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REVIEW TOPIC OF THE WEEK

Cardiac Rehabilitation and Risk Reduction

Time to "Rebrand and Reinvigorate"

Pratik B. Sandesara, MD,* Cameron T. Lambert, MD,* Neil F. Gordon, MD, PhD, MPH,† Gerald F. Fletcher, MD,‡ Barry A. Franklin, PhD,§ Nanette K. Wenger, MD,* Laurence Sperling, MD*

ABSTRACT

Atherosclerotic cardiovascular disease (ASCVD) continues to increase annually in the United States along with its associated enormous costs. A multidisciplinary cardiac rehabilitation (CR) and risk reduction program is an essential component of ASCVD prevention and management. Despite the strong evidence for CR in the secondary prevention of ASCVD, it remains vastly underutilized due to significant barriers. The current model of CR delivery is unsustainable and needs significant improvement to provide cost-effective, patient-centered, comprehensive secondary ASCVD prevention. (J Am Coll Cardiol 2015;65:389–95) © 2015 by the American College of Cardiology Foundation.

The growing epidemics of obesity (almost 35% of adults with a body mass index ≥30 kg/m^2), metabolic syndrome (35% of adults), diabetes mellitus (8.3% of adults had diagnoses of diabetes, and 38.2% were pre-diabetic), sedentary lifestyle (around 30% of the population reported physical inactivity in 2012, and 49.9% did not meet the federal aerobic physical activity guidelines for adults), hypertension (33% of adults), and smoking (20.5% of men and 15.9 % women) contribute to the increasing burden and prevalence of atherosclerotic cardiovascular disease (ASCVD) in the United States (1,2). An estimated 75% to 90% incidence of coronary artery disease (CAD) in a variety of populations is explained by antecedent exposure to conventional risk factors, influenced by the most proximal or foundational factors for heart disease, including poor dietary habits, physical inactivity, and cigarette smoking (**Central Illustration**) (3–5). With ASCVD increasing annually and costs related to ASCVD and stroke exceeding $315 billion in 2010, and projected to triple over the next 20 years, there is a clear need for comprehensive multidisciplinary cardiac rehabilitation (CR) and risk reduction programs to provide primary and secondary prevention for ASCVD (1,6). Since 1995, CR has been defined as "the provision of comprehensive long-term services involving medical evaluation, prescriptive exercise, cardiac risk factor modification, and education, counseling, and behavioral interventions" (7).

Exercise can be viewed as a preventive medical treatment, like a "pill" that should be taken on an almost daily basis.

—2013 American Heart Association scientific statement on exercise standards for testing and training (8)

Beneficial cardioprotective effects of physical activity and cardiorespiratory fitness include improvements in multiple ASCVD risk factors together with antiatherogenic, anti-inflammatory, anti-ischemic, antithrombotic, and antiarrhythmic effects (**Table 1**) (8,9). The efficacy of exercise-based CR in secondary prevention of ASCVD is well established. A systematic review and meta-analysis of 34 randomized controlled trials showed that exercise-based CR programs are

From the *Division of Cardiology, Department of Medicine, Emory University School of Medicine, Atlanta, Georgia; †Intervent International, Savannah, Georgia; ‡Mayo Clinic, Rochester, Minnesota; and the §Department of Cardiovascular Medicine, William Beaumont Hospital, Royal Oak, Michigan. Dr. Gordon is the CEO of Intervent International, LLC. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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ABBREVIATIONS AND ACRONYMS

