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Let the games begin: Serious games in prevention and rehabilitation to improve outcomes in patients with cardiovascular disease

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Sustainable lifestyle changes are needed in primary and secondary prevention of cardiovascular disease (CVD), however, traditional strategies that have been used in the past might not be effective anymore. These strategies have gone through a steady evolution in the last decades, moving from traditional face-to-face instruction sessions over patient-tailored leaflets and information brochures to instruction via tablets, mobile phones and internet-based technologies.\textsuperscript{1,2} There is an increasing interest within healthcare in the use of so-called serious games i.e. computer games which are designed for educational purposes to affect knowledge, attitudes, or behaviour and subsequently improve health outcomes.\textsuperscript{3} Serious games have been described as having three basic components from which they can be evaluated i.e. user experience, play and learning.\textsuperscript{4}

Serious games may be targeted at the public, patients, or healthcare professionals. The most common topics in serious games in healthcare are cognitive training, indirect health education, and medical provision followed by a variety of games for different health problems.\textsuperscript{5} Although a more rigorous evaluation of serious games in healthcare has been called for\textsuperscript{3,4} promising examples of success have been reported within the fields of self-care in diabetes, asthma, cancer in for example, improving diet, pain management or mobility. In the field of cardiology, publications on serious games targeted at patients are scarce. In this editorial, we would like to raise interest in using serious games in the field of cardiovascular care by addressing possibilities and opportunities.

The present and current role of serious games

Characteristics of games, such as fantasy, rules/goals, sensory stimuli, challenge, mystery, immersion, and control can create positive emotions, improve problem-solving, and encourage active participation, use of previous experience and negotiation with continuous feedback. The opportunities in gaming for social interaction, either in playing together or watching others play, enjoying the spectacle and sharing comments, and the enhancement of emotional experience that comes from the presence of a crowd could explain game enjoyment. All of these characteristics can stimulate motivation, and thus support learning.\textsuperscript{3,6}

Currently, not only the younger generation but also older adults (50+, both men and women) are increasingly playing video games. Of the older adults, 44% are playing at least once a month and on average 5 hours per week,\textsuperscript{7} indicating that games are attractive and might have the potential to attract both the younger generation and older adults to learn.
Serious games can be fit to the specific needs of the individual player, they have possibilities for repetitiveness, and they make it possible to create a realistic scenario for the player to practice skills and tasks. These qualities are in concordance with current knowledge of what characterizes successful patient education, i.e., it can be provided in multiple sessions (repetitiveness), it is individualized, interactive, and is delivered using combined media. Because of these qualities, games could be an important and interesting addition to current patient education practices.

Gamification mechanics⁸, i.e., the application of game-design elements and game principles in non-entertainment contexts such as point scoring, rules of play, or competing with others, are frequently used in products such as serious smartphone applications designed to help patients manage diseases.¹ Furthermore, virtual reality is another form of serious gaming that can be utilized for patient education, since this also introduces possibilities to remote simulate real-world situations irrespective of time and place.

The opportunities of serious games in prevention and rehabilitation of CVD

Only a few serious games have been developed specifically for patients with CVD, but many general games are applicable to a diversity of patient populations, including patients with CVD. A recent scoping review⁹ reports eight articles on self-management in patients with CVD, of which several used commercially available games as the platform and only 3 used games specifically designed for patients with CVD.

Specifically, for patients with CVD, serious games to improve knowledge and beliefs could be developed to explain anatomy, organ function, disease-process, medical treatment, and how self-care impacts health within the body. An example is a study¹⁰ in which patients with heart failure played a tablet-based casino slot game about living with heart failure. They found a significant increase in patients’ heart failure knowledge after playing the game. Another study in patients with acute coronary syndrome used an avatar application to educate about the condition and appropriate responses resulted in significant improvements in patients’ symptom knowledge, attitudes, and beliefs.¹¹

Self-care behaviour such as lifestyle changes or medication management might need specific skills, such as perceived control¹², which patients with CVD could obtain through a serious game. Such games have been developed and tested for other patient populations and can be used for patients with CVD; for example, a novel smartphone game for patients with type 2 diabetes
has been shown to improve intrinsic physical activity motivation\textsuperscript{13} and de facto physical activity, measured as steps per day over 24-weeks.\textsuperscript{14} Self-care behaviour such as “body-listening”, i.e., helping patients to recognize symptoms of angina, fainting, breathlessness or oedema might also be learned and practiced through a serious game, specially designed for this patient group. Furthermore, games can be instrumental in helping patients to train their decision-making skills and to realize what can happen when different decisions are made in response to symptoms. An example of such an intervention is a game targeted at patients with hypertension in which the user interacts with avatar healthcare providers during virtual office visits, practicing self-care, using communication skills, and accessing educational resources.\textsuperscript{15}

A very specific type of game is exergames (games to do exercise). These games are promising for patients with CVD and can improve their exercise capacity and energy expenditure.\textsuperscript{14,16,17} Exergaming might be a feasible and safe supplementation to increase physical activity. Several characteristics, such as sensory stimuli or challenge, incorporated in exergaming could help make physical activity fun and engaging, while maintaining essential physical activity requirements. With an advanced understanding of learning with serious games, motivational game design, and immersive movement, exergames hold the potential to change how patients engage with their physical activity and cardiac rehabilitation as a whole. Exergaming can also be an option for patients with CVD to be physically active at home, especially when rehabilitation at the hospital is not possible (e.g. logistic problems for visiting the hospital) or not available (e.g. during the COVID-19 pandemic).\textsuperscript{18}

The design of a serious game for healthcare is not simple and its development requires interdisciplinary teamwork including computer scientists, game designers, and healthcare professionals, to name but few.

Knowledge is relatively poor and health risk behaviours are not uncommon in young persons with heart disease.\textsuperscript{19} Given that serious games displayed to be effective in increasing knowledge and self-management in young people with chronic conditions,\textsuperscript{20} such games have a place in the management of children and adolescents with congenital heart disease.

**Conclusion**

There is a need to constantly look for opportunities to support prevention and rehabilitation in persons with CVD to improve outcomes, especially to support a healthy lifestyle, symptom recognition, and symptom management. A growing generation of people who are used to playing
video games and continual innovation in technology offers potential and new possibilities for patients to learn and be physically active through games, and the possibility to do this at home. There is a need for well-designed studies in this fast-growing and exciting field of health game development based on a strong theoretical framework and also for more robust intervention studies to test adherence and the short/long-term effectiveness of serious games on outcomes.

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