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EDITORIAL COMMENT

Cardiac Rehabilitation and Healthy Life-Style Interventions

Rectifying Program Deficiencies to Improve Patient Outcomes*

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Comprehensive exercise-based cardiac rehabilitation (CR) programs represent a multifaceted intervention directed toward improving prognosis via healthy life-style (HL) modification. Previous studies have demonstrated that CR improves cardiorespiratory fitness, cardiovascular disease (CVD) risk factors, and quality of life, providing cost-effective secondary CVD prevention (1-5). For many years in the United States, CR has been a covered therapy in patients post-myocardial infarction (MI), following coronary revascularization procedures, and in those with stable angina pectoris, among other diagnoses (e.g., valvular repair/replacement). Recently, coverage has expanded to include patients with chronic stable systolic heart failure (6). The case for CR is well-documented and is supported by a broad consensus that all eligible patients should be referred and strongly encouraged to participate (1-4).

The first meta-analyses of exercise-based CR was published over 25 years ago, demonstrating 20% to 25% reductions in all-cause and CVD mortality from 22 randomized controlled trials in over 4,300 patients (7,8). A subsequent systematic review and meta-analysis of 34 randomized controlled trials showed that exercise-based CR was associated with reductions in MI, CVD mortality, and all-cause mortality by 47%, 36%, and 26%, respectively (9).

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In this issue of the *Journal*, Anderson et al. (10) undertook an updated systematic review and meta-analysis of exercise-based CR in patients with coronary heart disease (CHD), including 63 studies in 14,486 CR participants, and demonstrated reductions in CVD mortality and hospital readmission by 26% and 14%, respectively, as well as benefits on many quality of life measures. However, in this updated analysis (47 studies; 12,455 participants), there was only a 4% total mortality reduction (relative risk: 0.96; 95% confidence interval: 0.88 to 1.04), although the reduction was 9% in the 20 studies that assessed both CVD and total mortality (relative risk: 0.91; 95% confidence interval: 0.82 to 1.01). As the authors suggest, failure to show an overall survival benefit in their analysis may be due to including more mixed CHD populations, and recent studies were conducted in the era of optimal medical therapy for CHD. Notably, earlier studies suggested that the effects of CR on total mortality were independent of whether the trial was published before or after 1995, suggesting that the mortality benefit persisted in the current era (11). However, the present report contradicts this and shows a linear reduction in the all-cause mortality effect of CR over time (i.e., study publication date). Nevertheless, the current meta-analysis still supports quite profound overall positive effects of CR programs, even if the effect on total mortality has lessened (10).

The strength of the present analysis lies in the large number of studies and CR participants included, the inclusion of associated hospitalization

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admissions, and the widespread utilization of contemporary optimal medical therapy in more recent trials. The limitations are well-outlined by the authors, particularly the lack of quality data in several of the earlier studies included, which is typical in many meta-analyses. More importantly, however, considerable evidence indicates that our current model of CR delivery (e.g., 36 exercise and educational sessions delivered 3× weekly for 12 weeks) appears to be neither financially viable nor sustainable due to multiple factors, as recently reviewed in detail (1,12). Moreover, despite the benefits associated with CR, only a fraction of eligible patients are currently referred to, participate in, and complete CR. Moving forward, efforts must be made to increase CR program participation, which can be accomplished by improving processes and flexibility in the current model, creating and implementing alternative CR approaches, and capitalizing on recent technological advances (1,12,13).

For many CR candidates, automatic referral has become increasingly adopted. However, without strong endorsement for CR participation, patients will not generally attend (1,12,13). Although the patient's primary cardiologist may be the most important determinant of participation, strong multifaceted endorsement for CR participation from health care providers (e.g., physicians, nurses, exercise physiologists, physical therapists, and social workers, among others) is an important catalyst (13). Also, substantially shortening the delay between hospital discharge and formal outpatient CR initiation has been shown to significantly increase CR participation and completion (14).

The current CR model is often limited by long commutes and transportation issues and by the infrastructure, capacity, and focus of contemporary outpatient CR programs (1,12). Clearly, the "one size fits all" CR model has limitations, and will be even less effective in the future. More comprehensive CR models, including home-, internet-, and community-based programs, are needed to provide alternatives to conventional, medically supervised, facility-based exercise interventions (1,12). Because the prevalence of HL behaviors in patients with CVD remains extremely low (15) and a considerable percentage of patients do not achieve HL and risk factor goals at 1 year post-percutaneous coronary intervention, putting them at increased risk for recurrent CVD events (16), contemporary CR models need a renewed emphasis on these objectives.

Given the current interest in technology, the potential exists to greatly enhance the current outreach of CR, regardless of the particular setting and infrastructure (1,13). The use of web-based and mobile applications, telephonic coaching, hand-held computer technologies, the internet, and various wearable activity-tracking devices (e.g., pedometers and accelerometers) provide opportunities to regularly engage CR patients in HL messages and interventions, an approach that has the potential to substantially increase accessibility, reduce costs, and improve outcomes (1,12).

Finally, the future and true promise of HL interventions is primordial and primary CVD prevention. There is clear evidence that HL interventions, when adhered to, substantially reduce CVD and that an HL team approach is paramount in CR programs (17,18). The basic tenants of the longstanding CR model (i.e., physical activity/exercise training, healthy diet, weight loss, smoking cessation as needed, and blood pressure/lipid/glucose control) are generalizable strategies for population health. Simply stated, HL interventions represent an underrecognized and underutilized treatment approach, particularly for the current noncommunicable disease crisis (19). As such, consideration should be given to transforming the current CR to broader HL prevention programs, expanding the reach of risk reduction through proven HL interventions. With passage of the Affordable Care Act, self-responsibility (e.g., meeting certain health metrics) will become a greater priority, increasingly using insurance-mandated incentives and penalties to favorably modify HL behaviors (1). Flexibility in the structure and delivery of these programs is essential to reach as many individuals as possible and have the greatest effect.

In conclusion, as recently stated in the *Journal*, it is time to "rebrand and reinvigorate" CR (1). Alternative secondary prevention models do not need to replace conventional CR, but they should be used to reach a much larger patient population over an extended duration, that is, well beyond the traditional 12-week window. With such efforts, not only will CR be increasingly employed, but also an enhanced and invigorated CR brand may transform its effect from the individual to the population level and re-establish, or even improve upon, the previously reported overall mortality benefits of this intervention.

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