



DIGITAL ACCESS TO  
SCHOLARSHIP AT HARVARD  
DASH.HARVARD.EDU



HARVARD LIBRARY  
Office for Scholarly Communication

# “Road Map” to Improving Enrollment in Cardiac Rehabilitation: Identifying Barriers and Evaluating Alternatives

The Harvard community has made this article openly available. [Please share](#) how this access benefits you. Your story matters

Citation	Pirruccello, James P., Kathleen Traynor, and Krishna G. Aragam. 2017. ““Road Map” to Improving Enrollment in Cardiac Rehabilitation: Identifying Barriers and Evaluating Alternatives.” <i>Journal of the American Heart Association: Cardiovascular and Cerebrovascular Disease</i> 6 (10): e007468. doi:10.1161/JAHA.117.007468. <a href="http://dx.doi.org/10.1161/JAHA.117.007468">http://dx.doi.org/10.1161/JAHA.117.007468</a> .
Published Version	<a href="https://doi.org/10.1161/JAHA.117.007468">doi:10.1161/JAHA.117.007468</a>
Citable link	<a href="http://nrs.harvard.edu/urn-3:HUL.InstRepos:34651921">http://nrs.harvard.edu/urn-3:HUL.InstRepos:34651921</a>
Terms of Use	This article was downloaded from Harvard University’s DASH repository, and is made available under the terms and conditions applicable to Other Posted Material, as set forth at <a href="http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA">http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA</a>

## “Road Map” to Improving Enrollment in Cardiac Rehabilitation: Identifying Barriers and Evaluating Alternatives

James P. Pirruccello, MD; Kathleen Traynor, RN, MS; Krishna G. Aragam, MD, MS

Comprehensive cardiac rehabilitation (CR) is a multifaceted intervention associated with reductions in cardiovascular morbidity and mortality after acute myocardial infarction, percutaneous coronary intervention, and coronary artery bypass grafting.<sup>1–3</sup> The association of CR with favorable outcomes has persisted in contemporary practice despite significant pharmacological and procedural advances in cardiovascular care.<sup>4</sup>

Although evidence-based medications are routinely prescribed after acute myocardial infarction and/or revascularization (97.5% of patients are discharged on aspirin), CR utilization remains low. In the United States, fewer than 60% of patients are referred to CR after acute myocardial infarction and percutaneous coronary intervention, and for every 3 patients referred, just 1 enrolls into a CR program.<sup>5,6</sup> Taken together, only 20% of patients undergo any amount of CR within the first year of an index coronary event.

Given the low utilization of CR despite its benefits, the Million Hearts Cardiac Rehabilitation Collaborative was formed in 2015 and a “road map” was developed to increase participation in CR from 20% to 70% by 2022. It is estimated that an improvement in CR participation to this degree would translate to  $\approx$ 25 000 fewer deaths and  $\approx$ 180 000 fewer hospitalizations each year.<sup>7</sup> The Collaborative has identified 3 key areas—CR referral, enrollment, and adherence—that warrant increased attention in order to identify and overcome barriers to the stated CR participation goal.

Past studies have assessed individual-level, hospital-level, and regional factors that influence patterns of CR referral and participation.<sup>4–6</sup> The data suggest that younger age, white

ethnicity, male sex, higher individual socioeconomic status, and geographical location outside of the South are associated with increased rates of CR participation.<sup>5,6,8</sup> In this issue of *JAHA*, Bachmann et al, investigate neighborhood socioeconomic status as a predictor of CR utilization in a largely underserved population.<sup>9</sup> Of the 4096 participants hospitalized with a CR-qualifying condition for whom complete data were available, only 8% attended at least 1 CR session. The SCCS (Southern Community Cohort Study) neighborhood deprivation index—a previously established census tract-level score—was utilized to provide a quantifiable estimate of socioeconomic status at the community level.<sup>10</sup> The SCCS neighborhood deprivation index score strongly associated with CR participation: With each quintile increase in neighborhood deprivation (representing lower neighborhood socioeconomic status), the odds of participating in CR decreased by 15%. In the SCCS data set, individuals’ incomes are stratified into 1 of 3 levels, a limitation that could lead modeling algorithms to emphasize the significance of the neighborhood score relative to individual-level data. Nevertheless, the score’s association was robust to adjustment for individual-level characteristics, such as demographics, medical history, educational attainment, and even individual socioeconomic status and distance to the nearest CR center, suggesting that neighborhood socioeconomic status is an independent predictor of CR participation. Can the SCCS neighborhood deprivation index score be used to target public health interventions to underserved communities at high cardiovascular risk, thereby improving CR participation in these populations and narrowing the national gap in CR utilization? Certainly, the results of this study both enable and compel further research to understand and address the contextual socioeconomic barriers to CR.

