

CASE REPORT

GLOBAL HEALTH REPORT: SURGERY AND INTERVENTIONS

Novel Virtual World-Based Cardiac Rehabilitation Program to Broaden Access to Underserved Populations

A Patient Perspective

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ABSTRACT

This report describes *Destination Rehab*, a novel virtual world-based cardiac rehabilitation program, which aims to increase cardiac rehabilitation access to underserved populations. We highlight the experience of a cardiac patient whose successful participation in the program allowed her to overcome significant psychosocial and access barriers to cardiac rehabilitation. (J Am Coll Cardiol Case Rep 2022;4:911-914) © 2022 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Cardiac rehabilitation (CR) is an essential component of secondary prevention for patients after major adverse cardiac events. It integrates core components such as medical

evaluation, prescribed exercise, and cardiovascular (CV) risk factor modification to improve CV outcomes.¹ Despite these known benefits, it remains underused globally.¹ Efforts to establish alternative models to center-based cardiac rehabilitation (CBCR), such as home-based CR programs, are essential to increase CR participation and achieve CV health equity.

Cardiac patients are often burdened by numerous barriers to participation in CBCR. Sociodemographic factors such as race/ethnicity, sex, and socioeconomic status also have an impact on CR enrollment and participation.² Specifically, women are approximately 41% less likely to enroll in CR compared to men. Additionally, racial/ethnic minority groups are approximately 37% less likely to enroll in CR than their White counterparts. These disparities are

LEARNING OBJECTIVES

- To increase awareness of existing disparities in cardiac rehabilitation participation driven by patient-, provider-, and systems-level barriers to access.
- To describe an alternative home-based model for delivery of cardiac rehabilitation to increase access through innovative virtual world technology.
- To highlight the positive impact of a virtual world-based cardiac rehabilitation program from a patient perspective.

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**ABBREVIATIONS
AND ACRONYMS**

- CBCR** = center-based cardiac rehabilitation
- CR** = cardiac rehabilitation
- CV** = cardiovascular
- VW** = virtual world
- VWCR** = virtual world-based cardiac rehabilitation

attributed to various factors, including lower referral rates, transportation, and out-of-pocket costs not covered by insurance.² As a potential avenue to overcome barriers to participation and broaden access to CR, our team designed and implemented *Destination Rehab*, a novel CR program delivered via innovative virtual world (VW) technology on the Second Life platform.³

DESTINATION REHAB OVERVIEW

Destination Rehab offered an alternative to CBCR in the VW by simulating in-person experiences through an online persona or avatar. The VW platform afforded participation in the comfort of one’s home or any preferred location with access to broadband internet access.^{3,4} The program components were developed with input from community-based cardiac patients to enhance end-user receptivity and relevance. The program was piloted to evaluate its feasibility, acceptability, and effects on CV health outcomes.⁵ Patients engaged in weekly CV health education sessions and group virtual tours by CR clinicians and staff (Table 1). Embedded support groups allowed for real-time interaction between patients to reflect on the virtual world-based cardiac rehabilitation (VWCR) experience and how they implemented healthy lifestyle practices to their everyday lives. The VWCR program garnered excellent recruitment, retention, and attendance, with 93% of patients attending ≥ 1 session and 71% attending $\geq 75\%$ of sessions.⁵ Participation rates were particularly high among women: 84% of women attended each session. There were improvements in CV health behaviors and risk factors (eg, physical activity and weight).⁵ Participants provided overwhelmingly positive feedback regarding accessibility, convenience, and social connectivity.

**PATIENT EXPERIENCE WITH
DESTINATION REHAB**

“I think first thing is, you’ve got to have a made-up mind that this is what you want to do. You want to change your way of living if you want to live. Because if your heart’s not working then you’re not going to live.” This quote is from Mrs W, an inspirational participant in the *Destination Rehab* program. Mrs W is a 76-year-old African-American woman with chronic systolic heart failure who enrolled in *Destination Rehab* after percutaneous coronary intervention. Herein, we describe her challenges to participating in CBCR and how *Destination Rehab*, coupled with her tenacity and determination, improved her CV health. Her story illustrates the potential for VWCR programs to expand CR access to underserved populations.

