

**DEVELOPMENT, IMPLEMENTATION AND EVALUATION OF A CO-
DESIGNED WEB-BASED CARDIAC REHABILITATION PROGRAM FOR
PATIENTS LIVING IN RURAL AND REMOTE AREAS**

by

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Thesis

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“It’s not ‘us versus them’ or even ‘us on behalf of them... it has to be ‘us with them’.”

TIM BROWN, CEO AND PRESIDENT OF
IDEO

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Abbreviations

ACRA	Australian Cardiovascular Rehabilitation Association
AYH	Activate Your Heart
BCT	Behaviour change technique
BMI	Body mass index
CAP	Care assessment platform
CATCH	Country Access to Cardiac Health
CHAP	Country Heart Attack Prevention
CR	Cardiac rehabilitation
DBP	Diastolic blood pressure
DRG	Diagnostic-related groups
EAPC	European Association of Preventive Cardiology
IT	Information technology
LDL	Low-density lipoprotein
LHN	Local Health Networks
MI	Myocardial infarction
NCD	Non-communicable diseases
NHRMC	National Health and Research Medical Council
PAD	Peripheral artery disease
QOL	Quality of life
RCT	Randomised controlled trials
RR	Risk ratio
SBCHDP	Smartphone-based coronary heart disease prevention
SBP	Systolic blood pressure
SD	Standard deviations
SMS	Short messaging service
SUS	System Usability Scale
TA	Thematic analysis
UK	United Kingdom
US	United States
VW	Virtual world

Abstract

Aim: This doctoral thesis aimed to develop, implement and evaluate a web-based cardiovascular rehabilitation program to improve cardiovascular rehabilitation access for populations living in rural and remote areas through a web-based delivery model, thus increasing attendance at and completion of cardiovascular rehabilitation.

Methods: First, a systematic review was conducted to examine the effectiveness of web-based cardiac rehabilitation (CR) programs on attendance and completion compared to usual care. Second, a co-design study was conducted to develop the essential elements used to build the web-based program and guide its implementation into clinical use. Finally, an evaluation of the web-based CR program's implementation was conducted. Using the RE-AIM framework it reported on its reach, effectiveness, adoption, implementation and maintenance.

Results: Web-based programs were 43% more likely to be completed than usual care [RR: 1.43; 95% CI: 0.96, 2.13] based on the systematic review of the literature, while there was no difference between groups for clinical outcomes. The evolution of the web-based CR program development was completed with an improvement in usability and launched for clinical use on July 1, 2021. Despite low enrolment and completion, our web-based cardiovascular rehabilitation program has successfully been implemented through adoption and utilisation at health service, clinician and patient levels.

Conclusions: This research resulted in a newly developed and implemented web-based CR program, providing a third option, along with face to face and telephone, to complete CR in rural and remote areas. This program was successfully implemented and although attendance at and completion of the web-based CR mode were less than usual care, it provided a mainstream option during COVID-19 pandemic restrictions. Future research and policy efforts should address barriers to engaging patients and clinicians and the routine integration of web-based cardiovascular

rehabilitation programs into mainstream clinical use and already established programs in particular.

Declaration

I certify that this thesis:

1. does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university
2. and the research within will not be submitted for any other future degree or diploma without the permission of Flinders University; and
3. to the best of my knowledge and belief, does not contain any material previously published or written by another person except where due reference is made in the text.

Date 15 November 2023

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Anthology of Publication and Presentations

Published Papers in this Thesis

1. **Nesbitt, K.**, Beleigoli, A., Champion, S., Gebremichael, L. G., Bulamu, N., Tirimacco, R. & Clark, R. A. (2023). Development and evaluation of a co-designed website for delivering interactive self-directed cardiac rehabilitation. *European Journal of Cardiovascular Nursing*, zvad026.
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Presentations

1. **K. Nesbitt**, S. Champion, Jonathon Foote, L. Gebremichael, N. Bulamu, R.A. Clark, A. Beleigoli, Implementation of a Web-Based Cardiac Rehabilitation Program in Rural Australia Improves Access, 28 November 2023, Successes and Failures in Telehealth ASM 2023
2. **K, Nesbitt**, S. Champion, Jonathon Foote, L. Gebremichael, N. Bulamu, R.A. Clark, A. Beleigoli, Implementation of a Web-Based Cardiac Rehabilitation Program in Rural Australia Improves Access, 12 November 2023, American Heart Association 2023. (Not presented at))
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6. **Nesbitt, K.** Usability of a Co- Designed, Web Based Cardiac Rehabilitation Program for Cardiac Patients Living in Rural and Remote Areas: Country Access to Cardiac Health (CATCH Web). Oral presentation.11 Nov, Successes and Failures in Telehealth ASM 2022.