AHA = American Heart Association

ASCVD = atherosclerotic cardiovascular disease

CAD = coronary artery disease

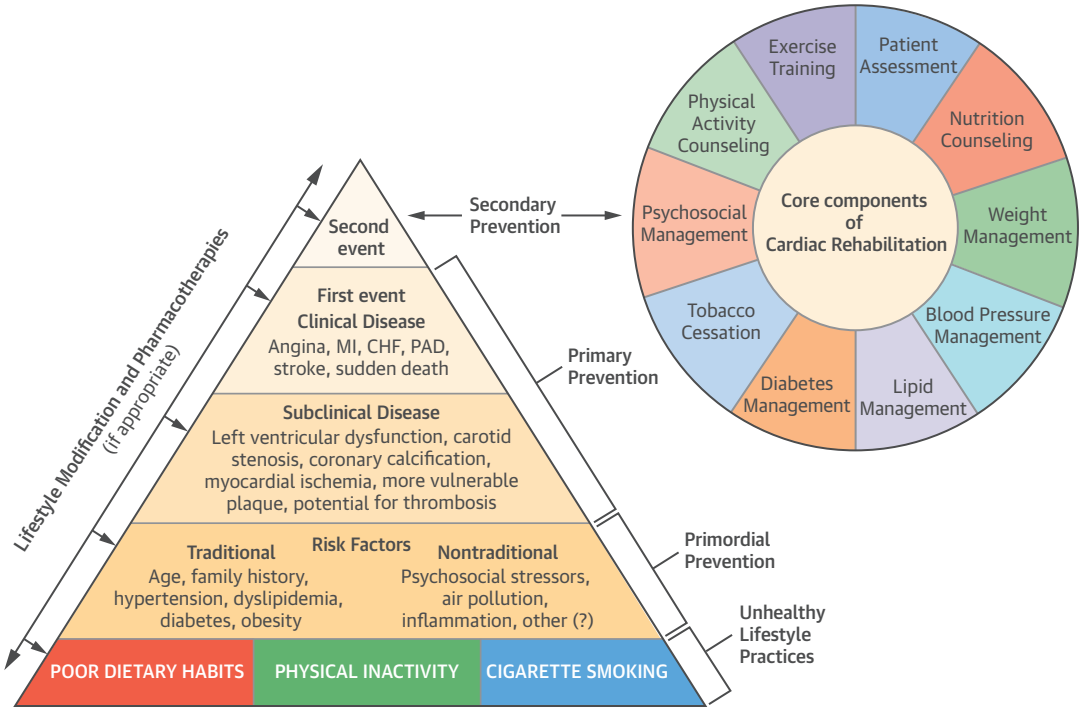
CR = cardiac rehabilitation

MI = myocardial infarction

QOL = quality of life

associated with a lower risk of reinfarction (odds ratio [OR]: 0.53; 95% confidence interval [CI]: 0.38 to 0.76), cardiac mortality (OR: 0.64; 95% CI: 0.46 to 0.88), and all-cause mortality (OR 0.74, 95% CI: 0.58 to 0.95) (22). Another meta-analysis of randomized controlled trials showed that compared with usual care, patients in the exercise-based CR group had greater improvements in ASCVD risk factors such as lipid levels and systolic blood pressure and had lower rates of self-reported smoking (23). Notably, the effect of CR on total mortality was independent of whether the trial was published before or after 1995, suggesting that the mortality benefits of CR persist in modern cardiology. Patients who undergo percutaneous coronary intervention or coronary artery bypass graft surgery also benefit from CR, with a reduction in all-cause mortality of 20% to 50% compared with that in the control groups receiving usual care (24–26). Additional documented benefits of CR include improved exercise performance and health-related quality of life (QOL), decreased hospitalizations, and reduced depression and anginal symptoms (23,27,28).

CENTRAL ILLUSTRATION **Cardiac Rehabilitation and the ASCVD Prevention Pyramid**



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Pyramid **(left)** shows how unhealthy lifestyle practices lead to development of risk factors, progression of ASCVD, and, ultimately, to adverse outcomes or clinical endpoints. There are 3 types of prevention: primordial (prevention of risk factors); primary (treatment of risk factors); and secondary (prevention of recurrent cardiovascular events), which can be modulated by environmental (e.g., air pollution) and psychosocial stressors, lifestyle changes, and cardioprotective medications, if appropriate. The first-line strategy to prevent initial or recurrent cardiac events is to favorably modify unhealthy lifestyle habits or practices, including poor dietary habits, physical inactivity, and cigarette smoking. Circular chart **(right)** shows core components of CR/secondary prevention programs. The current model of CR involves 3 phases. Phase I (inpatient phase) involves physical therapy and patient education after a cardiac event. Phase II (outpatient phase) consists of individualized exercise prescription and risk factor reduction under supervision of a medical team. Phase III (maintenance phase) consists of independent continuation of the exercise program and cardiovascular risk reduction learned during phase II (37,39). CR also provides the referring physician with ongoing valuable surveillance data (such as exertional angina symptoms, onset of AF, heart failure symptoms) that can aid with ongoing medical management of the patient. Adapted with permission from Franklin et al. (5). AF = atrial fibrillation; ASCVD = atherosclerotic cardiovascular disease; CABG = coronary artery bypass graft; CHF = congestive heart failure; MI = myocardial infarction; NSTEMI = non-ST-segment elevation myocardial infarction; PAD = peripheral arterial disease; PCI = percutaneous coronary intervention.

