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REVIEW

Integrating Digital Coaching into Cardiac Practice: Strategies to Advance Health Equity

Erin M. Schikowski[1] · Arinze Bosah[1] · Anisha Reddy[1] · Sam Younes[1] · Jared W. Magnani[1,2,3]

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Abstract

Purpose of Review To summarize the promises and pitfalls of the implementation of digital coaching for cardiovascular disease.

Recent Findings Recent studies demonstrate the challenges of implementation of digital coaching for cardiovascular disease. The literature has identified individual- and community-level obstacles to digital coaching that include social and structural factors. A literature has established a best practices approach that incorporates stakeholder engagement to develop and apply digital health technology. Nonetheless, there is potential for digital coaching to exacerbate cardiovascular disparities, particularly for individuals with limited resources. Integration of the results of digital devices and coaching with the electronic health record remains elusive.

Summary Digital coaching has immense promise to improve patient monitoring and advance care for cardiovascular disease. Social and structural challenges remain fundamental obstacles to successful achievement of the promise of digital coaching. Inclusion of patient stakeholders, awareness of structural obstacles (such as redlining), and collaboration between health care systems and industry are essential to advancing digital coaching to realize its contribution to health equity and patient care.

Keywords Social determinants of health · Health equity · Digital health · Multidisciplinary care

Introduction

Digital coaching is a broad term that encompasses the application of mobile health technologies to monitor and guide health-related metrics, activities, and behaviors. As pertaining to cardiovascular disease, digital coaching has massive potential to facilitate the collection, organization, and use of patient-generated health data. For patients, engagement in digital coaching can provide empowering opportunities for self-monitoring, behavioral guidance for primary and secondary cardiovascular prevention, and inform clinical decision making.

In this review, we apply an implementation science and health equity lens to review and summarize digital coaching and its application to cardiovascular care. We focus foremost on the individual- and community-level challenges with application of new technologies for cardiovascular disease monitoring and care, in contrast to prior reviews that have prioritized the promises of remote monitoring. We particularly focus on the relationship between social and structural determinants of health and engagement and utilization of digital coaching. The objectives of this review are to [1] describe individual- and community-level challenges to digital coaching; [2] examine the role of stakeholder engagement in developing and applying digital health technology; [3] explore the potential for improved access to care among individuals with limited resources; and [4] identify barriers to integrating the results of digital coaching into the electronic health record.

We suggest that digital coaching is associated with both promises and pitfalls (Table 1) and comes with a two-fold

✉ Jared W. Magnani
magnanij@pitt.edu

[1] Department of Medicine, University of Pittsburgh Medical Center, Pittsburgh, PA, USA

[2] University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

[3] Center for Research on Health Care, University of Pittsburgh, Pittsburgh, PA, USA

Table 1 Promises and pitfalls of digital coaching in cardiovascular care

Promises	Rationale
Patient engagement	Information is available to patients, allowing them to view data and respond to physician recommendations
Improvement in adherence to medical therapies	Increased engagement in self-monitoring may bolster adherence to medications
Personalized care	Real time data provides insight into patient metrics to facilitate tailored, more precise interventions, support or guidance
Improvement in quality of life	Availability of patient-facing metrics may improve health-related quality of life
Improved monitoring and data collection	Technological advances, including AI, enable remote monitoring and real-time data transmission, allowing healthcare providers to manage disease remotely
Remote access	Elimination of geographic and structural barriers to care
Potential for reduced healthcare and social costs	Reduced need for in-office visits and in turn reduced costs for transportation, missed work, etc.
Pitfalls	**Rationale**
Potential barrier to health literacy	Increased technological complexity to individuals with low health literacy
Additional upfront cost of devices	Increased out-of-pocket cost to patient or healthcare system
Absence of standardized regulatory oversight	Risk for inconsistent quality control with related potential to compromise care
Data privacy and cybersecurity	Potential for hacking and data leaks
Digital divide	Inequitable internet access exacerbates neighborhood- and community-based disparities
Integration with existing healthcare systems	No unified system currently exists that integrates data into electronic health records
Interoperability of digital coaching platforms	Absence of capacity to streamline data collected from multiple platforms
Sustainability	Long-term compliance, potential for outdated software, etc.
Information overload for both patient and provider	Potential to overwhelm patient as well as provider; potential for unnecessary testing and/or treatment

implementation challenge. First, how can digital coaching in combination with wearable, patient monitoring devices empower individuals to participate in self-management and health care decision? Second, how can differential access to technologies, particularly digital tools, avoid or address the potential to worsen pre-existing healthcare disparities and inequality?

