle and suggest where within the normal routine of a day a patient may dedicate time for physical activity and exercise. As it does not require large changes in physical activity to make a significant difference in health parameters and modest changes in physical activity are relatively easy to institute, formulating a plan with an individual in the clinic setting is important. Often, for example, in order to promote daily, moderate levels of activity of about 30 min duration, we often suggest that patients walk the dog daily—whether he/she has one or not! Once a plan is made, it is important to document it in the clinic record for later reference.

15.4.2.4 Follow-Up at the Next Encounter: The Importance of Contracting

The final essential step in a clinic-based process promoting behavior change is follow-up and reinforcement. By recording the plan in the clinic note, the clinician is prepared to query progress at the next visit. Contracting also is a useful approach. For example, if weight loss is a goal, one might agree on a target for a given amount of weight loss in the interim until the next visit (e.g., agreeing on a 10 lb weight loss in 5 months). One might reinforce the understanding by contracting on the behavior (looking the patient in the eyes, shaking hands on the agreement, and recording it in the chart). This can be particularly effective in helping the individual recall the contract. The contract and progress in achieving the agreement are then reviewed at the next encounter and a new contract formed. When it is important to reinforce behavior when change is actively taking place, more as opposed to less frequent clinic visits might be arranged.

15.5 Summary and Outstanding Questions

Assessing global cardiovascular risk is important in both the cardiac rehabilitation setting and in the cardiovascular disease prevention or primary care clinic working in parallel. Assessing risk permits one to assess the effectiveness and make necessary adaptation of procedures and tactics for promoting lifestyle changes in these settings. In the clinic set-

ting, promotion of lifestyle change is a progressive process, often based upon behavioral change strategies, such as the transtheoretical model, where a series of stepwise counseling can be considered a program. Although many of the suggestions presented in this summary are seemingly rational and self-evident, many questions are in need of scientific testing for efficacy in randomized trials. For example, an important question might be, when multiple behaviors need to be addressed, whether it is better to address a behavior that the individual is open to change (i.e., contemplative) or one that potentially presents the greatest risk (e.g., smoking). Scientific studies addressing such questions will greatly assist those that promote lifestyle change strategies in the clinic setting.

15.6 Summary

These are exciting times for professionals working in the field of cardiac rehabilitation and secondary prevention. Although much is known about how patients respond to and benefit from regular exercise and therapeutic lifestyle changes, more work is needed relative to improving long-term compliance to known beneficial lifestyle and medical therapies, improving referral rates of eligible patients to secondary prevention programs, and improving the retention of patients who are referred to and begin participation in cardiac rehabilitation. Despite cardiac rehabilitation representing a Class 1A guideline therapy for most patients with cardiovascular disease, gender, age, and racial discrepancies persist in terms of program access and utilization. Like other therapies available to patients with cardiovascular disease, cardiac rehabilitation is a cost-effective strategy that improves mood, restores functional capacity, lessens or alleviates symptoms, and lowers the risk for and occurrence of subsequent clinical cardiovascular events, with all of the attendant social, economic, and medical benefits that ensue from its successes. It is imperative that primary care physicians ally themselves with the multidisciplinary team approach which cardiac rehabilitation offers to patients who have sustained acute coronary syndromes, have undergone coronary revascularization, have had cardiac surgery, or who have chronic systolic heart failure.

15.7 Patient Examples

15.7.1 Patient Example 1

The patient is a 58-year-old gentleman referred to cardiac rehabilitation with a diagnosis of recurrent angina pectoris and status post-angioplasty. He has a history of coronary artery disease dating back 4 years when he presented with classical angina pectoris and underwent percutaneous coronary intervention with a stent to the right coronary artery (RCA). Now 4 years later, he presented with an abnormal stress ECG and underwent coronary catheterization and stent placement for an in-stent restenosis in the RCA and to a 90% new lesion in the large optional marginal coronary artery. A 40% lesion in the proximal left anterior descending coronary artery was not stented. The patient carries cardiac comorbidities and risk conditions including diabetes mellitus, dyslipidemia, hypertension, and depression. His medical regimen includes aspirin, simvastatin/ezetimibe-40/10, valsartan, clopidogrel, triamterene/HCTZ, metformin, rosiglitazone, glipizide, and Wellbutrin XL (Fig. 15.2).