7. **Nesbitt, K.,** A. Beleigoli, S. Champion, L. Gebremichael, H. Du, J. Foote, R. Tirimacco, and Clark R.A. Evaluating the Usability of a Co-Designed Interactive Web Application for Cardiac Rehabilitation. Oral Presentation -Nesbitt, K. 11 - 14 Aug. CSANZ Annual Scientific Meeting 2022 Gold Coast, 2022.
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10. **Nesbitt, K.** EJCvN Twitter video 14 February 2022 ‘User experience design as a co-design methodology’, https://twitter.com/esc_journals/status/1505122281281961988, *European Journal of Cardiovascular Nursing*.
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14. Clark RA and **Nesbitt K.**, Overview of the CHAP Study and website co-design project. Heart Foundation Cardiac Rehabilitation State-wide Workshop, Hindmarch Education Centre September 17th, 2021.
15. **Nesbitt K.**, Beleigoli, A., Du, H., Clark, R. & Tirimacco, R. CSANZ 2021 Abstract presentation: Web-based cardiac rehabilitation: a co-design experience with patients living in rural and remote South Australia in the Country Heart Attack (CHAP) Prevention Project. Multi-disciplinary Session Friday 6 August 2021 (Virtual Meeting)

Concurrent Published Papers Not Included in this Thesis

1. **Nesbitt, K.**, Gebremichael, L. G., Champion, S., Bulamu, N., Clark, R. A. & Beleigoli, A. (2023). Cardiovascular disease patient reported experiences with a web-based, interactive, clinically integrated cardiac rehabilitation program. *European Journal of Cardiovascular Nursing*, 22(Supp. 1), zvad064-099.
(Impact factor 3.593)
2. Beleigoli, A., Foote, J., Bulamu, N., **Nesbitt, K.**, Gebremichael, L., Ramos, J. & Clark, R. (2023). Completion of cardiac rehabilitation leads to improved clinical outcomes in 10954 patients within 365 days following an acute coronary syndrome or revascularization procedure admission. *European Journal of Cardiovascular Nursing*, 22(Supplement_1), zvad064. 091.
(Impact factor 3.593)
3. Beleigoli, A., Foote, J., Gebremichael, L., Bulamu, N., Astley, C., Keech, W., ... **Nesbitt, K.**, de Plaza, M. P. (2023). Improving Cardiac Rehabilitation Utilisation is Essential to Reducing Mortality and Cardiovascular Readmission: A Data Linkage Analysis of Cardiac Rehabilitation

Utilisation and Clinical Outcomes of 84,064 Eligible Separations in South Australia. *Heart, Lung and Circulation*, 32, S389.

(Impact factor 2.6)

4. Beleigoli, A., Foote, J., Ramos, J., Powell, S., Gebremichael, L., **Nesbitt, K.**, ... Clark, R. (2023). Quality of Cardiac Rehabilitation in Rural South Australia After a Quality Improvement Program: Results of the Country Heart Attack Prevention (CHAP) Project. *Heart, Lung and Circulation*, 32, S399–S400.

(Impact factor 2.6)

5. Bulto, L., Roseleur, J., Noonan, S., de Plaza, M. P., Champion, S., Dafny, H., **Nesbitt, K** ... Beleigoli, A. (2023). Nurse-Led Interventions Versus Usual Care to Manage Hypertension: A Systematic Review and Meta-Analysis. *Heart, Lung and Circulation*, 32, S330.