Individual- and Community-Level Challenges

Individual- and community-level structural barriers challenge the equitable incorporation of digital technology into cardiovascular care. At the individual level, patients' access and utilization of digital technologies requires adequate health and digital literacy. Health literacy refers to an individual's ability to access and understand health information, enabling them to engage in health-related decision making [1]. Low health literacy is highly prevalent, affecting up to 80 million individuals in the United States [2]. Moreover, populations at risk of having lower health literacy are also more likely to be affected by cardiovascular disease and conditions such as diabetes, obesity, cancer, and HIV [3]. The National Institutes of Health advise that patient-centered reading material be written at or below a sixth-grade reading level [4], yet cardiovascular professional societies' patient-oriented web-based educational material frequently exceeds this level [5]. Educational attainment is related not only to health literacy, but also access to digital resources. For example, among those with less than a high school education, 2.8% had a fitness tracker compared to 56.5% of those with a bachelor's degree or higher [6].

Digital engagement is also heterogeneous across populations. Older individuals and those with lower educational attainment are particularly at risk for limited access to mobile health and digital tools [7, 8]. In a study of nationally representative survey data from non-institutionalized adults, individuals age 18–34 were 2-fold more likely than those over age 65 to have used a website to help with diet, weight, or physical activity (Odds Ratio [OR] 2.24, 95% Confidence Interval [CI] 1.20–4.16). Similarly, individuals with less than a high school degree were less likely to search for a healthcare provider online compared to those with greater than a college degree (OR 0.50, 95% CI 0.33–0.76) [8]. More recent data confirm these trends; the *All of Us* Research Program demonstrated that individuals with a college degree or higher were over five times more likely to have access to home-based or other device to access the internet and feel comfortable using for healthcare-related purposes than those with less than a high school degree [9].

Cost is another important equity barrier for many who stand to benefit from digital advances in longitudinal cardiovascular monitoring. For example, among adults with household income <$30,000/year, 24% do not own a smart phone [10]. For those who do own smartphones or wearable devices, levels of access and device functionality differ among wealthy versus lower income populations. Non-iPhone Operating System devices subsidized by some government programs have operability and compatibility concerns that may limit data gathering from wearable

devices [11]. Other federal government–sponsored programs provide low-income consumers with discounts on phone and internet coverage but come with limitations such as allowing only discount per household, capping mobile voice usage to a fixed number of minutes per month, and imposing limits on upgrades and plan changes [12]. Additionally, programs that offer free government phone service warn that individuals may experience "lower speeds than other customers due to data prioritization" [13]. In this way, limited device functionality and reduced access to high speed internet present challenges to participation in digital coaching among lower income individuals.

At the community level, access to high-speed internet and virtual healthcare may contribute to healthcare outcomes. The term "digital divide" describes a phenomenon in which populations with poorer health outcomes remain disadvantaged despite improvements in healthcare technology [14]. The COVID pandemic provided salient examples of the accelerated adoption of telemedicine accompanied by exclusion of populations lacking adequate home internet. Counties with higher percentages of digitally excluded populations had lower levels of vaccination, higher case rates, and increased mortality [15]. For counties in which > 40% of the population lacked internet access, the COVID death rate was 458/100,000 people, compared to 161/100,000 people in counties where 0–10% of the population lacked internet access [15].