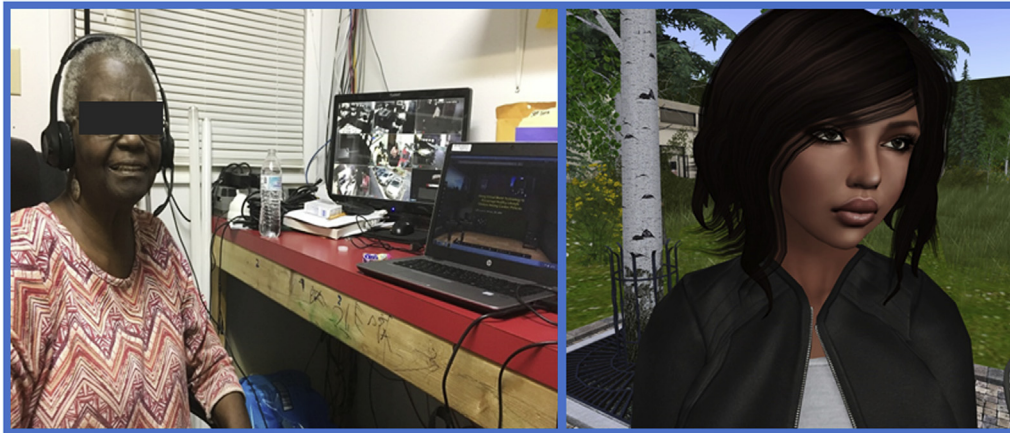
Mrs W was already experienced with CBCR after multiple prior myocardial infarctions but was confronted with several systemic barriers to participation. Most cumbersome was the financial burden of CBCR, citing a US\$50 out-of-pocket cost per session despite having 2 insurance policies. She also noted that the nearest CBCR program was 45 minutes away from her home, which required her to travel 90 minutes by bus (US\$4 fare per session). Given the financial stress and transportation burden of CBCR participation, she became frustrated and did not return. When approached by our study team about participating in *Destination Rehab*, she was reluctant, but excited to try something new.

Upon starting the program, she did not have broadband internet access or a personal computer at home. Determined to participate, she approached her church leadership to request their access to the internet and was provided a laptop computer by the study team. With support from her pastor, she brought her laptop to the church each week to engage in the sessions (Figure 1). This mitigated the cost burden and was an easier alternative to the long commute to the CBCR program. Given her minimal experience with computers and the internet, she received technical support from the study team to ensure that she would be comfortable with the technology and navigation in the VW platform. She also received assistance from family and fellow church members to connect to the platform for timely attendance at sessions. Demonstrating her dedication and perseverance, she noted, “I didn’t give up. I got on. I didn’t miss my classes. No. I enjoyed that. I really did.” She was initially awed by the platform, stating, “It was just like little people walking around

TABLE 1 Virtual World Cardiac Rehabilitation Education Session Topics

Session	Topic
1	Anatomy and physiology of the heart
2	Managing heart disease risk factors
3	Stress management and heart disease
4	Cardiac medications
5	Sexuality and heart disease
6	High blood pressure
7	Fitness concepts and implementation strategies (including fitness center tour with exercise physiologist)
8	Dining out the healthy way (including interactive restaurant tour with dietician)
All	Weekly peer social support group

FIGURE 1 Virtual World-Based Cardiac Rehabilitation Platform



Mrs W (left) and her avatar (right) in the virtual world-based cardiac rehabilitation platform *Destination Rehab* during a peer support group session.

and going into the library and going to the beach. And oh! I just couldn't believe the things I was seeing. Sit down and having classes. They talked to you about your heart and stuff. It was just unreal." She described learning about practical exercise tips and a healthy diet, and she felt that the program improved her quality of life.

Mrs W also received excellent reports during her outpatient cardiology follow-up visits. Her cardiologist was impressed with her progress and informed the study team that he was certain the program facilitated her recovery and may have saved her life. She also recalled how the peer support group inspired her to change some health behaviors listening to other participants share their personal experiences in adopting healthier lifestyles (Videos 1 and 2). She was intrigued by the virtual sessions and asserted that she would eagerly join a similar program if one were to become available. Overall, she expressed that the program positively influenced her health and well-being.

CONCLUSIONS

Destination Rehab provided a platform for CR that mitigated many traditional barriers to participation while maintaining critical aspects of CBCR. The ease of participation reflected by excellent attendance rates demonstrates the potential scalability of *Destination Rehab* to reach under-resourced patients overwhelmed by barriers to CBCR access. Expanding

broadband internet access to socioeconomically disadvantaged patients may help bridge the digital divide. Future studies should continue to assess the effectiveness of VWCR as an alternative approach to CBCR to improve CV outcomes for diverse patient populations, including those in resource-limited communities.

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REFERENCES

1. Thomas RJ, Beatty AL, Beckie TM, 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. *J Am Coll Cardiol*. 2019;74(1):133-153.
2. Mathews L, Brewer LC. A review of disparities in cardiac rehabilitation: EVIDENCE, DRIVERS, AND SOLUTIONS. *J Cardiopulm Rehabil Prev*. 2021;41(6):375-382.
3. Brewer LC, Kaihoi B, Schaepe K, et al. Patient-perceived acceptability of a virtual world-based cardiac rehabilitation program. *Digit Health*. 2017;3:2055207617705548.
4. Brewer LC, Kaihoi B, Zarling KK, et al. The use of virtual world-based cardiac rehabilitation to encourage healthy lifestyle choices among cardiac patients: intervention development and pilot study protocol. *JMIR Res Protoc*. 2015;4(2):e39.
5. Brewer L, Abraham H, Kaihoi B, et al. Community-informed virtual world-based cardiac rehabilitation program as an extension of center-based cardiac rehabilitation: mixed methods analysis of a multicenter pilot study. *J Cardiopulm Rehabil Prev*. 2022. In press. <https://doi.org/10.1097/HCR.0000000000000705>

KEY WORDS cardiac rehabilitation, cardiovascular disease, health disparities, secondary prevention, social determinants of health

 **APPENDIX** For supplemental videos, please see the online version of this paper.