(Impact factor 2.6)

6. **Nesbitt, K.**, Beleigoli, A., Champion, S., Gebremichael, L., Du, H., Foote, J., ... Clark, R. (2022). Evaluating the Usability of a Co-Designed Interactive Web Application for Cardiac Rehabilitation. *Heart, Lung, and Circulation*, 31, S47.

(Impact factor 2.6)

7. **Nesbitt, K.**, Beleigoli, A & Clark, R. (2022) Patient centred cardiac rehabilitation: flexible, individualised, and online. INSPIRE, Research Australia Ltd, vol. 024, p. 42-43

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(Impact factor 6.344)

9. **Nesbitt, K.,** Beleigoli, A., Du, H., Clark, R. & Tirimacco, R. (2021). Co-designing digital cardiac rehabilitation with patients living in rural and remote Australia-the country heart attack prevention project. *European Journal of Cardiovascular Nursing*, 20(Supplement_1), zva060. 138.

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10. **Nesbitt, K.,** Beleigoli, A., Du, H., Clark, R. & Tirimacco, R. (2021). Web-based Cardiac Rehabilitation: A Co-design Experience With Patients Living in Rural and Remote South Australia in the Country Heart Attack (CHAP) Prevention Project. *Heart, Lung and Circulation*, 30, S285.

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13. Beleigoli, A., Champion, S., Tirimacco, R., **Nesbitt, K.,** Tideman, P. & Clark, R. A. (2021). A co-designed telehealth-based model of care to improve attendance and completion to cardiac rehabilitation of rural and remote Australians: The Country Heart Attack Prevention (CHAP) project. *Journal of Telemedicine and Telecare*, 27(10), 685-690.

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14. Beleigoli, A., Nicholls, S. J., Brown, A., Chew, D. P., Beltrame, J., Maeder, A., . **Nesbitt, K.**
 Tideman, P. (2022). Implementation and prospective evaluation of the Country Heart Attack Prevention model of care to improve attendance and completion of cardiac rehabilitation for patients with cardiovascular diseases living in rural Australia: a study protocol. *BMJ Open*, 12(2), e054558.
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15. Beleigoli, A., Nicholls, S. J., Brown, A., Chew, D. P., Beltrame, J., Maeder, A., **Nesbitt, K...**
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 Beleigoli, A. (2023). Effectiveness of nurse-led interventions to manage hypertension and lifestyle behaviour effectively: A systematic review and meta-analysis. *Europace*, 25(Supp. 1), euad122. 763.
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18. Dafny, H., Champion, S., Gebremichael, L., Pearson, V., **Nesbitt, K.**, de Plaza, M. A. P., ... Hendriks, J. (2022). Effectiveness of using activity monitoring devices on physical activity of

patients with cardiovascular disease participating in cardiac rehabilitation programs: An umbrella review protocol. *JBIM Evidence Synthesis*.

(Impact factor none)

19. Dafny, H. A., Champion, S., Gebremichael, L. G., Pearson, V., **Nesbitt, K.**, de Plaza, M. A. P., ... Hendriks, J. M. (2022). Effectiveness of activity-monitoring devices in patients with cardiovascular disease participating in cardiac rehabilitation programs: an umbrella review protocol. *JBIM Evidence Synthesis*, 20(11), 2806-2814.

(Impact factor none)

20. de Plaza, M. A. P., Beleigoli, A., Brown, S., Bulto, L. N., Gebremichael, L. G., **Nesbitt, K.**, ... McMillan, P. (2022). Effectiveness of telehealth versus standard care on health care utilization, health-related quality of life, and well-being in homebound populations: a systematic review protocol. *JBIM Evidence Synthesis*, 20(11), 2734-2742.

(Impact factor none)

21. Gebremichael, L. G., Beleigoli, A., Champion, S., **Nesbitt, K.**, Bulto, L. N., de Plaza, M. A. P., ... Hines, S. (2022). Effectiveness of cardiac rehabilitation programs versus standard care on medication adherence in patients with cardiovascular disease: a systematic review protocol. *JBIM Evidence Synthesis*.

(Impact factor none)

Structure of this thesis

Chapter 1 focuses on the significance of this research by defining and describing cardiovascular disease and its health burden on the world and Australia, as well as its diagnosis and management. It also describes CR itself, the timeline of its evolution, the delivery of CR and the barriers presented to attendance and completion of programs. Finally, it describes the nature and importance of implementation science research, closing with the aim of the thesis and its objectives.