"Digital redlining" is a community-level phenomenon that describes policies and practices resulting in unequal access to telecommunications infrastructure among minority groups and lower-income populations [11]. Redlining historically refers to federal policies that articulated neighborhood zones and, as a result, excluded majority Black communities from home ownership and lending programs in the 1930s [16]. Digital redlining, by contrast, is not directly related to federal policymaking but a consequence of regulatory and private industry decision making that results in disinvestment in broadband infrastructure for historically marginalized populations [17]. Internet service provider investment in broadband is lower in low income, rural, and minority communities [18]. Data from the City Health Dashboard and American Community Survey indicate that 87% of high-income neighborhoods had broadband access, compared to 59% of low-income neighborhoods [19]. Further, White-majority neighborhoods enjoy better access to high speed internet compared to Black- and Hispanic-majority neighborhoods. Restricted access to digital services may preclude using web-based portals for scheduling, text message appointment reminders, digital patient monitoring, and other forms of interaction with the healthcare system. Further, reduced access to digital services may limit capacity to engage in telehealth and virtual visits. These deficits can contribute to disparities in preventive health for cardiovascular disease and other conditions.

Stakeholder Engagement in Digital Coaching

Digital coaching has the potential to improve health outcomes for individuals and other stakeholders within the larger healthcare system. The cornerstone of digital coaching involves mobile health, defined as the integration of smartphones, smartwatches, and other wearable devices into self-monitoring and care [1]. However, failure to include all stakeholders in the development and implementation of mobile health technology results in suboptimal utilization and outcomes. Here we define the end users, healthcare providers, healthcare systems, manufacturers, data centers, and regulatory bodies as stakeholders. We prioritize the end user – the patient – to emphasize health literacy and patient engagement.

Patient outcomes are improved when developers consider end-user characteristics such as health literacy during the design process [20]. Codesign, also referred to as coproduction or patient engagement, is a collaborative design process in which developers work with patient stakeholders to create solutions to a problem [21]. This method allows for open communication, shared understanding, and user feedback. One difference between codesign and traditional approaches is that codesign has a greater focus on implementation and actively involves end users throughout the design process.

Codesign has been used in a variety of contexts to develop digital solutions for populations at high risk of cardiovascular disease. One mobile platform aimed to improve care and thereby reduce disparities in individuals with decreased access to preventive care and treatment, [22]. Stakeholders were educated about cardiovascular disease with the goal of engaging them to generate prototypes of a meaningful and accessible platform. In another study, researchers utilized codesign by seeking feedback from patients with history of myocardial infarction and their healthcare providers to develop a digital health solution for post-myocardial infarction care [23]. These examples underscore the importance of incorporating end-user feedback during the development of mobile health technology.

Can Digital Coaching Address Social Determinants of Health?

Digital coaching offers promising avenues to address social determinants of health by overcoming traditional barriers such as geographic limitations, low health literacy, and inadequate health resources. The success of digital health hinges on its accessibility, incorporation of stakeholder needs and agendas, and prioritization of health and digital literacy.

The integration of digital tools in cardiology offers a promising avenue to overcome structural barriers to care such as geographic isolation, economic constraints, and inadequate healthcare resources. High quality healthcare centers with specialty services are concentrated in high-income and urban centers, and healthcare funding and affordability vary across communities [24]. Technological advances enable remote monitoring and real-time data transmission, allowing healthcare providers to manage disease from afar. Real-time data monitoring can help address geographical and economic barriers for those unable to attend in-person appointments. Reducing the need for in-office visits lowers transportation costs and time lost from work, which constitute significant economic hurdles for many individuals [25].

Digital health tools can be used proactively to manage chronic disease and reduce the burden on patients who have geographical constraints [26]. Blood pressure management can involve remote blood pressure monitoring, virtual coaching, and text-message reminders for medication adherence [26]. Remote blood pressure monitoring provides educational content, motivational support, and timely reminders directly to patients' mobile devices, enhancing engagement without the need for frequent office visits [27]. Generative artificial intelligence (AI) has capacity to augment digital health by integrating into these roles. For example, AI may customize and guide algorithmic response to data acquired via digital monitoring. It may further identify warning signs based upon pattern recognition from accumulated digital data [28]. At present AI requires selective and deliberate integration into digital health. Its promise to serve as a kind of surrogate community health worker or health advisor, not yet achieved, may further enhance accessibility of resources to underserved communities.

