Review

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Review

Technological Interventions to Implement Prevention and Health Promotion in Cardiovascular Patients

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Abstract: Background/Objectives: The aim of the narrative review was to identify information on the impact of technological interventions (such as telehealth and mobile health) on the health promotion of cardiac patients from diverse populations; Methods: The online databases of PubMed and Cochrane Library were searched for articles in the English language regarding technological interventions for health promotion in cardiac patients. In addition, a methodological quality control process was conducted. Exclusion was based on first reading the abstract and then the full manuscript was scanned to confirm the content was not related to cardiac patients and technological interventions; **Results**: 11 studies were included in the review after quality control analysis. The sample size reported in these studies ranged from 12 to 1424 subjects. In 8 studies mobile phones, smartphones and apps were used as mHealth intervention with tracking and texting component; 2 studies used videoconferencing as a digital intervention program, while one study focused on using physical activity trackers; **Conclusions**: This review highlights the digital divide as individuals with limited eHealth literacy and lack of technological knowledge are not motivated or able participate in these interventions. Finding methods to overcome these barriers are important and can be solved to some extent by providing the technology and technical support.

Keywords: Health promotion; cardiology; technology; cardiac rehabilitation; telemedicine and telehealth

1. Introduction

Cardiovascular disease is responsible for nearly 30% of all deaths globally and is deemed the leading cause of death and disease worldwide [1]. Self-monitoring for signs of emerging complications and better self-care between face-to-face health care provider office visits can contribute to improved cardiovascular outcomes in this patient population [1–3]. Due to the complexity of medication regimens, comorbidities and lack of caregiver support lack; self-management; adequate home care and cardiac rehabilitation (CR) is often challenging. At the same time there is a need for health promotion and preventive measures consisting of lifestyle behavior modifications including healthy diet, increased physical activity, weight loss and smoking cessation [1,2]. There are further challenges observed due to limited interaction of the health care providers in resource-constrained settings, such as rural areas, impoverished neighborhoods, and low-income populations [3–5]. The use of telecommunications technology to provide health care from a distance is called telehealth [4]. The implementation of telehealth in medical care of a variety of chronic diseases, including cardiovascular diseases has become increasingly popular [1,2]. The effective use of telehealth interventions and patient-centered mobile health technology helps extend the reach of health systems to provide continuous support to the cardiovascular patient population belonging to all age groups and demographics [4–6]. Starting in utero, cardiovascular monitoring of maternal and fetal health, is essential and implemented through regular visits with the health care provider, along

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with prenatal ultrasound conducted at the recommended timelines [6]. The health outcomes of mothers and infants can be improved through trustworthy guidance and regular monitoring of parameters such as weight, physical activity and nutrition. This can be achieved through mobile health (mHealth) tools such as mobile applications (apps).

Understanding the implementation of successful mHealth interventions in cardiovascular disease management and their use in a wide variety of populations is important. Studies generally consist of adult male populations owning smartphones; however cardiovascular disease is present in all age groups regardless of gender, race and socioeconomic status [4,6–8]. Additionally, the congenital heart disease population remains underrepresented in many studies [5–7]. This review aims to address limitations and explore the status of mHealth strategies, in real clinical and community settings, consisting of diverse populations and demographics.

2. Methods

We conducted a broad search in PubMed and the Cochrane library aligned with the goals for narrative reviews. To capture the updated literature on the efficacy of these technological interventions, we limited studies to publications between 2014 and 2024. In addition, a methodological quality control process was conducted [9]. Due to heterogeneity in the nature of the studies and implementation of the technologies, we did not conduct a meta-analysis, and therefore reported results narratively.

Search strategy: The MeSH-terms of "cardiovascular", "cardiac", "telehealth" or "telemedicine" "health promotion" and "technology" were used. The reference lists from the articles included were searched for additional relevant articles

Inclusion and exclusion criteria: The articles identified in the literature search were thoroughly reviewed in order to meet the inclusion and exclusion criteria and appropriateness for the objective of the narrative review. The articles included in the review were qualitatively synthesized [9]. Criteria for inclusion were publications: (i) available in the English language (ii) pertaining to technological interventions, and (iii) including cardiac population (for example, telemedicine or mobile health's role in health promotion, cardiac rehabilitation etc.) (Table 1). The review was not limited by the study design of the articles. Exclusion was based on reading the abstract first and then going through the full manuscript to confirm that content was not related to the cardiac population and technology.