15.7.2 Patient Example 2

The patient is a 60-year-old woman referred to cardiac rehabilitation after bypass surgery for a single-vessel coronary artery lesion. She had no significant past medical history before she presented to her primary doctor complaining of a history of chest discomfort and palpitations for several months that had been increasing in frequency. The chest discomfort was described as a pressure sensation without radiation, diaphoresis, or shortness of breath, originally only associated with exertion but now also occurs at rest and upon awakening in the morning. Risk factor evaluation revealed a lipid panel of total cholesterol 251 mg/dL, LDL cholesterol of 154 mg/dL, triglycerides of 50 mg/dL, and HDL cholesterol of 78 mg/dL. A stress echocardiogram revealed evidence of stress-induced anteroseptal and apical wall motion abnormalities with a normal left ventricular ejection fraction. Cardiac catheterization revealed a 95% proximal left anterior descending (LAD) coronary artery lesion that was not approachable by percutaneous angioplasty; therefore, the patient underwent single-vessel coronary artery bypass grafting to the LAD. She was discharged home on aspirin, clopidogrel, metoprolol, atorvastatin, omega-3 fatty acids, and sublingual nitroglycerin as needed and referred to cardiac rehabilitation.

The patient's cardiac rehabilitation course is described in Fig. 15.3. She experienced improvement in serum lipids, Framingham risk factor score, exercise fitness level, 6-min walk, waist circumference, and education level regarding cardiac risk. She had also adopted a regular exercise habit, better nutrition habits, and a plan for managing job-related stress. A recommended discharge treatment plan is provided.

DUKE CARDIAC REHABILITATION

PATIENT'S NAME: Mr. XXXXX
MD: XXXXX HISTORY NUMBER: XY0000

EXIT SUMMARY

Program dates: 10.29.07 to 3.12.08 Number of sessions: 32/36

	Initial	Exit	%Change	Comments
Metabolic Syndrome	Yes	No		Diabetic; HTN
Smoking	No	No		
Hypertension				Average of first and last 3 BP readings
systolic	132	117	11%	
diastolic	74	67	9%	
Hyperlipidemia				
Total	138	113	18%	
LDL	57	32	44%	Goal for LDL is <70mg/dL
HDL	35	45	29%	Goal : >40mg/dL men, >50 mg/dL women
Triglycerides	228	179	21%	Goal for TG is <150 mg/dL
Diabetes				
HBA1C	6.7	6.2	7%	
Fasting glucose	183	110	40%	Average of first and last 3 fasting glucoses
Framingham 10 yr. CHD Risk	9%	6%	33%	
Exercise METS	3.6	9.5	164%	
6 Minute Walk (meters)	510.3	774.4	52%	
Waist Circumference (cm)	106.5	96	10%	Goal for men < 102 cm
Educational score	15	18	20%	20 total questions

MEDICATIONS AT DISCHARGE: Aspirin, 81 mg daily; Diovan, 160 mg daily; Plavix, 75 mg daily; Metformin, 500 mg twice daily; Avandia, 4 mg daily; Vytorin, 10/40 mg daily; Wellbutrin XL, 150 mg daily; Triamterene/HCTZ, 32.5/25 mg ½ daily

PROGRESSION TOWARD GOALS: Mr. XXXXX's goals coming into rehab were to lose 20 pounds and to run a 5k race in under 35 minutes. His weight at the beginning of rehab was 196.4 and on the last session of rehab his weight was 176. He recently competed in a race in Raleigh and finished the 3.2 miles in 31:40.

BEHAVIOR MODIFICATION: Mr. XXXXX saw great improvements in his lipids, blood glucose, exercise METS and waist measurement. He made significant lifestyle changes and seemed to do so in a way that he will be able to maintain. Throughout his participation in rehab, he appeared to handle his stress well and did not cite any anxiety or depressive symptoms.

NUTRITION COMPONENT: Mr. XXXXX attended the November classes and found he was eating more starches than needed and less vegetables than suggested. His weight loss is evidence of adopting positive eating habits.

OTHER SERVICES ATTENDED: Regular lecture attendance ☐ Stress Management series ☐ Relaxation/Meditation class ☐
Strength training ☐ Flexibility program ☐ Consistent exercise outside of cardiac rehab ☐

RECOMMENDED EXERCISE PLAN

	AEROBIC EXERCISE	STRENGTH	FLEXIBILITY
FREQUENCY	3 -4 times/week	2 – 3 times/week	After each exercise session
INTENSITY	120 – 144 bpm	Somewhat hard	Light
TYPE	Jogging; walking	Free weights	Stretches
TIME	30 – 50 minutes	20 -30 minutes	10 minutes
ENERGY EXPENDITURE	1200 calories/week		

EXERCISE PHYSIOLOGIST

MEDICAL DIRECTOR

If you have any concerns, please call our team at 660-6724.