Multiple populations disproportionately suffer from cardiovascular disease and have worse outcomes, particularly those who are Black race, Hispanic ethnicity, have limited social resources [29]. Utilization of digital platforms that aim to address disparities in care is crucial. Black and Hispanic populations utilize mobile phones at higher rates than White populations to search for health information [30]. In one study, patients from Black and Hispanic populations receiving a mobile health intervention had greater reductions in systolic blood pressure at 6 months (4.2 mmHg; 95% CI −7.3 to −1.1 mmHg; $p=0.01$) and systolic blood pressure changes at 12 months (−4.3 mmHg; 95% CI −8.4 to −0.2 mmHg; $p=0.04$) compared with standard in-person care [26].

Mobile phone-based telemonitoring in managing heart failure is also effective at enhancing patient care outside traditional settings [31]. One example of a promising platform for protocolized heart failure management is based out of Canada and combines home measurements (weight, heart rate, blood pressure, and symptoms) with an integrated nurse-led model of care to manage heart failure remotely [32]. In a study of 315 patients, this program improved access to care while reducing all-cause hospitalizations by 50% [32]. In addition to lowering costs for both patients and the healthcare system, digital health provides an efficient alternative to monitor and treat non-emergency situations while also expanding the reach to communities that may not have accessible facilities for healthcare nearby [33]. Patients who live in rural areas are equally as likely as urban residents to own and use digital technology to manage their health according to the 2019 Health Information National Trends Survey [34]. Digital interventions for heart failure management in patients residing in underserved rural communities have led to significant improvement in patient-reported adherence to diet and medications. One study included 100 heart failure patients discharged from a rural critical access hospital. The intervention group received a 12-week remote self-management and coaching program delivered by mobile phone [35]. The intervention group displayed greater improvement in patient-reported adherence: weighing themselves, following a low-sodium diet, taking prescribed medication, and exercising daily (all $p<0.0005$) at 3 and 6 months after discharge compared to referents who received standard care.

The success of digital coaching programs depends on their ability to adapt to the diverse needs of different communities, such as education level, health literacy, and cultural beliefs. Digital health platforms can be customized to varying literacy levels by incorporating simple, intuitive interfaces and providing content in multiple languages or through visual and auditory formats [36]. Remote blood pressure–monitoring programs have been successful in increasing access to care for individuals with low health literacy [37]. In one study, 117 of 181 patients with hypertension had limited literacy. At follow up, the systolic blood pressure of patients receiving remote monitoring had decreased by 4.2 mm Hg (95% CI -9.1 to 0.7, $p=0.09$) relative to those receiving standard office blood pressure monitoring. In the subgroup with limited literacy, the average systolic blood pressure decreased by 8.8 mm Hg (95% CI -14.2 to -3.4, $p=0.002$) [37]. Another digital platform focuses on management of diabetes and hypertension with a product designed to be accessible and user-friendly for individuals with diverse literacy levels [38]. The platform promotes accessibility by utilizing a straightforward interface with clear icons and minimal text, making it easy for users to navigate without requiring advanced reading skills. It also offers content in multiple languages, catering to a diverse user base. Such inclusivity ensures that individuals with limited health literacy or those who do not speak English can still benefit from digital coaching. In neighborhoods

or communities with high prevalence of risk factors such as obesity or smoking, digital tools can also be programmed to focus on dietary guidance, exercise promotion, or smoking cessation [39].

Integration of Digital Coaching with the Healthcare System

Even though digital health technology has become prevalent in cardiovascular care, there is no clear guideline for its integration into clinical practice. A digital coach is needed to help integrate this novel approach to health care into clinical practice. A successful digital coach can be a health care worker skilled in motivational interviewing, with a basic knowledge of common cardiovascular conditions such as atrial fibrillation, heart failure, hypertension, and diabetes. Such an individual may also have training in common digital health technologies. These healthcare workers may be registered nurses, clinical pharmacists, physician assistants, nurse practitioners (also known as advanced practice providers), or physicians working independently or collaboratively. While not a coach per se, AI may provide an avenue to organize, collate, and respond to the data from digital monitoring that enters the health care system [40]. Leveraging AI will provide opportunities for health care workers and systems to expand integration of the results of digital monitoring.