Table 1. Reference table. Characteristics (summary and details) of the articles included.

Article	Sample(n)	Type of study	Intervention and patient information	Summary
1. Chow et al [10]	1424	Randomized control trial (RCT)	1424 patients (mean age=58 years, 79% male) with heart disease (from 18 Australian teaching hospitals), owning a text capable, mobile phone, with the ability to read messages in English, were followed for a year. The participants were compared to a	The program delivered consistent education and support to cardiac patients after hopitalization. Results showed favorable response from patients, including high levels of acceptability, usefulness in being a unified source of information, program engagement, and emotional support. However medication adherence was not improved.

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				control group, with no text messages.	
2.	Beatty et al [11]	13	Observational study	13 participants (1 female) mean age=63, with cardiac surgery, angina or heart failure, owning a mobile phone or computer with internet access, participated in this study related to feedback of Veteran use of a mobile application. The mobile app VA FitHeart, included health education along with reminders and feedback. The app also provided physical activity goal setting, alongwith daily logs for physical activity tracking and health metrics recording(e.g., blood pressure, weight and mood/ emotional well-being)	The study used patients feedback to improve the usability of the app, through questionnaitres and semistructured interviews. Patient expectations for using a mobile app for Cardiac rehabilitation (CR) included tracking health metrics, introductory training, and sharing data with providers. Patients in the study desired the ability to track physical activity.
3.	Harzand et al [12]	258	Open label trial	Patients with cardiac disease were required to own an Android or an iOS smartphone in working condition with access to Wi-Fi or a data plan to enroll in this digital health intervention (DHI) program for the cardiac	Results indicated that the remote CR with DHI was feasible in the VA hospital setting. Participants health status improved with better walking capabilities and low density lipoprotein cholesterol, while smoking decreased. Additionally, no adverse events were noted.

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				rehabilitation program at the VHA medical center. A total of 258 participants mean age 60±9 yrs, 93% male and 48% blacks, enrolled in the program for three months.	
4.	Lunde et al [13]	113	RCT	113 patients completing cardiac rehab, were randomly allocated to the intervention. Mean age of particpants= 59, 22% females (coronary artery disease= 73.4%, 16.8%= valve surgery, and other heart diseases= 9.8%). The intervention consisted of receiving follow up with the m-health app or a control group with usual care. Patients were recruited from two CR centers in the eastern region of Norway.	Post-CR patients were compared with control group in this study consisting of individualized follow up for one year with an app. Improvements were seen in VO_{2peak}, exercise performance and exercise habits, as well as self-perceived goal achievement. No other outcomes were different.
5.	Villani et al [14]	268	Descriptive mixed methods study	The questionnaire was distributed among 268 patients attending an outpatient arrhythmia clinic. 82.4 % men with mean age 69 years, participated in this study conducted in Northern, Italy.	In this study the results indicate that the patients expressed a greater interest in receiving information related to the effectivenes and integrity of the device. Lower interest towards the clinical status and arrythmic episodes and healthy lifestyle counselling was observed.

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6.	Kathuria-Prakash et al [15]	40	Community participatory research design	40 Black women aged 25-45 years with at least two cardiovascular risk factors, completed 4 sessions of cardiovascular disease risk reduction education as well as a 6-month smartphone coaching and cardiovascular disease risk reduction monitoring, which targeted heart healthy lifestyle and behavior modifications.	The results indicate that m-Health intervention was a feasible tool for implemeting cardiovascular disease risk reduction for young black women. Imrpoving the health awareness of the participants had indirect benefits for other family members especially children.
7.	Sankaran et al [16]	32	RCT	The impact of HeartHab app was studied on 32 coronary artery disease patients for 4 months, in Belgium. Overall patients motivation, physical activity, exercise target achievement, quality of life and modifiable risk factors were investigated.	Results demonstated positive improvements in VO2 max, glucose, HDL cholesterol, weight and quality of life.
8.	Martin et al [17]	48	RCT	48 participants (46% women, 58 years age mean) from a cardiology center in Baltimore, owning smartphones, took part in this study for 4 months with the objective that mHealth	Smart texts with activity tracking led to the best physical activity outcomes, such as increased daily steps(better outcomes than tracking only).