In the HF-ACTION (Heart Failure: A Controlled Trial Investigating Outcomes of Exercise Training) study, patients with systolic heart failure randomized to an exercise training program had hazard ratios of 0.89 ($p = 0.03$), 0.91 ($p = 0.09$), and 0.85 ($p = 0.03$) for all-cause mortality or hospitalization, cardiovascular mortality or cardiovascular hospitalization, and cardiovascular mortality or heart failure hospitalization, respectively (29). Patients in the exercise training program also demonstrated significant improvements in QOL measures after 3 months that were sustained at 3 years' follow-up (30). Similarly, a recent Cochrane review of 33 trials in patients with heart failure with reduced or preserved ejection fraction found a decreased risk of hospital admissions and improvement in health-related QOL for patients in the exercise-based rehabilitation group compared with that in the control group receiving usual care (31). Hence, CR programs confer significant benefits on patients with heart failure through reduced mortality, enhanced QOL, and reduced hospitalizations.

TABLE 1 Potential Cardioprotective Effects of Increased Lifestyle Activity, Structured Exercise, and/or Improved Cardiorespiratory Fitness

Anti-inflammatory	Reduced plasma level of C-reactive protein, which is a biomarker of inflammation (10)
Antithrombotic	Decreased platelet aggregation (11)
	Enhanced fibrinolysis activity (12)
Antiarrhythmic	Improved cardiac autonomic function (13,14)
	Increased vagal tone and decreased sympathetic activity (14)
Antiatherogenic	Improvement in established ASCVD risk factors
	Improved endothelial function due to increased blood flow and shear stress on arterial walls (15,16)
	Enhanced synthesis and release of nitric oxide, which is responsible for the inhibition of processes involved in atherogenesis (15)
Improved ASCVD risk factors	Decrease in total cholesterol, LDL-C, and triglycerides (17)
	Increase in HDL-C levels (17)
	Reduced blood pressure (18)
	Increased insulin sensitivity (19)
	Weight reduction (19)
Anti-ischemic	Improved myocardial perfusion (20)
	Raised ischemic threshold (11)
	Ischemic preconditioning of the myocardium (21)

ASCVD = atherosclerotic cardiovascular disease; HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol.

HISTORICAL PERSPECTIVE

In the 1930s, restriction of physical activity and prolonged bed rest were standard of care for patients with myocardial infarction (MI) (32). Subsequent evolution of practices such as chair therapy (1940s), brief daily walks of 3 to 5 min (1950s), and structured inpatient CR programs for early ambulation post-MI (1960s) led to the development of contemporary multidisciplinary, comprehensive CR and secondary prevention programs for patients with ASCVD (32–37).

CURRENT MODEL OF CR IN THE UNITED STATES

In the current U.S. healthcare system, CR continues to evolve as a treatment modality (**Central Illustration**). Until recently, CR was approved for insurance coverage by Medicare only for patients with chronic stable angina pectoris and/or who had sustained an MI (NSTEMI or STEMI) in the last 12 months, or had undergone cardiac surgery (coronary artery bypass, valve replacement/repair, or heart/heart-lung transplant) or percutaneous coronary intervention. After approximately 20 years of deliberation, Medicare recently approved systolic heart failure as a reimbursable diagnosis for CR (38). To improve timely referrals and enrollment in this vastly underutilized treatment option, the American Association of Cardiovascular and Pulmonary Rehabilitation, the American College of Cardiology (ACC), and the American Heart Association (AHA) have published performance measurements for the referral and delivery of CR services designed for hospital settings, office practices, and university settings (39–41). Although there are class IA recommendations for CR in the AHA/ACC management guidelines and performance measures, up to 80% of eligible patients are apparently not referred (42).

Specific patient populations including the elderly, women, ethnic minorities, and people of lower socioeconomic status have especially low referral rates (9). There are at least 4 reasons why eligible patients are not referred for CR, namely: 1) lack of a centralized method for referral; 2) inadequate communication among treatment teams, patients, and CR facilities; 3) unfamiliarity with CR among potential referring physicians; and, 4) limited access, competing responsibilities, and perceived inconvenience for the patient (9,39,42–44).

Even among patients who are appropriately and/or automatically referred to CR, certain patients are less likely to enroll and, once enrolled, are more likely to drop out. Within 1 and 6 months after acute MI, only 29% and 48% of referred patients participated in CR, respectively (43). Predictors of suboptimal participation include poor functional status, higher body mass index, tobacco use, depression, long-distance to CR facilities, low health literacy, high costs (e.g., copays), and inflexible work schedules (42). Relevant data from European CR programs indicate that, once referred, patients are more likely to enroll and complete CR due to stronger financial assistance (national health insurance pays) and employer support for employee health needs (45).

