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Commentary

Older women and cardiac rehabilitation: Next steps on the journey

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Introduction

Cardiovascular disease, which includes coronary heart disease, hypertension and stroke, is the predominant cause of morbidity and mortality in older women. Cardiac rehabilitation is pivotal in the secondary prevention of cardiovascular disease, in that it lowers cardiovascular risk and mortality, reduces recurrent episodes and hospital admissions, improves cardiopulmonary function, mood, quality of life, and enhances prognosis [1-6]. Despite this, as Drs. Yoo and I noted in a prior publication [7], older women remain under-referred, under-enrolled, and under-represented in cardiac rehabilitation services throughout the nation. Despite the proliferation of manuscripts addressing cardiac rehabilitation and the designation of cardiac rehabilitation as a Class IA indication in most cardiovascular Clinical Practice Guidelines, and some policy positions regarding systematic referral and utilization [8], older women remain suboptimally represented in the populations described [9,10]. The core components of cardiac rehabilitation and prevention continue to include a baseline patient assessment, nutritional counseling, risk factor management, psychosocial intervention, physical activity counselling, and exercise training [11].

With aging of the population and the dramatic increase in the percentage of patients surviving acute episodes of cardiovascular disease, cardiac rehabilitation services will comprise an increased resource requirement [12]. The application of cardiac rehabilitation has shifted from the traditional disease-centered model to a patient-centered model and the global COVID-19 pandemic has shifted the emphasis from facility-based cardiac rehabilitation to home-based cardiac rehabilitation using contemporary technologies.

Cardiac Rehabilitation: Eligibility for CMS Reimbursement

Patients are eligible for CMS reimbursement for cardiac rehabilitation following myocardial infarction, percutaneous coronary intervention, coronary artery bypass graft surgery, stable angina, heart valve repair or replacement and cardiac transplantation More recent expansion of the approvals has been for systolic heart failure and symptomatic peripheral artery disease. An ongoing concern is that heart failure with preserved ejection fraction predominates among older women, yet this diagnosis remains unapproved for Medicare reimbursement. This is of particular concern, given the results of a recent randomized clinical trial of older patients with heart failure, 53% of whom had a preserved ejection fraction and 97% of whom were frail and pre-frail, the REHAB-HF Trial [13]. These patients with a mean age of 73 years and multiple comorbidities, and including women and minority patients, underwent a rehabilitation program focusing on strength, balance, mobility and endurance which resulted in a 3-month improvement in the 6-minute walk distance, the modified Fried Frailty Criteria, the Kansas City Cardiomyopathy Questionnaire Score and Geriatric Depression Score. CMS reimbursement criteria remain pivotal in that the private insurers who provide supplementary Medicare insurance characteristically follow CMS guidelines for approved services. During the COVID-19 public health emergency, CMS expanded reimbursement for telehealth-related visits with reimbursement at the same rate as in-person visits. A number of private insurers have followed this example, with Procedural Terminology established for billing codes and relevant modifiers. The extent to which this has been applied to cardiac rehabilitation services and whether this will extend beyond the coronavirus public health emergency is currently under active discussion.

Older Women: Cardiac Rehabilitation Data

Older adults have an increased risk of disability after a coronary event, important in that more than half of all patients eligible for cardiac rehabilitation are older than age 65 [14,15]. As previously noted, there is less referral and participation among older women, despite comparable trainability to younger patients. In a study of Medicare enrollee demographics (2016-2017), of patients in cardiac rehabilitation, 18.9% of eligible women and 28.6% of eligible men enrolled. Added to this gender disparity, there was further concern with minority enrollment, with 13.6 of eligible non-Hispanic blacks, 13.2% of eligible Hispanics, and 16.3% of eligible Asians enrolled. Often not appreciated by providers, the adherence to cardiac rehabilitation, once referral and participation occur, is high in older adults, who do not have an increase in complications or in adverse effects. The format of a cardiac rehabilitation program for an older adult requires only modest modification in exercise prescription, training techniques and components. The emphasis is on the limitation of high-impact activities and the mantra to "start low, go slow". Conventional wisdom has stated that standard cardiac rehabilitation programs require little tailoring for older adults. However, sex-based differences in improvement have only recently been delineated. Despite their lower level of cardiorespiratory fitness at baseline, women did not improve as much as men in a cardiac rehabilitation program [16]. Suggested interventions include greater emphasis on resistance training, and potentially higher intensity interval training, although the applicability of the latter to older women remains to be ascertained.