				intervention with tracking and texting components would increase physical activity.	
9.	Chen et al [18]	14	Clinical trial (pilot study)	14 (8-19 year old) patients (at least 1 year postcardiac transplant surgery) underwent a 12- 16 week diet and exercise intervention which was delivered via live video conferencing to improve cardiovascular health.	Results indicate that the lifestyle intervention of exercise and nutrition was feasible with excellent adherence, improvements in cardiac,vascular, nutritional and functional health.
10.	Tierney et al [19]	24	Cohort study	24 patients with Marfan syndrome (8 to 19 years old) participated in a 6-month physical activity intervention and their steps were tracked.	Physical activity intervention was feasible in this population and has the potential to decrease the aortic root (AoR) dilation rate.
11.	Ziebel, et al [20]	**12**	Feasibility study	Mean age of participants was 15.4 years (SD = 3.4) with mean time since cardiac transplant of 9.7 years (SD= 4.3). Participants wore a FitBit accelerometer throughout the duration of the study to monitor daily activity levels. The participants underwent the intervention for 16 weeks, which consisted of exercise	Results of the study indicate the successful implementaton of a virtual cardiac fitness intervention with improvement in QoL metrics and excellent adherence of participants.

sessions twice a week for 30 mins, supervised by a trained exercise physiologist over a virtual platform. At the conclusion of the intervention participants repeated the strength and flexibility assessment, a 6MWT and quality of life (QoL) parameters measurement to compare with baseline.

Quality control: The methodological quality examination of every article was conducted using the methodological checklist" Critical review form quantitative studies." [9] (Table 2). The articles were analyzed for technological interventions in the cardiac population, the findings, limitations and proposed solutions presented in these studies were summarized.

Table 2. Overview of the methodological quality checklist "Critical review form quantitative studies" [9].

	Chow et al	**Beatty et al**	**Harzand et al**	**Lunde et al**	**Villani et al**	**Kathuria-Prakash et al**	**Sankaran et al**	**Martin et al**	**Chen et al**	**Tiernay et al**	**Ziebell et al**
Study purpose: was the purpose stated clearly?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Literature: was relevant and background literature reviewed?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Design	RCT	Observational study	Open label trial	RCT	Descriptive mixed methods study	Community participatory research design	RCT	RCT	Open label trial	Cohort	Feasibility study
Sample	N=1424	N=13	N=258	N= 113	N= 268	N=40	N=32	N=48	N= 14	N=24	N=12
Was the sample described in detail?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was the sample size justified?	Yes	No	No	Yes	No	No	Yes	Yes	Yes	No	No

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Results: Results were reported in terms of statistical significance.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Were the analysis method(s) appropriate?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clinical importance was reported?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Drop-outs were reported?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Conclusions and clinical implications: Con clusions were appropriate given the study methods and results	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(Abbreviation used in the table: RCT= randomized controlled trial).

3. Results

Search terms: cardiology (Cardiac* OR cardiovascular); telehealth, telemedicine; technology and health promotion. This yielded 37 articles which were narrowed down to 11 articles relevant to the topic (Table 1). Articles that were unrelated to cardiology patients, or other pathological conditions such as neurological or endocrine disorders, as well as those that did not include technology, were not included in the review. In general, the papers included design, sample size and proper analysis (Table 2); therefore, we included all 11 articles in the review after quality control analysis.

3.1. Descriptive Analysis:

The outcomes with respect to the technological intervention type if reported, and patient population are described in this review. Table 1 describes the content of the included studies. The studies included a variety of research methods and design including but not limited to randomized trials, qualitative and quantitative studies. The sample size reported in these studies ranged from 12 to 1424 subjects [10–20].

3.2. Types of Technological Intervention and Patient Population

In 8 studies mobile phones, smartphones and apps were used as mHealth intervention with tracking and texting component [10–16,19]; 2 studies used videoconferencing (telehealth) as a digital intervention program [18,19]; while 3 studies focused on using physical activity trackers [18]. The summaries of the interventions presented in these studies and outline of the results are described below.