Cardiac Rehab Plan

- ☐ Join the Fred Cobb Healing HEARTS program
- ☐ Join the Duke Health and Fitness Center
- ☒ Home exercise program
- ☐ Discharge to exercise facility of choice

Fig. 15.2 Patient example 1. The cardiac rehabilitation program report to his primary care doctor is presented here. One can see from the report that the patient was able to develop rigorous exercise habits, better nutrition habits, and lose 9 kg (20 lb) in the process so that he was able to participate in a 5 k race. As a consequence, there were significant improvements in serum lipids, blood glucose control, fitness, and waist circumference. A recommended discharge treatment plan is provided

DUKE CARDIAC REHABILITATION

PATIENT'S NAME: Ms. YYYYY
MD: YYYYY
HISTORY NUMBER: XY11111

EXIT SUMMARY

Program dates: 7-9 to 12-19-07 Number of sessions: 36

	Initial	Exit	% Change	Comments
Metabolic Syndrome	no	no		
Smoking	no	no		
Hypertension	no	no		Average of first and last 3 BP readings
systolic	96	106	-10%	
diastolic	62	68	-10%	
Hyperlipidemia	yes	yes		
Total	205	134	35%	
LDL	112	52	54%	Goal for LDL is <70mg/dL
HDL	77	73	-5%	Goal : >40mg/dL men, >50 mg/dL women
Triglycerides	79	45	43%	Goal for TG is <150 mg/dL
Diabetes	no	no		
HBA1C	5.8	n/a		
Fasting glucose	n/a	n/a		Average of first and last 3 fasting glucoses
Framingham 10 yr. CHD Risk	6%	4%	33%	
Exercise METS	4.0	5.8	45%	
6 Minute Walk (meters)	574.9	680.8	18%	
Waist Circumference (cm)	77	70.5	8%	Goal for women: <88cm
Educational score	13	17	31%	20 total questions

MEDICATIONS AT DISCHARGE: Plavix 75 mg daily, Axid 150 mg daily, Lipitor 20 mg daily, ASA 81 mg daily, Iron 325 mg daily, Vitamin C 250 mg tid, Lopressor 12.5 mg bid

PROGRESSION TOWARD GOALS: Ms. YYYYY's goals included exercising 3-5 days per week, learn meditation skills and to get to a goal weight of 130. She achieved all of her stated goals and plans on maintaining her current exercise program.

BEHAVIOR MODIFICATION: She is regularly meditating at home and is working on her primary stressor, which is her job.

NUTRITION COMPONENT: She attended the 4 hour nutrition class in December.

OTHER SERVICES ATTENDED: Regular lecture attendance ☒ Stress Management series ☐ Relaxation/Meditation class ☒
Strength training ☒ Flexibility program ☒ Consistent exercise outside of cardiac rehab ☒

RECOMMENDED EXERCISE PLAN

	AEROBIC EXERCISE	STRENGTH	FLEXIBILITY
FREQUENCY	3-5 days per week	2-3 days per week	After each exercise session
INTENSITY	TR: 96-123	1-3 sets; 10-15 reps	
TYPE	TM, EFX, biking		
TIME	30-60 minutes		
ENERGY EXPENDITURE	1000-1200 calories/week		

EXERCISE PHYSIOLOGIST

MEDICAL DIRECTOR

If you have any concerns, please call our team at 660-6724.

Cardiac Rehab Plan

- ☐ Join the Fred Cobb Healing HEARTS program
- ☒ Join the Duke Health and Fitness Center
- ☐ Home exercise program
- ☐ Discharge to exercise facility of choice

Fig. 15.3 Patient example 2. The report provided to the referring physician about the course during participation in cardiac rehabilitation is shown here. Note the improvement in serum lipids, Framingham risk factor score, exercise fitness level, 6-min walk, waist circumference, education level regarding cardiac risk, adoption of a regular exercise habit, better nutrition habits, and a plan for managing job-related stress. A recommended discharge treatment plan is provided

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