Among the over 600,000 Medicare beneficiaries hospitalized for coronary heart disease, the data documented a 21% decrease in 5-year mortality associated with participation in a coronary secondary prevention program. Further, 2 meta-analyses of randomized controlled trials show 20% and 23% decrease in mortality in age-matched older adults who participated in secondary prevention programs [17,18].

The Million Hearts Cardiac Rehabilitation Collaborative identified potential savings based on patients enrolled in cardiac rehabilitation, in that it reduces readmissions; completion of cardiac rehabilitation may enable potential savings between $4,950 and $9,200 per year of life. The Million Hearts Cardiac Rehabilitation Collaborative has also promoted pilot programs of home-based cardiac rehabilitation, some virtual and some hybrid, with modest adoption within the Veteran's Administration healthcare system and by selected insurers. Virtual visits for cardiac rehabilitation offer potential benefit to multiple stakeholders, particularly during the COVID-19 pandemic. For patients, virtual visits provide access to cardiac rehabilitation services, allow them to receive medical advice, reduce their in-person exposure to COVID-19, can limit patient isolation owing to the absence of their cardiac rehabilitation services and may involve caregivers as well. For the healthcare professionals, valuable is the reduction of patient exposure to COVID-19, with connections able to be maintained between the patient and the providers. This requires reallocation of resources, which has been accomplished in a number of settings. The healthcare systems as well may benefit, in that virtual visits can generate revenue.

Barriers to the Participation of Older Women in Cardiac Rehabilitation

Older patients, and particularly older women, are susceptible to multimorbidity, such that complicating chronic obstructive pulmonary disease, osteoarthritis, peripheral artery disease, and diabetes complicate their functional status owing to dyspnea, fatigue, and pain, all of which deter their participation in cardiac rehabilitation. The decreased referral rate of women to cardiac rehabilitation is in contrast to the features that would make cardiac rehabilitation even more beneficial – multiple comorbidities, psychologic comorbidities, and older age. Further, owing to their multimorbidity, older patients have multiple medical appointments, limiting their ability to attend a 3-times-weekly time-structured cardiac rehabilitation program. Older women are more likely to have the risk factors of hypertension, diabetes, and hypercholesterolemia than are men, particularly so for women of racial and ethnic minorities. This may be amenable to the benefits of the education and counselling components of cardiac rehabilitation. In a recent study of cardiac rehabilitation participants, women tended to be older at entry into cardiac rehabilitation. In this study, at entry women had lower levels of cardiorespiratory fitness [16,19]. In the same study, women were more likely to be referred with a diagnosis of myocardial infarction or after a heart valve procedure, in contrast to men referred after coronary artery bypass graft surgery. Issues of transportation, particularly lack of ability to drive, appear a far more prominent problem for older women.

Patient barriers

The patient barriers include lack of or limited healthcare insurance (although Medicare is the primary insurance in this age group), low socioeconomic status, low self-efficacy, low health literacy, lack of perceived need for cardiac rehabilitation, language issues for non-English speakers, and importantly cultural beliefs related to the understanding of the cardiovascular disease and its treatment, and the beneficial role of physical activity. For the few older women who continue to work, the work-related factors such as job flexibility, loss of salary, self-employment, lack of healthcare and disability benefits are relevant. Importantly, there is often limited social support and in particular, the female-centric home responsibilities involving care of grandchildren, spouses, and other family adults.

In a recent study by Khadanga [20] high levels of social support were predictive of cardiac rehabilitation attendance, whereas lower self-reported physical function seemed to deter attendance. Women, even older women, are more likely to resume household activities following a cardiovascular hospitalization and thus appear less likely to perceive their need for cardiac rehabilitation. The low social support for women, coupled with their substantial caregiving roles and other social obligations, can severely adversely affect cardiac rehabilitation participation [21].

Medical barriers

The medical barriers, in addition to the multiple comorbidities noted above, include depression, which is common among older women with coronary disease and heart failure; and a variety of musculoskeletal conditions. Because anxiety and depression are associated with lower levels of cardiac rehabilitation participation and persistence, that these problems are more common among older women than men is an important variable. The fact that anxiety and depression may be alleviated by participation in cardiac rehabilitation has not ben adequately emphasized [22].

Healthcare system barriers

Within the healthcare system, barriers include a lack of referral,

limited facilitation of enrollment after referral, the patient-provider relationship, and the strength of endorsement by the woman's physician – physicians enthusiastic about cardiac rehabilitation for their patients have a higher rate of patient participation in this activity.