- **Text messages and medication adherence [10].** In the study called "Text Messages to Improve Medication Adherence (TextMeds) and Secondary Prevention after Acute Coronary Syndrome (ACS) [10]" the effects of text message delivered cardiac education, support and adherence to medication were studied after ACS. Providing support and consistent care to ACS patients after discharge remains an implement challenge for many hospitals and health systems [10,20]. It is important to reduce the burden of readmissions and provide the post-discharge care needed through implementation of best practice secondary prevention strategies such as healthy living, medicines and emotional well-being [20,21]. The intervention consisted of a personalized and customized text

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message-based program for one year which required minimal central staff support. Intervention participants were more motivated to eat recommended servings of fruit and vegetables and normalize their body mass index. However, the study found that within the participants there were no significant effects on the primary outcomes of blood pressure, low density lipoprotein cholesterol and medication adherence. Overall, there was high levels of acceptability of the intervention, program engagement and usefulness in being a credible source of information and support to the patients after discharge [10].

- **A mobile application for technology-facilitated home Cardiac Rehabilitation [11]** In Smart HEART (Health Education and Rehabilitation Technology), direct communication between patient and a health coach was provided through a mobile smart phone app, to encourage self-monitoring. A wrist worn activity tracker encouraged regular exercise [11]. The remote CR enhanced with a digital health intervention (DHI) was provided to the patients to check the usability and to determine if the intervention improves CR access, patient reported outcomes and cardiac risk factors [11]. After the in-person baseline visit, the participants received a 3-month, remote CR program, which consist of structured home exercise enhanced with the Movn smartphone app (Movn Health, Irvine, California) and a wearable fitness tracking device and data was shared with a dedicated health coach [11,12,23]. Results indicated that the DHI-enhanced remote CR program was associated with enhanced CR access, improvement in the markers of cardiovascular risk, and healthy behaviors in this study.
- **A patient-centered digital health intervention for cardiac rehabilitation [12]**.258 patients enrolled in remote CR enhanced with the DHI. In order to participate in the (DHI) program for the cardiac rehabilitation program at the Veteran Health Administration (VHA) or VA medical center participants were required to own an Android or an iOS smartphone, enabled with access to Wi-Fi or a data plan. The DHI intervention consisted of remote CR with a structured, 3-month home exercise program partnered with multi-component coaching, a commercial smartphone app, and a wearable activity tracker. Patient-reported outcomes from pre- to post-intervention were measured along with changes in 6-min walk distance, cardiovascular risk factors and intervention completion rates. Results showed the intervention was associated with enhanced CR access, improved markers of cardiovascular risk, high completion rates and healthy behaviors.
- **A smartphone application post cardiac rehabilitation improves exercise capacity with long term follow up [13].** In this study conducted in Norway the intervention group received an app which was developed to guide and help patients change behavior and maintain habits, post cardiac rehabilitation. A physiotherapist was the supervisor of the group for the year and patients could submit questions and received feedback via email regularly as well as short tailored motivational feedback regularly [13]. Results indicated that compared with a control group post-CR, improvements were seen in VO_{2peak}, exercise performance and exercise habits, as well as self-perceived goal achievement.
- **Mobile health and implantable cardiac devices: Patients' expectations [14].** Remote monitoring systems in patients with implantable cardioverter defibrillators (ICDs) are a common area of implementation of mHealth in clinical practice. In this study conducted in an outpatient clinic in Italy patients' perspectives and interest on receiving data from their implantable cardiac devices, clinical and health related advice via remote monitoring was studied. The ICD patients showed interest in receiving information pertaining to the technical functioning of the device but there was a lack of interest regarding the role of these tools in self-management of the disease. Presence of caregiver support as well as higher education were associated with greater interest in receiving information via mobile phone [14]. These results were limited by being conducted in a single center however should be expanded to other centers to achieve an impact in the future development of novel mHealth patient centered devices.
- **Participation of young African American females in an m-Health study in cardiovascular disease reduction [15]**. 40 black female participants between the ages of 25 and 45 years, with CVD risk factors participated in a 4-week (two hours per week) intervention consisting of self-management educational classes and six months of wireless coaching and monitoring. Women responded to a semi qualitative online survey assessing the user- friendliness and perceived helpfulness of the intervention at follow up.

Results were favorable with positive implications for practice. Most of the participants did not encounter barriers to participation, which suggests that mobile health interventions can be effective tools to improve health behavior patterns and provide helpful support in the prevention of cardiovascular disease. Targeting women provided indirect benefits for other family members, especially children. Women mentioned their family were more inclined to participate in healthy habits. This study had a few limitations, including that it was conducted on a small sample size in urban Southern California, and therefore cannot be generalized to the African American communities. In order to help bridge some of the disparities in access to health care in this population a larger-scale multicenter trial would be helpful and help validate the findings of the study [15].