Chapter 2 presents a literature review exploring the existence, integration and effectiveness of web-based CR programs, including websites, phone apps and remote monitoring, highlighting patients' attendance and completion of their CR program. This literature review also identifies the theoretical framework(s) for developing a web-based CR program, highlighting the appropriate approach for adoption in this study; this is followed by a systematic review examining the effectiveness of interactive, web-based CR programs on attendance and completion of programs in a manuscript accepted for publication.

Chapter 3 provides an overview of the research methodology for co-designing the web-based CR program, which is a user experience (UX) design approach, to develop the CR web-based program. In addition, this chapter also discusses the management of the study and its ethical issues. It then provides an overview for the evaluation of the implementation of the web-based CR program, using the research methodology RE-AIM, to evaluate the implementation process and outcomes from this.

Chapter 4 provides a practical description of the project's implementation process and then reports the outcomes from the co-design of the web-based CR program in the form of a published manuscript. It then reports the findings of the evaluation of the implementation of the

web-based CR program, the implementation study in the form of a manuscript submitted for publication.

Chapter 5 discusses the findings and conclusions, including the study's limitations and their implications for policy, practice and future research.

Chapter 1: Background and Significance of the Study

1.1 Chapter Overview

This chapter contains an overview of the author's interest in this field and a background to the study, its significance, main purpose, research questions, aims and objectives and a brief description of the research approach and the structure of this thesis.

1.2 Introduction

Cardiovascular disease is an established public health burden and the continuing leading cause of death globally (World Health Organization, 2021). Over the last 20 years, cardiovascular mortality has increased with a reciprocal effect on burgeoning health care costs (Gheorghe et al., 2018; Roth et al., 2020; World Health Organization, 2021). The current reduction in the incidence of cardiovascular mortality belies the reality of cardiovascular disease morbidity and its impact on quality of life (Timmis et al., 2018).

Cardiac rehabilitation is offered as an outpatient program delivering education and interventions to people who have experienced acute coronary syndrome, including unstable angina, non-ST-segment elevation, and ST-segment elevation myocardial infarction (MI), stable angina, coronary artery bypass surgery, percutaneous coronary interventions, and heart failure (Abreu et al., 2020). Other referral criteria are valve devices, replacement and repair, permanent pacemaker and implantable defibrillator insertion, heart transplant and arrhythmia patients (Abreu et al., 2020). Traditionally, this service is delivered face-to-face or via telephone. These programs ensure the best physical, psychological, and social outcomes for people, slowing the progression of cardiovascular disease and restoring quality of life. It significantly reduces death, reoccurring cardiac events and hospital admissions while improving quality of life (Anderson et al., 2017; Oliveros, Seron, Buitrago-Garcia & Grace, 2020).

This thesis presents the conceptual underpinnings for and the development, implementation and evaluation of an intervention to improve attendance at and completion of CR for patients with cardiovascular disease. This chapter describes cardiovascular disease, the burden of cardiovascular disease, the beginnings of and role of CR in the secondary prevention of reoccurring cardiovascular events, the delivery modes of CR and the influence of web application CR program interventions on attendance and completion of programs.

The study focuses on cardiovascular disease as the catalyst for commencing a CR program; therefore, I use this umbrella term throughout this thesis. The specificity of cardiovascular conditions will only be used contextually.

1.3 Definition of Cardiovascular Disease

1.3.1 Cardiovascular disease.

Cardiovascular disease is a term used to describe a variety of conditions affecting the heart and blood vessels (Aarosan, 2020). Coronary artery disease, or ischaemic heart disease, precipitated by atherosclerosis, is responsible for various clinical syndromes: coronary artery disease, cerebrovascular disease and peripheral artery disease (Aarosan, 2020).

1.3.2 Risk factors.

Cardiovascular risk factors are divided into risk predictors and risk reducers, thus identifying causation and informing disease management (see Figure 1.1; Libby, 2009).