Three randomized controlled trials evaluated heart failure outcomes comparing telemonitoring combined with standard care to standard care [31, 41, 42]. Two trials employed cardiologists as coaches, while the other used a heart failure nurse; all used mobile phones with a preinstalled software application for weekly monitoring of patient's symptoms, weight, heart rate, and blood pressure. With this approach, one study found a 54% relative risk reduction in the combined primary endpoint of cardiovascular mortality or heart failure hospitalization (95% CI 7–79%, $P=0.04$) [41]. Another group found an improvement in quality of life in the telemonitoring group ($P=0.02$), though did not identify differences in brain natriuretic peptide, New York Heart Association functional class, or left ventricular ejection fraction.(31) Another study found no significant differences in heart failure hospitalizations between groups (Incidence Rate Ratio of 0.81, 95% CI 0.53–1.26, $P=0.35$)

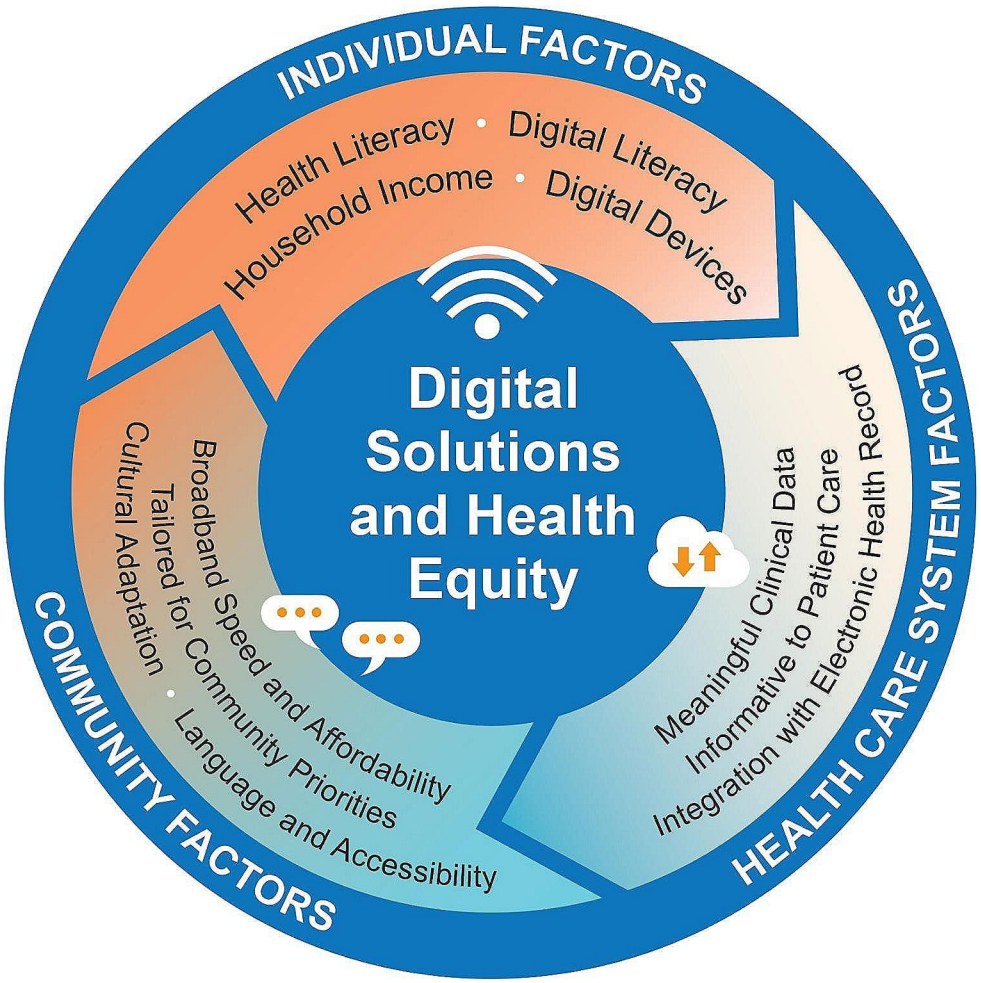

Fig. 1 Interrelationship of individual-, community-, and health care system-level factors in relation to digital coaching, digital solutions, and advancement of health equity

[42]. Studies that combined interactive voice response with remote pharmacist follow up showed improvement in blood pressure control compared to those in the usual care [43, 44].