As with the Million Hearts Cardiac Rehabilitation Collaborative, most initiatives to address the CR paradox—vast underutilization despite demonstrated benefit—have focused on increasing participation in CR. It should be noted, however, that CR programs in the United States currently lack capacity to accommodate a national enrollment rate of 70% as well as improved CR adherence. Furthermore, achieving 70% CR participation still leaves 30% of the population—perhaps concentrated in lower socioeconomic areas—unaccounted for with respect to evidenced-based approaches for

The opinions expressed in this article are not necessarily those of the editors or of the American Heart Association.

From the Cardiology Division, Massachusetts General Hospital, Harvard Medical School, Boston, MA.

**Correspondence to:** Krishna G. Aragam, MD, MS, Massachusetts General Hospital, 55 Fruit St, GRB-8, Boston, MA 02114. E-mail: karagam@partners.org  
*J Am Heart Assoc.* 2017;6:e007468. DOI: 10.1161/JAHA.117.007468.

© 2017 The Authors. Published on behalf of the American Heart Association, Inc., by Wiley. This is an open access article under the terms of the Creative Commons Attribution-NonCommercial License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

rehabilitation following acute coronary care. These and other considerations have spurred efforts to develop “alternatives” to CR, including home-based rehabilitation programs, and hybrid approaches using mobile technologies for remote health monitoring.<sup>11</sup>

In the current issue of *JAHA*, Salmoirago-Blotcher et al, provide data from an exploratory clinical trial assessing tai chi in coronary artery disease patients who declined to enroll in CR.<sup>12</sup> Pointing to tai chi’s safety profile, and to the perception that it may be more facile and appealing than CR for many individuals, the researchers posit tai chi as a complementary and/or alternative approach to CR. Whereas roughly half of all 106 eligible subjects did not participate because of lack of interest, 29 ultimately started the intervention and were randomized to tai chi within a CR facility twice-weekly for 12 weeks (LITE) or 3 times weekly for 12 weeks with an extended taper (PLUS). Additional instructions for 3-times weekly home tai chi were provided for both groups. Each participant underwent stress testing at the start of the study and wore a home accelerometer to ascertain baseline and follow-up levels of activity. The primary feasibility, acceptability, and safety outcomes were achieved: 95% of participants gave the program a favorable rating, and there was 90% retention at 9 months, with 55% of enrollees attending at least 70% of classes. No significant adverse events were attributed to tai chi.

Although incorporating tai chi in lieu of CR appears feasible, acceptable (to at least some decliners of CR), and safe, its efficacy for reducing cardiovascular morbidity and mortality after a coronary event remains in question. The researchers have conducted past trials of up to 100 heart failure patients engaging in tai chi versus usual care and shown equivocal results with respect to 6-minute walk test and VO<sub>2</sub> max.<sup>13,14</sup>

However, it is worth restating that CR is a comprehensive intervention that includes exercise training, diet and weight management, education on cardiovascular risk reduction, and psychosocial counseling to reduce stress, with the noted benefits of CR likely arising from any 1 or all of these components. It is quite possible that interventions like tai chi influence cardiovascular outcomes through mechanisms other than physical activity and fitness—namely, breathing and relaxation exercises that reduce stress. A recent study linked perceived stress to amygdala activation, and increased cardiovascular inflammation, whereas a separate study showed that enhanced stress management training in the context of traditional CR was associated with more-favorable outcomes.<sup>15,16</sup> Ultimately, it may become possible to attribute the benefits of CR to its different components, and it may be prudent to prescribe the particular component (or equivalent alternative) most needed and/or preferred by each patient, especially for those unable or unwilling to participate in a comprehensive CR program.

CR remains a powerful, yet underutilized, tool in the management of post-myocardial infarction and post-percutaneous coronary intervention patients. Bachmann et al, add to existing literature on the barriers to CR engagement by showing the deprivation experienced by those in areas of low socioeconomic status and its association with lower CR participation. Salmoirago-Blotcher et al explore an alternative to cardiac rehabilitation that addresses barriers at the individual level (eg, negative sentiment toward exercise) and at the systems level (eg, permitting CR-like activity outside of designated CR facilities) and may improve access to care across socioeconomic strata. Ongoing efforts to understand and address the barriers to CR through novel and, perhaps, alternative solutions will be important on the “road to increased participation” in rehabilitative services after a coronary event, with the ultimate goal of reducing disparities in care and improving secondary cardiovascular prevention.

