

# Remote Assisted Cardiac Rehabilitation

Subjects: Cardiac & Cardiovascular Systems

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Cardiac rehabilitation is an individualized outpatient program of physical exercises and medical education designed to accelerate recovery and improve health status in heart disease patients. Home-based cardiac rehabilitation is a way for patients to enjoy all the benefits of clinician-supervised cardiac recovery from the comfort of their homes, under medical supervision. In addition, virtual communication, the development of digital modules, and the monitoring of vital signs are all possible with wearable devices.

Keywords: virtual assistant ; cardiac rehabilitation ; telerehabilitation

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## 1. Introduction

Cardiac rehabilitation is an individualized outpatient program of physical exercises and medical education designed to accelerate recovery and improve health status in heart disease patients <sup>[1]</sup>.

A cardiac rehabilitation program is structured with three stages: the acute phase (in hospital), the subacute phase (center-based), and outpatient therapy (home-based). Unfortunately, the second and third phases of a cardiac rehabilitation program face many barriers of implementation with an overall participation of under 50%, despite international guidelines prescribing recommendations <sup>[2][3]</sup>.

The main factors leading to low adherence of patients to cardiac rehabilitation can be classified into person-related (advanced age, female gender, unemployed status, low education, and low-income background) and aspect-related (rural areas, lack of means of transport) <sup>[4]</sup>.

## 2. Cardiovascular Disease: Epidemiology, Economic Impact, and Management Strategies

The 21st century is characterized by a longer life expectancy as the number of people aged over 65 years is increasing. It is expected that by 2030 the percentage of people over 65 years old will grow from 17.4% to 25.6%. The ageing of the population translates into a high prevalence of cardiac diseases and loss of cognitive and physical autonomy. It represents a medical and social issue, which should be addressed sooner rather than later in order to secure the future well-being of this fragile group of patients <sup>[5]</sup>.

Heart disease has been the leading cause of death worldwide for the past 20 years, and the number is steadily rising, from 2 million deaths per year in 2000 to nearly 9 million deaths in 2019 <sup>[6]</sup>.

Clinical and epidemiological ones developed short- and long-term risk prediction algorithms for identifying patients at high-risk of developing cardiovascular disease. These patients are the main beneficiaries of reducing cardiovascular risk factors through primary prevention programs <sup>[7]</sup>.

Globally, the costs of hospitalization, drug or interventional treatment, and monitoring visits of cardiovascular disease patients are huge and increasing alongside patient life expectancy. As an example, in the United States of America in 2010, medical costs were approximately USD 863 billion, with an estimated increase of up to USD 1 trillion by the year 2030 <sup>[8][9]</sup>.

Home-based cardiac rehabilitation is a way for patients to enjoy all the benefits of clinician-supervised cardiac recovery from the comfort of their homes, under medical supervision. In addition, virtual communication, the development of digital modules, and the monitoring of vital signs are all possible with wearable devices <sup>[10]</sup>.

Although it represented an alternative for many years, there were no premises of the rapid implementation of online cardiac rehabilitation. The COVID-19 pandemic raised the opportunity for rapid integration among the services offered by healthcare providers. These services were translated into telemedicine and the use of remote assistance devices <sup>[11]</sup>.

The switch from classic to online cardiac rehabilitation means waiting time reduction, flexible participation schedules, no need for the patient to travel, and benefits in terms of morbidity, mortality, and quality of life <sup>[12][13]</sup>.

Beyond the COVID-19 pandemic, adopting technology as the standard practice looks promising and might be the best alternative for specific cardiac patients in terms of efficiency in secondary prevention management of cardiovascular disease <sup>[14]</sup>.

### **3. Virtual Assistants: A Solution to Telerehabilitation Implementation Difficulties in Eastern European Countries**

Although ambulatory cardiac rehabilitation programs prove to be efficient, they are rarely prescribed to patients due to uneven access to health services <sup>[15]</sup>.

Telerehabilitation could be the answer to this problem. Currently, it was supported that the use of digital technology to address health inequalities and create compelling and constant changes in medical services offered. The ability of telerehabilitation to overcome temporal and spatial barriers is highlighted even more in the current COVID-19 pandemic situation <sup>[16]</sup>.

Romania and many other European Countries face health inequalities, as significant numbers of patients are not admitted to rehabilitation programs, mostly due to lack of financial resources and lack of reimbursement. Recently it was investigated key barriers in cardiac rehabilitation in East-Central Europe highlighted demographic issues as one of the most significant drawbacks for rehabilitation adherence <sup>[17][18]</sup>.

In a successful implementation, rural communities would be the main beneficiaries of these services. Despite these limitations, the overall image is auspicious. Digital health technology could answer many of the challenges faced by on-site cardiac rehabilitation. Virtual coaches, also known as e-coaches, can vary, from classic rule-based smartphone apps that guide the patient, to more advanced machine learning algorithms, that intelligently support patient rehabilitation with automatic adaptation of clinical pathways. Virtual coaches can provide medical follow-up in the community and can reach out to demographically remote areas that are difficult to access by health care providers <sup>[19][20]</sup>.

Apart from improving patient quality of life, the virtual coach optimizes the economics of medical and social care treatments <sup>[21]</sup>.

One example of a virtual assistant under development is the virtual coach for rehabilitation in the elderly patients developed in the vCare project. Under the funding of the European Union's Horizon 2020 Research and Innovation Programme grant no 769807, the vCARE project has the overall objective to support the recovery of active and independent life at home <sup>[22]</sup>.

The development of the vCARE project involves twelve partners from seven European countries with a multidisciplinary consortium of researchers, healthcare providers, and industry experts. The virtual coach must be used in different national systems for various pathologies and rehabilitation settings to ensure a multi-site and multi-setting approach <sup>[22]</sup>.

The chosen pathologies are stroke, Parkinson's disease, heart failure, and ischemic heart disease, divided among the healthcare providers participating in the project <sup>[22]</sup>.

One of the project sub-goals is evaluating patient perception of the virtual assistant as a constant in their lives, an essential parameter for patient's motivation and further participation in the system testing, and a vital evaluation of the public receptivity of virtual coaches <sup>[22]</sup>.

It was showed that patient perception of telemedicine state a 95–100% patient satisfaction rate compared with classic medical appointments <sup>[23]</sup>.

Decreased time travel, the presence of administrative support, reliable and easy-to-use technology, and adequate reimbursement of medical services are a few of the positive arguments patients cite in favor of telemedicine <sup>[23]</sup>.

In the center of the active development of telemedicine and remote medical assistance, one should see patient perception as essential for technology's future growth and implementation [24][25].

Telemedicine represents a healthy mix of medical care and technology. Therefore, it should be instituted in all urban medical centers to support rural, isolated areas, acting as a bridge for broader accessibility of patients to medical services and a good strategy in the second prevention management of cardiovascular disease and more [26].

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