Program availability and characteristics

The facility-based cardiac rehabilitation presents a number of challenges, not the least of which is the lack of programs that serve specific geographic areas, such as rural and low-income communities. Often these programs are at sizeable distance from the woman's home, the hours of operation are limited, there is sparse parking and public transportation access, and often a lack of racial/ethnic diversity among the cardiac rehabilitation workforce. Certainly, gender-dominated programs may deter older women who find participation in a predominantly male program challenging. The gender dominance of men in most cardiac rehabilitation programs may adversely affect women's participation. However, the favorable effect of a gender-tailored intervention, although reported by Beckie [23] was not seen in the population studied by Grace [24]; this issue remains unresolved in that the populations studied differ by nation, health insurance models, and numerous other variables. The Million Hearts Initiative suggests additional research to identify features that may increase female cardiac rehabilitation participation [25] including new models of care and activities that may particularly appeal to older women.

Alternative Modes of Delivery of Cardiac Rehabilitation Services

Even prior to COVID-19, we had seen the emergence of novel modes of delivery of cardiac rehabilitation services during the past 2 decades. Initially home-based programs involved a nurse case manager to supervise and monitor programs and the use of transtelephonic electrocardiograms. Concomitantly, community-based group programs enabled guidance by nurses or non-MD healthcare providers, often reimbursed by CMS. Currently before the U.S. Congress is legislation enabling provision of cardiac rehabilitation services by non-physician personnel, without an MD on site, to be implemented in 2022 (rather than the initial plan for 2024). This will help eliminate unnecessary obstacles and delays for this therapy especially in rural and underserved communities [26]. Newer are the internet-based programs such as computer-assisted home-based exercise training and counseling, internet or electronic mail, and social media outlet-based technologies that permit remote delivery of exercise surveillance and concomitantly offer dietary and lifestyle coaching. Many platforms provide comprehensive risk management and other educational activities and often there is guidance of a structured exercise program [27,28]. Even more recently, smartphone app-assisted exercise and lifestyle coaching have come to the forefront. supplementing the individualized increase in daily lifestyle activity such as the recommendation of 10,000 steps at work and at leisure.

Studies identify that low- to moderate-risk patients, and particularly working patients, prefer medically directed home-based as compared with facility-based cardiac rehabilitation programs and demonstrate similar adherence to exercise regimens. Limited follow-up of such patients following the termination of a formal cardiac rehabilitation program indicates that the self-efficacy associated with home-based cardiac rehabilitation is associated with an increased adherence to an exercise-based lifestyle. A challenge to the advantages of this system relates to lack of Medicare and private insurance reimbursement for home-based cardiac rehabilitation; advocacy for this has been a priority of the Million Hearts Program.

Home-Based Cardiac Rehabilitation (HBCR)

A scientific statement from the AACVPR. AHA and ACC [29] defines HBCR as remote coaching, indirect exercise supervision, mostly or entirely outside a traditional center-based setting. Prior randomized clinical trials of home-based cardiac rehabilitation were considered to have a low- to moderate strength of evidence showing them to be similar to 3-12 month clinical outcomes of center-based cardiac rehabilitation. Although data are limited for older adults, women, under-represented minorities and higher risk and other understudied groups, this scientific statement indicated that cardiac rehabilitation is a reasonable option for low- to moderate-risk patients eligible for cardiac rehabilitation who cannot attend traditional center-based cardiac rehabilitation programs.

The advantages of the technology-based programs are that they are less staff-intensive, more convenient, and of lower cost. There is high acceptability and adherence and, albeit limited, good safety data. There is an emphasis on independent exercise and self-reporting. These involve web-based technologies such as text messaging or tele-conferencing; mobile information devices such as smartphones with texting and information apps; blood pressure, glucose, and heart rate monitors [30-32]. Important is that these cost-effective systems of technology-based can be individualized to patient needs and yet maintain a standard quality of care. The ongoing HATICE study (Healthy Aging through Internet Counseling in the Elderly Trial) identifies the value of feedback from older adults to guide the development of technologies and adding a coach to support the adoption of m-health technologies by older adults [33].