FUTURE OF CR

The current model of CR delivery appears to be neither financially viable nor sustainable due to barriers to consistent and appropriate referral (especially for women, the elderly, ethnic minorities, and low socioeconomic status populations), accessibility (transportation, number, and geographic distribution of CR programs), and affordability (lack of insurance coverage, high copayments, and use of resource-intensive, inefficient and costly models) (46). According to a recent AHA science advisory, many CR programs do not receive adequate referrals to maintain financial viability (44). In another recent report, none of the 3 CR programs included in the analysis generated revenues that were sufficient to cover costs (47).

TABLE 2 Deficiencies of Conventional Cardiac Rehabilitation and Secondary Prevention Interventions and Future Trends

Among a sample of 7,519 individuals with self-reported atherosclerotic cardiovascular disease, 19% continued to smoke cigarettes, just 35% undertook recommended levels of moderate-to-vigorous physical activity, and only 39% had healthy diets (60). Moreover, a substantial percentage of patients receiving percutaneous coronary intervention do not achieve lifestyle and risk factor goals at 1 year after procedure and therefore remain at increased risk for recurrent cardiac events or coronary revascularization procedures (61). Early referral and long-term follow-up should help to improve program access and compliance with lifestyle modification.
Conventional cardiac rehabilitation (CR) programs routinely emphasize structured exercise and use of continuous electrocardiographic monitoring for reimbursement, yet the primary beneficiaries of structured exercise programs are those at the bottom of the fitness/activity chain, patients in the least fit, least active cohort (i.e., the bottom 20%) (62). Contemporary CR programs should prioritize low-fit patients and increasingly focus on facilitating long-term behavior change (e.g., promoting lifestyle physical activity) and comprehensive risk reduction by incorporating new modalities such as home-based, internet-based, and telephone-based CR programs.
Although nearly 90% of patients are discharged with appropriate medications after acute myocardial infarction, most patients receive doses prescribed substantially below those with proven efficacy in clinical trials (63). For a variety of reasons (e.g., cost, adverse effects, apathy) many patients also report inconsistent long-term use of beta-blockers, lipid-lowering therapy, or combinations of these potentially lifesaving drugs (64). In multivariate analysis, medication nonadherence remained significantly associated with increased all-cause mortality risk in patients with coronary artery disease (65). A potential solution that will maximize the outcomes of patients with coronary disease is to target medication dosing and nonadherence for quality improvement initiatives in CR.
Because patients with chronic disease typically spend ≥5,000 h each year independent of medical providers, it is critical to arm them with research-based behavior change strategies that they can implement in their immediate environment (e.g., home, work, community) (66). Tailoring messages about lifestyle counseling to patients' individual readiness to change will increase the likelihood of behavioral transformation (67), as will motivational interviewing as a form of talk therapy during patient encounters (68,69).
More than 80% of adults currently have an established source of healthcare services, and this percentage is expected to appreciably increase with implementation of the Affordable Care Act. This shift will enable vulnerable subsets of the population, who are more often plagued by unhealthy lifestyle practices, to seek medical evaluation and care, empowering medical providers with heightened opportunities to facilitate behavioral improvements in population health over time (70). The 5As approach can be used to elicit significant improvements in a variety of health behaviors, including smoking cessation, dietary choices, and physical activity (71,72).
Self-responsibility (e.g., meeting certain health metrics) will become a greater priority in the new healthcare coverage environment. For example, completing health habit surveys and/or serial risk factor profiles, along with regular physical examinations, and attaining certain risk factor ranges will be increasingly mandated by insurers and employers, orchestrated in part by financial incentives and penalties.

CR = cardiac rehabilitation.

As highlighted in the AHA science advisory referred to earlier, further efforts must be made going forward to systematically increase CR program participation. In addition to escalating research initiatives to fill knowledge gaps in the CR literature, these efforts include: 1) educating providers, healthcare systems, patients, and their families about the benefits of CR (including efforts to change the perception that CR is less important than pharmacological or interventional/surgical therapy); 2) reducing specific barriers to referral and participation in CR that are attributable to patients (e.g., lack of knowledge of benefits and motivation to participate), physicians/health systems (e.g., perception of value of CR and acute care priority), and the community (e.g., availability of programs and public policy); 3) promoting a better understanding of CR as a cost-effective, multidisciplinary, secondary prevention treatment option and chronic disease management service, rather than an exercise-only, gym-based therapy; 4) continuing efforts to increase insurance coverage and decrease copays for CR services; 5) increasing awareness of CR performance measures and use of system-based approaches such as automatic referral and discharge checklists for eligible patients; 6) expanding the spectrum of responsibilities of home health nurses, clinical exercise physiologists, physical therapists, and other healthcare providers to provide home-based or community-based CR; and 7) continuing innovative strategies to bring CR to more patients (44).