- **Evaluation of the impact of the HeartHab on motivation, physical activity, quality of life and risk factors of cardiovascular disease patients [16].** The aim of this study conducted in Belgium was to investigate the impact of the HeartHab application on the patients' motivation, physical activity, exercise target fulfilment, QoL and modifiable risk factors in patients with CAD during telerehabilitation. 32 CAD patients were randomized on a 1:1 ratio to telerehabilitation or usual care. The persuasive design techniques integrated in the HeartHab, and the tailoring of exercise targets were effective in motivating patients to reach their telerehabilitation targets. Results demonstrated positive improvements in VO2 max, glucose, HDL cholesterol, weight and quality of life [16]. A larger sample size and longer evaluation would be beneficial and shed more light on these results.
- **An Automated mHealth Intervention for Physical Activity Promotion [17].** Smartphone users aged 18 to 69 were enrolled in the mActive study years at an ambulatory cardiology center in Baltimore, Maryland. In this study smart texts through smartphone-delivered coaching 3 times a day aimed at individual encouragement. Participants used their own smartphones and feedback loops were created by a fully automated, physician-written, theoretical algorithm, which used the patient real-time activity data, 16 personal factors and the goal of 10,000 steps per day. Digital physical activity tracking was performed using a wearable, display-free, triaxial accelerometer that paired with low-energy Bluetooth and compatible smartphones. Smart texts with activity tracking led to the best physical activity outcomes, such as increased daily steps (better outcomes than tracking only).
The mHealth intervention with smart text component and digital tracking, significantly increased physical activity. Despite the positive results this was considered a pilot study and future steps of including human coaches and increasing the sample size will be more beneficial in understanding the impact of mActive study [17].
- **A live Videoconferencing Intervention in Pediatric Heart Transplant Recipients [18]. I**n this study the feasibility and impact of a supervised exercise and diet intervention delivered via videoconferencing was tested, at least one year post transplant [18]. The lifestyle intervention in this pediatric heart transplant recipients resulted in excellent adherence and improvements in cardiac, vascular, functional and nutritional health. After transitioning to maintenance phase, several of these health indices were sustained. The researchers aim to shift clinical focus from "exercise restrictions to exercise prescriptions", in a vulnerable pediatric population.
- **Physical activity trackers and pediatric Marfan patients [19].** In this clinical intervention, 24 pediatric patients with Marfan syndrome between 8 and 19 years of age participated, and their physical activity was tracked. They were instructed to take 10,000 steps per day for 8 months. The AoR dimension, arterial stiffness, endothelial function, physical activity indices, inflammatory biomarkers and coping scores were measured at baseline, and 6 months. This study demonstrated the feasibility of a physical activity intervention in the pediatric patients with Marfan syndrome and the potential to decrease the AoR dilation rate [19]. The focus has been more towards exercise restrictions rather than promotion of exercise in this patient population, the researchers hope that the results of the study might help and shift the paradigm [21]. Additional similar studies can help provide guidelines on how supervised exercise therapy can be further explored in a multicenter study consisting of a larger sample size.
- **Virtual cardiac fitness training in pediatric heart transplant patients [20].** Participants between the age of 10 and 20 years old underwent the intervention which consisted of exercise sessions twice a week for 30 minutes under the supervision of a trained exercise physiologist over a virtual platform for 16-weeks. Patients wore a FitBit accelerometer to monitor daily activity levels throughout the duration of the study. At the conclusion of the intervention participants repeated the strength and flexibility assessment, a 6MWT and quality of life parameters measurement to compare with baseline measurements. The results of the study showed a successful implementation of the intervention with excellent adherence and improvement in physical fitness and quality of life.

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4. Discussion

The evidence based on the above literature search indicate implementation of technological interventions including text messages, smart phone apps, physical activity interventions, video conferencing, telehealth and other methods mentioned in these articles are deemed feasible and accepted by diverse cardiac populations [15–20]. These studies are important in laying the groundwork towards improving cardiac patients' health and providing positive reinforcements [10–18]. Patients with heart disease can receive proper support and education from the implementation of digital health strategies [21–25]. Reassuringly, cardiac patients seem to be seeking information from credible sources and organizations including health professionals such as cardiologists, primary care physicians and staff, nursing and allied health care providers [26–28]. Family engagement and caregiver support is improved with these technologies and parents of pediatric cardiac patients find this method useful and acceptable with positive results [18–20].