Using healthcare professionals as digital coaches requires considerable time and potentially increases costs. An alternative approach involves application systems that enable self-monitoring and automated patient interactions that alert patients to contact their providers as needed. In one randomized controlled trial, researchers assessed whether an avatar-based heart failure application improved heart failure knowledge and care among individuals admitted for acute decompensated heart failure at elevated risk (≥ 33%) for 30-day readmission or death [45]. Only 28% of patients in the heart failure application group used the application effectively, primarily due to lack of willingness or internet access. Younger patients aged < 70 years (OR 0.89, 95% CI 0.82–0.97; $P < 0.01$) and those with higher educational attainment (OR 1.58, 95% CI 1.09–2.28; $P = 0.03$) were more likely to enroll and engage with the application.

Other studies targeting younger (age < 70 years) outpatients with chronic heart failure showed increased enrollment in similar applications and improved knowledge but no significant difference in overall healthcare utilization in up to 90-days follow up period [46, 47]. Older patients are more likely to engage with application-based care if it is user-friendly and modifiable [48]. A systematic review found no significant difference in heart failure-related hospitalization (OR 0.74, 95% CI 0.52–1.06; $P = 0.10$) or knowledge improvement (mean deviation 0.10, 95% CI −0.2–0.40; $P = 0.5$) through mobile health interventions compared to usual care [49].

A crucial issue is the integration of patient-generated health data into the electronic health record. Electronic health record platforms have capacity to generate patient-generated health data, but there are challenges concerning its effective integration [50]. These include a lack of regulatory and industry standards, poor data governance, technology hurdles, requirement for manual data entry, lack of analytic capacity. Patient-generated health data could enhance patent monitoring and reduce need for in-person visits, but its integration into an electronic record requires resources of time, attention, and expertise [51]. As stated, AI has capacity to organize and manage this heightened volume of digital health data. Further challenges are the translation of digital coaching and monitoring its effects into salient health data to complement what exists in the electronic health record. The Figure 1 synthesizes the interrelation of individual and community factors with those of the health care system in relation to digital solutions and health equity.

Conclusion

This review explores the role and limitations of digital health coaching in to enhance cardiovascular care and management. Digital coaching can provide personalized guidance and support to patients, particularly for management of chronic cardiovascular disease. However, successful integration of digital solutions requires attention to equity and access. We focus here on the critical influence of structural and social determinants of health and the imperative to consider both individual and community-level barriers when implementing digital coaching. We also acknowledge co-development as a prominent opportunity to ensure effective development of technologies that are appropriate within varying social contexts and levels of health literacy.

The promise of digital coaching lies in its potential to democratize access to health resources, making high quality care more accessible and personalized. Table 2 summarizes future directions and their inherent challenges for digital coaching. However, for digital coaching to truly transform healthcare, it must seamlessly integrate into the electronic health record. It is crucial to continue refining digital coaching platforms to be more inclusive and adaptable, ensuring they can meet the diverse needs of all patient populations. Ongoing research and development, guided by robust stakeholder input and awareness of social and

Table 2 Summary of challenges for success with digital coaching, stakeholder relevance and potential solutions

Domain	Patients	Clinicians and health care systems	Solutions
Individual	Low health and digital literacy, lower educational attainment, older age, and cost	Awareness that social determinants of health impact the use of mobile health and integration of digital health coaching	Attention to implementation of strategies to mitigate these factors.
Community	Digital divide and digital redlining	Documentation of digital access in the electronic health record	Municipal, state, and federal policies to reduce neighborhood-based inequity
Stakeholder	Participation in codesign	Engagement of end-users throughout development process	Prioritized implementation of community-based participatory research
Data integration	Accessible avenues for provision of meaningful patient-generated data	Capacity of the electronic health record	Partnership between health care systems, developers of the health record, and device manufacturers

structural determinants of health, will be key to realizing the full potential of digital health coaching in cardiovascular disease prevention and care.

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Data Availability No datasets were generated or analysed during the current study.

Declarations

Ethical Approval Erin Schikowski, Arinze Bosah, Anisha Reddy, Sam Younes, and Jared W Magnani declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

Competing Interests The authors declare no competing interests.

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