Regarding the use of innovative strategies to bring exercise-based CR to more patients, new delivery models must be adopted, especially for patients at low or low-to-intermediate risk. These include the use of telemedicine as well as internet-based, home-based, and community-based programs to provide alternatives to conventional, medically supervised, facility-based programs (48,49). Home-based programs using appropriately qualified nonphysician health professionals to supervise and monitor patient care is practical and feasible and has shown outcomes in patients with CAD similar to those for conventional hospital-based programs (49–52). From a medical-legal liability perspective, appropriately prescribed home-based exercise programs in selected patients have been reported to be acceptably safe and effective, compared with conventional, medically supervised group programs (7,39,50).

Given Americans' increasing access to mobile phones and Internet, telemedicine programs are emerging as promising alternatives to in-person programs, with improved accessibility and reduced costs (53). Home-based CR interventions are equally if not

more cost-effective than conventional center-based programs (54–56).

As emphasized in a recent presidential advisory from the AHA, these new CR delivery models should not replace conventional programs but should be used to help better meet the various needs of individual patients, to engage the many patients who currently do not participate, and to provide ongoing monitoring and treatment after completion of a conventional CR program (46). Moreover, experimental or hybrid CR delivery models should not be widely adopted until they have been shown to be both clinically effective and cost effective (46).

The Affordable Care Act is a paradigm shift in the United States and provides potential opportunities for the deployment of new models of CR (57,58). In addition to benefiting patients with ASCVD, new CR delivery models may be especially well suited to apparently healthy patients with risk factors or subclinical disease, or both. Redesigning future ASCVD interventions to attract and manage a wider spectrum of patients, including primary prevention patients, may help reduce personnel, program, and facility redundancies.

CONCLUSIONS

An ounce of prevention is worth a pound of cure.
—Benjamin Franklin (73)

This enduring axiom remains as applicable today as when it was first promulgated. Fundamental objectives of ASCVD prevention include modification of risk factors such as obesity, metabolic syndrome, hypertension, physical inactivity, unhealthy diet, smoking, hyperlipidemia, diabetes, and psychosocial stressors (particularly depression, which was recently elevated to risk factor status by the AHA) (59), among others. CR has evolved considerably since the 1930s and is now viewed as a comprehensive multidisciplinary approach to complex medical conditions requiring behavioral, physical, emotional, and social care management in the secondary prevention of ASCVD. It has been almost 2 decades since the initial emphasis on the urgent need to develop and implement "approaches that enable all persons with CAD to have access to high-quality, cost-effective, long-term, comprehensive ASCVD risk reduction and rehabilitation services that are appropriate for their specific needs and personal circumstances" (7). To achieve this goal, we will need to adopt research-based behavioral approaches and policies that increase patient motivation and self-responsibility, while overcoming the deficiencies of conventional CR programs (**Table 2**) (74). It has also been more than a decade since a randomized clinical trial found that alternative approaches to conventional CR have the potential to substantially reduce the costs of care while increasing accessibility and achieving comparable improvements in multiple risk factors in low-risk or moderate-risk patients (75). Although our health care system has made large strides, there is still room for significant improvement. How can the referral and participation rates of eligible patients be increased? Should referral be the responsibility of the physician or of the healthcare team? How will working and nonworking patients afford to pay for these services? The landscape of American healthcare delivery is dramatically changing with passage of the Affordable Care Act. This provides an opportune time to develop and implement innovative ways to deliver comprehensive multidisciplinary prevention interventions, including CR.

It is time to rebrand and reinvigorate. CR of the future must be a patient-centered, comprehensive secondary prevention program delivered through a variety of easily accessible care models that emphasize the value of CR in healthcare outcomes and cost effectiveness.

REPRINT REQUESTS AND CORRESPONDENCE: Dr. Laurence Sperling, Emory University, 1365 Clifton Road, NE, Building A, Suite 2200, Atlanta, Georgia 30322. E-mail: lsperli@emory.edu.

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