The promise of improving cardiovascular care in older adults by the use of digital health technologies is based on circumventing barriers to transportation, limited geographic access, lack of community-based programs, and limited staffing [34]. As mobile health technologies gain wider leverage and popularity, they have become more user-friendly for older adults; with the rapid advancement of these m-health technologies, and increasing technologic engagement of older adults, data have shown improvements in health behaviors and medication adherence [35]. Despite the perceived barriers to the adoption of technologies by older adults, 80% of adults older than age 65 own a cell phone and 2/3 use the internet [36]. Smartphone apps and wearables may serve as potential adjuncts to other cardiac rehabilitation services prompting and/or reenforcing program participation, daily exercise and physical activity, as well as healthy behaviors [37]. Text messaging can serve or augment or facilitate cardiac rehabilitation and expand the opportunities for supervision and oversight typically associated with facility-based cardiac rehabilitation to patients who participate in physical activity at home or in community centers.

Impact of the Covid-19 Pandemic

The impact of the mandated quarantine and social isolation during the COVID-19 pandemic in the U.S. resulted in the discontinuation of virtually all center-based programs of cardiac rehabilitation, leaving patients without a valuable resource. The Coronavirus Preparedness and Response Supplementary

Appropriations Act of 2020 allowed HHS to temporarily waive selected Medicare restrictions and requirements regarding telehealth services during a national emergency, enabling HHS additionally to temporarily waive selected requirements of Medicare, Medicaid and the Health Insurance Portability and Accountability Act (HIPAA).

Advances in internet technology and the widespread availability of smart mobile devices leading to the availability of mobile health, changed the landscape of rehabilitation services during the COVID-19 pandemic. COVID-19 also demonstrated the feasibility of delivery of cardiovascular services, including cardiac rehabilitation, to an elderly population, using a variety of virtual platforms and hybrid models. An example of at-home cardiac rehabilitation exercise videos emerging during the pandemic is from the British Heart Foundation (http//www.bhf.org.uk/informationsupport/support/cardiac-rehabilitation-at-home-cardiac-rehabilitation-exercise-videos). The emphasis is that elderly patients had the potential to benefit from interventions utilizing m-health and we are faced with the likelihood that home-based cardiac rehabilitation may be a complement or even an alternative to facility-based cardiac rehabilitation, given its underutilization in the elderly population and with evidence that older patients may be willing to adopt these newer technologies [38,39].

Summary

Older women have traditionally been under-referred, under-enrolled and under-represented in cardiac rehabilitation services throughout the US. This has been exacerbated by COVID-19. Home-based and telehealth-based interventions are increasingly considered as alternatives to traditional center-based cardiac rehabilitation, with data on participants comparing favorably with outcomes of facility-based rehabilitation in terms of hospitalization, quality of life and cost. COVID-19 has provided the opportunity for utilization of novel ways of delivering cardiac rehabilitation services, including virtual visits and hybrid models, that hopefully will persist into the future, enabling older women a wider choice and greater access to and uptake of cardiac rehabilitation services [40].