The studies conducted through the Veteran Health administration mention that larger studies consisting of a wider variety of research for longer duration is needed to understand the role of their program by comparing with other centers. This will help in creating an understanding on the significance of the impact on long term health outcomes and hospital readmissions due to coronary diseases [12,23]. Overall, the digital health interventions in the cardiac population at the VHA had positive results, despite the high risk patient population with low socioeconomic status, and also factoring in that many such studies are challenging to implement because of VA-specific privacy requirements.

In the study conducted by Kathuria-Prakash et al, smartphones were the main source of internet access in the African American female population and barriers mentioned stemmed from providing an additional phone [15]. Forgetting to charge the device and finding technical difficulties while using were experienced by some participants in the smartphone studies [12,15,23]. These issues can be resolved by implementing minor changes to the study design, such as using another fitness tracking modality or wearable device [15]. For example, in another study the lithium battery was provided with the device and did not need recharging for the study duration [17]. Our results show similar findings in comparison to other studies which show that diverse populations with heart disease benefit from mHealth and technological interventions including those who have suboptimal access to health care resources, lack of transportation, often had a lower health literacy level [27–32]. Studies mention patients were more inclined to self-care and felt a sense of security as the health providers were continuously monitoring their situation and aware of their health issues [20,21,34,35].

Limitations and Future Directions:

The review did not comprise the level of rigor that is implemented in systematic reviews; they are likely missed articles in the narrative review approach. However, for the articles included in the review some of the common factors were that the studies were limited by the access to technology, and only those individuals with smartphones were enrolled in the studies which required cell phone participation of the patients [10–14]. Some of the studies were conducted by the VA health system where all the participants were veterans belonging to the integrated health care system, consisting of mostly males, which limits its generalizability [11,19]. The sicker and older Veterans were often not comfortable with technology and therefore did not enroll [11,19,23]. Additionally, it is mentioned that in the rural population the VHA should equip the eligible Veterans with devices that have WiFi capabilities, to increase participation, access and limit inclusion bias [36,37]. Lessons can be learnt from the several studies conducted showcasing the COVID-19 pandemics impact on the field of telehealth cardiology [38–41]. At the same time much can be learned from the methods implemented in pilot studies and health care systems existing outside the United States. For example, this review includes studies conducted in Australia, Canada, Norway, Italy and Belgium, however it may not be possible to replicate the interventions here due to differences in the health care systems and reimbursements [7,13,14,16].

Future directions should focus on identifying the individuals with cardiovascular diseases who may not benefit from the increasing focus on the technological services, such as those that are

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socioeconomically deprived, lacking internet access, or having limited eHealth literacy and finding methods to increase their participation by providing the technical support and technology needed for the interventions [12,24]. A broader approach is probably needed to motivate the patients in taking a more active role in promoting their own healthcare, with the help of technological interventions [13,14]. More information can be obtained by conducting studies including those who own and are comfortable with technology; and comparing to those who have barriers to learn the new methods or appear to be naïve to these interventions [4,5,13].

5. Conclusions

Overall, from pediatrics to geriatrics, diverse groups and populations can benefit from cardiovascular monitoring through technological interventions including but not limited to, interactive applications on smartphones for monitoring, telehealth, video conferencing and physical activity trackers [10–20]. One size fits all approach may not work with these modalities and interventions [36,37]. These studies highlight the digital divide as individuals having limited eHealth literacy and lack of technological knowledge are not motivated to participate in these interventions. Even though digital health care services are showing the potential to make information widely accessible to patients, it is ironic that this may propagate disparities and create obstacles in some scenarios where these technologies are employed to improve access to health-related information [4,31–34]. Hence finding methods to overcome these barriers are important and could be solved to some extent by conducting studies in a diverse population with larger sample size and providing the technology and the technical support [34–37].

Abbreviations

CR-cardiac rehabilitation; ACS- acute coronary syndrome; ICDs-implantable cardioverter defibrillators; AoR – aortic root; CVD- cardiovascular disease; DHI- digital health intervention; CAD- coronary artery disease; ICD-implantable cardioverter

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