## Disclosures

Dr Aragam is supported by a postdoctoral training grant from the National Heart, Lung, and Blood Institute of the National Institutes of Health (T32 HL 007208). The remaining authors have no disclosures to report.

## References

- Ades PA, Huang D, Weaver SO. Cardiac rehabilitation participation predicts lower rehospitalization costs. *Am Heart J*. 1992;123:916–921.
- Ades PA. Cardiac rehabilitation and secondary prevention of coronary heart disease. *N Engl J Med*. 2001;345:892–902.
- Dunlay SM, Pack QR, Thomas RJ, Killian JM, Roger VL. Participation in cardiac rehabilitation, readmissions, and death after acute myocardial infarction. *Am J Med*. 2014;127:538–546.
- Anderson L, Oldridge N, Thompson DR, Zwisler A-D, Rees K, Martin N, Taylor RS. Exercise-based cardiac rehabilitation for coronary heart disease. *J Am Coll Cardiol*. 2016;67:1–12.
- Aragam KG, Dai D, Neely ML, Bhatt DL, Roe MT, Rumsfeld JS, Gurm HS. Gaps in referral to cardiac rehabilitation of patients undergoing percutaneous coronary intervention in the United States. *J Am Coll Cardiol*. 2015;65:2079–2088.
- Doll JA, Hellkamp A, Ho PM, Kontos MC, Whooley MA, Peterson ED, Wang TY. Participation in cardiac rehabilitation programs among older patients after acute myocardial infarction. *JAMA Intern Med*. 2015;175:1700–1702.
- Ades PA, Keteyian SJ, Wright JS, Hamm LF, Lui K, Newlin K, Shepard DS, Thomas RJ. Increasing cardiac rehabilitation participation from 20% to 70%: a road map from the Million Hearts Cardiac Rehabilitation Collaborative. *Mayo Clin Proc*. 2017;92:234–242.
- Polk DM, O’Gara PT. Closing the treatment gap for cardiac rehabilitation. *JAMA Intern Med*. 2015;175:1702–1703.
- Bachmann JM, Huang S, Gupta DK, Lipworth L, Mumma MT, Blot WJ, Akwo EA, Kripalani S, Whooley MA, Wang TJ, Freiberg MS. Association of neighborhood socioeconomic context with participation in cardiac rehabilitation. *J Am Heart Assoc*. 2017;6:e006260. doi: 10.1161/JAHA.117.006260.
- Signorello LB, Cohen SS, Williams DR, Munro HM, Hargreaves MK, Blot WJ. Socioeconomic status, race, and mortality: a prospective cohort study. *Am J Public Health*. 2014;104:e98–e107.
- Beatty AL, Fukuoka Y, Whooley MA. Using mobile technology for cardiac rehabilitation: a review and framework for development and evaluation. *J Am Heart Assoc*. 2013;2:e000568. doi: 10.1161/JAHA.113.000568.
- Salmoirago-Blotcher E, Wayne PM, Dunsiger S, Krol J, Breault C, Bock BC, Wu W, Yeh GY. Tai chi is a promising exercise option for patients with coronary heart disease declining cardiac rehabilitation. *J Am Heart Assoc*. 2017;6:e006603. doi: 10.1161/JAHA.117.006603.

13. Yeh GY, Wood MJ, Lorell BH, Stevenson LW, Eisenberg DM, Wayne PM, Goldberger AL, Davis RB, Phillips SR. Effects of tai chi mind-body movement therapy on functional status and exercise capacity in patients with chronic heart failure: a randomized controlled trial. *Am J Med.* 2004;117:541–548.
14. Yeh GY, McCarthy EP, Wayne PM, Stevenson LW, Wood MJ, Forman D, Davis RB, Phillips RS. Tai chi exercise in patients with chronic heart failure: a randomized clinical trial. *Arch Intern Med.* 2011;171:750–757.
15. Tawakol A, Ishai A, Takx RA, Figueroa AL, Ali A, Kaiser Y, Truong QA, Solomon CJ, Calcagno C, Mani V, Tang CY, Mulder WJ, Murrrough JW, Hoffmann U, Nahrendorf M, Shin LM, Fayad ZA, Pitman RK. Relation between resting amygdalar activity and cardiovascular events: a longitudinal and cohort study. *Lancet.* 2017;389:834–845.
16. Blumenthal JA, Sherwood A, Smith PJ, Watkins L, Mabe S, Kraus WE, Ingle K, Miller P, Hinderliter A. Enhancing cardiac rehabilitation with stress management training: a randomized clinical efficacy trial. *Circulation.* 2016;133:1341–1350.

---

**Key Words:** Editorials • cardiac rehabilitation • secondary prevention