References

1. Anderson L, Thompson DR, Oldridge N, Zwisler AD, Rees K, Martin N, et al. Exercise-based cardiac rehabilitation for coronary heart disease. Cochrane Database of Systematic Reviews JACC. 2016; 67:1-12.
2. Taylor RS, Brown A, Ebrahim S, Jolliffe J, Noorani H, Rees K, et al. Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials. The American Journal of Medicine. 2004 May 15;116(10):682-92.
3. Davies EJ, Moxham T, Rees K, Singh S, Coats AJ, Ebrahim S, et al. Exercise based rehabilitation for heart failure. Cochrane Database of Systematic Reviews. 2010 Apr 14;(4):CD003331.
4. Lawler PR, Filion KB, Eisenberg MJ. Efficacy of exercise-based cardiac rehabilitation post–myocardial infarction: A systematic review and meta-analysis of randomized controlled trials. American Heart Journal. 2011 Oct 1;162(4):571-84.
5. Taylor R, Walker S, Ciani O, Warren FC, Smart NA, Piepoli M, et al. Exercise-based cardiac rehabilitation for chronic heart failure: the EXTRAMATCH II individual participant data meta-analysis. Health Technol Assess. 2019; 23:1-98.
6. Cao RY, Zheng H, Hong Y, Zheng Y, Ding Y, Zhao L, et al. Cardiac rehabilitation with targeted intensity improves cardiopulmonary functions accompanying with reduced copeptin level in patients with coronary artery disease. Journal of Cardiovascular Translational Research. 2021 Apr;14(2):317-26.
7. Yoo BW, Wenger NK. Gender Disparities in Cardiac Rehabilitation Among Older Women: Key Opportunities to Improve Care. Clinics in Geriatric Medicine. 2019 Jul 12;35(4):587-94.
8. Grace SL, Bennett S, Ardern CI, Clark AM. Cardiac rehabilitation series: Canada. Progress in Cardiovascular Diseases. 2014 Mar 1;56(5):530-5.
9. Ritchey MD, Maresh S, McNeely J, Shaffer T, Jackson SL, Keteyian SJ, et al. Tracking cardiac rehabilitation participation and completion among Medicare beneficiaries to inform the efforts of a national initiative. Circulation: Cardiovascular Quality and Outcomes. 2020 Jan;13(1):e005902.
10. O'Neill D, Forman DE. Never too old for cardiac rehabilitation. Clinics in Geriatric Medicine. 2019 Nov 1;35(4):407-21.
11. Balady GJ, Williams MA, Ades PA, Bittner V, Comoss P, Foody JM, Franklin B, et al. Core components of cardiac rehabilitation/secondary prevention programs: 2007 update: A scientific statement from the american heart association exercise, cardiac rehabilitation, and prevention committee, the council on clinical cardiology; the councils on cardiovascular nursing, epidemiology and prevention, and nutrition, physical activity, and metabolism; and the american association of cardiovascular and pulmonary rehabilitation. Circulation. 2007 May 22;115(20):2675-82.
12. Williams MA, Fleg JL, Ades PA, Chaitman BR, Miller NH, Mohiuddin SM, et al. Secondary prevention of coronary heart disease in the elderly (with emphasis on patients≥ 75 years of age) an American Heart Association scientific statement from the council on clinical cardiology subcommittee on exercise, cardiac rehabilitation, and prevention. Circulation. 2002 Apr 9;105(14):1735-43.
13. Kitzman DW, Whellan DJ, Duncan P, Pastva AM, Mentz RJ, Reeves GR, et al. Physical rehabilitation for older patients hospitalized for heart failure. New England Journal of Medicine. 2021 May 16.
14. Suaya JA, Shepard DS, Normand SL, Ades PA, Prottas J, Stason WB. Use of cardiac rehabilitation by Medicare beneficiaries after myocardial infarction or coronary bypass surgery. Circulation. 2007 Oct 9;116(15):1653-62.
15. Pasquali SK, Alexander KP, Peterson ED. Cardiac rehabilitation in the elderly. American Heart Journal. 2001 Nov 1;142(5):748-55.
16. Rengo JL, Khadanga S, Savage PD, Ades PA. Response to exercise training during cardiac rehabilitation differs by sex. Journal of Cardiopulmonary Rehabilitation and Prevention. 2020 Sep 1;40(5):319-24.
17. Suaya JA, Stason WB, Ades PA, Normand SL, Shepard DS. Cardiac rehabilitation and survival in older coronary patients. Journal of the American College of Cardiology. 2009 Jun 30;54(1):25-33.
18. Clark AM, Hartling L, Vandermeer B, McAlister FA. Meta-analysis: secondary prevention programs for patients with coronary artery disease. Annals of Internal Medicine. 2005 Nov 1;143(9):659-72.
19. Ades PA, Savage PD, Brawner CA, Lyon CE, Ehrman JK, Bunn JY, Keteyian SJ. Aerobic capacity in patients entering cardiac rehabilitation. Circulation. 2006 Jun 13;113(23):2706-12.
20. Khadanga S, Gaalema DE, Savage P, Ades PA. Underutilization of Cardiac Rehabilitation in Women: barriers and solutions. Journal of Cardiopulmonary Rehabilitation and Prevention. 2021 Jul 1;41(4):207-13.

21. Resurrección DM, Moreno-Peral P, Gomez-Herranz M, Rubio-Valera M, Pastor L, Caldas de Almeida JM, et al. Factors associated with non-participation in and dropout from cardiac rehabilitation programmes: a systematic review of prospective cohort studies. European Journal of Cardiovascular Nursing. 2019 Jan 1;18(1):38-47.

22. Caulin-Glaser T, Maciejewski PK, Snow R, LaLonde M, Mazure C. Depressive symptoms and sex affect completion rates and clinical outcomes in cardiac rehabilitation. Preventive Cardiology. 2007 Jan;10(1):15-21.

23. Beckie TM, Beckstead JW. Predicting cardiac rehabilitation attendance in a gender-tailored randomized clinical trial. Journal of Cardiopulmonary Rehabilitation and Prevention. 2010 May;30(3):147-156.

24. Grace SL, Midence L, Oh P, Brister S, Chessex C, Stewart DE, Arthur HM. Cardiac rehabilitation program adherence and functional capacity among women: a randomized controlled trial. Mayo Clinic Proceedings. 2016;91:140-148.

25. Wall HK, Stolp H, Wright JS, Ritchey MD, Thomas RJ, Ades PA, et al. The Million Hearts Initiative: catalyzing utilization of cardiac rehabilitation and accelerating implementation of new care models. Journal of Cardiopulmonary Rehabilitation and Prevention. 2020 Sep 1;40(5):290-3.

26. Increasing Access to Quality Cardiac Rehabilitation Care Act of 2021 (S1986) (2021-2022).

27. Leon AS, Franklin BA, Costa F, Balady GJ, Berra KA, Stewart KJ, et al. Cardiac rehabilitation and secondary prevention of coronary heart disease: an American Heart Association scientific statement from the Council on Clinical Cardiology (Subcommittee on Exercise, Cardiac Rehabilitation, and Prevention) and the Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity), in collaboration with the American association of Cardiovascular and Pulmonary Rehabilitation. Circulation. 2005 Jan 25;111(3):369-76.

28. Grace SL, McDonald J, Fishman D, Caruso V. Patient preferences for home-based versus hospital-based cardiac rehabilitation. Journal of Cardiopulmonary Rehabilitation and Prevention. 2005 Jan 1;25(1):24-9.

29. Thomas RJ, Beatty AL, Beckie TM, Brewer LC, Brown TM, Forman DE, et al. Home-based cardiac rehabilitation: a scientific statement from the American Association of Cardiovascular and Pulmonary Rehabilitation, the American Heart Association, and the American College of Cardiology. Circulation. 2019 Jul 2;140(1):e69-89.

30. Neubeck L, Redfern JU, Fernandez R, Briffa T, Bauman A, Freedman SB. Telehealth interventions for the secondary prevention of coronary heart disease: a systematic review. European Journal of Preventive Cardiology. 2009 Jun 1;16(3):281-9.

31. Prochaska JJ, Zabinski MF, Calfas KJ, Sallis JF, Patrick K. PACE+: interactive communication technology for behavior change in clinical settings. American Journal of Preventive Medicine. 2000 Aug 1;19(2):127-31.

32. Vandelanotte C, Dwyer T, Van Itallie A, Hanley C, Mummery WK. The development of an internet-based outpatient cardiac rehabilitation intervention: a Delphi study. BMC Cardiovascular Disorders. 2010 Dec;10(1):1-8.

33. Richard E, Jongstra S, Soininen H, Brayne C, van Charante EP, Meiller Y, et al. Healthy ageing through internet counselling in the elderly: the HATICE randomised controlled trial for the prevention of cardiovascular disease and cognitive impairment. BMJ Open. 2016 Jun 1;6(6):e010806.

34. Krishnaswami A, Beavers C, Dorsch MP, Dodson JA, Masterson CR, Kitsiou S, et al. Gerotechnology for older adults with cardiovascular diseases: JACC state-of-the-art review. Journal of the American College of Cardiology. 2020 Dec 1;76(22):2650-70.

35. Schorr EN, Gepner AD, Dolansky MA, Forman DE, Park LG, Petersen KS, et al. Harnessing Mobile Health Technology for Secondary Cardiovascular Disease Prevention in Older Adults: A Scientific Statement From the American Heart Association. Circulation: Cardiovascular Quality and Outcomes. 2021 May;14(5):e000103.

36. Pew Research Center. Tech adoption climbs among older adults. 2017. Accessed February 17, 2021. https://www.pewresearch.org/internet/2017/05/17/tech-adoption-climbs-among-older-adults/

37. Forman DE, LaFond K, Panch T, Allsup K, Manning K, Sattelmair J. Utility and efficacy of a smartphone application to enhance the learning and behavior goals of traditional cardiac rehabilitation: a feasibility study. Journal of Cardiopulmonary Rehabilitation and Prevention. 2014 Sep 1;34(5):327-34.

38. Andraos C, Arthur HM, Oh P, Chessex C, Brister S, Grace SL. Women's preferences for cardiac rehabilitation program model: a randomized controlled trial. European Journal of Preventive Cardiology. 2015 Dec 1;22(12):1513-22.

39. Ades PA, Maloney A, Savage P, Carhart RL. Determinants of physical functioning in coronary patients: response to cardiac rehabilitation. Archives of Internal Medicine. 1999 Oct 25;159(19):2357-60.

40. Dalal HM, Doherty P, McDonagh ST, Paul K, Taylor RS. Virtual and in-person cardiac rehabilitation. BMJ. 2021 Jun 3;373:n1270.