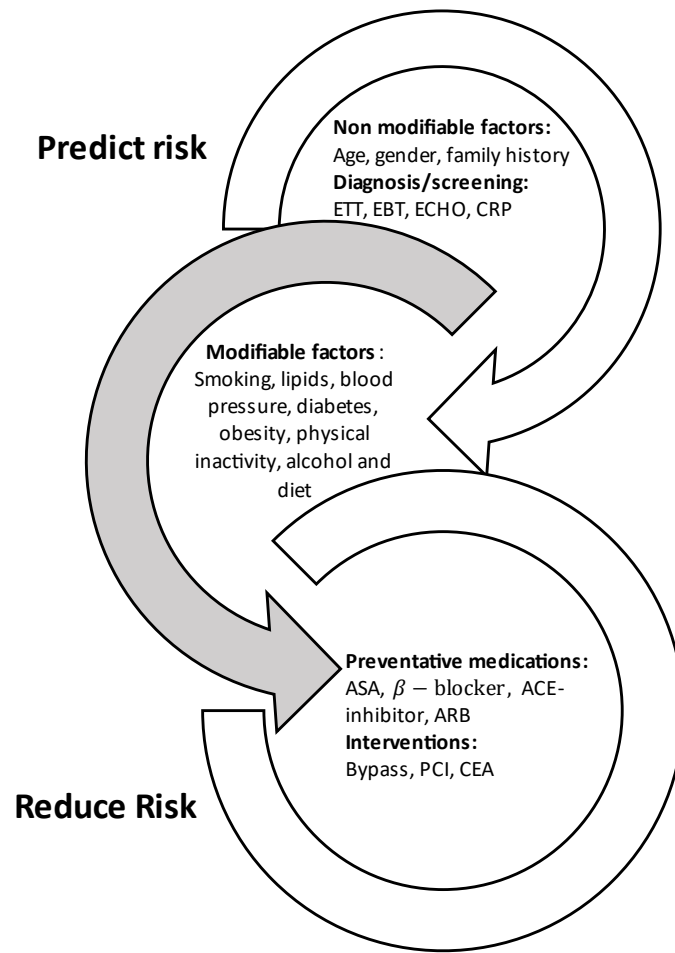


Figure 1.1. Risk predictors and reducers. *Note.* ETT = exercise tolerance test, EBT = electron-beam computed tomography, ECHO = echocardiogram, CRP = C-reactive protein, ASA = acetylsalicylic acid, β blocker = beta blocker, ACE inhibitor = angiotensin-converting enzyme, PCI = percutaneous coronary intervention, CEA = carotid endarterectomy.

Current guidelines recommend the assessment in clinical practice of total cardiovascular disease risk on the background of multifactorial contributors to atherosclerosis (Visseren et al., 2021). Risk factor prediction can be opportunistic, incidental findings during a presentation for other clinical reasons or a systematic formal approach in a target population (Visseren et al., 2021). Both effectively detect cardiovascular disease risk and should not be seen as stand-alone events but rather the beginning of ongoing surveillance and management.

1.3.2.1 Risk reducers.

Primary and secondary cardiovascular disease prevention requires collaboration between clinicians and patients. A high level of self-effectiveness is required for patients to successfully

reduce cardiovascular disease risk wherever they sit on the risk continuum. Risk factors such as age, gender (male) and family history are *fixed* (Aaronson, 2013; Visseren et al., 2021). However, increased cholesterol (dyslipidaemia), smoking, hypertension, type 2 diabetes mellitus, obesity and physical inactivity are *modifiable* (Aaronson, 2013; Visseren et al., 2021). Modifiable risk factors contribute to ~90% of atherosclerosis, thus reinforcing the importance of early risk reduction in both primary and secondary prevention (Aaronson, 2020). Risk reduction involves clinical, pharmacological and non-pharmacological management interventions. Clinical interventions commonly include coronary bypass grafting and percutaneous coronary interventions, with or without stenting. Table 1.1 highlights the risks of cardiovascular disease and the pharmacological and non-pharmacological strategies to reduce them (Aaronson, 2020).

Table 1.1

Pharmacological and Non-Pharmacological Cardiovascular Disease Interventions

Risk reduction intervention	Non-pharmacological	Pharmacological
Reduce/quit smoking		
Healthy food choices		
Physical activity		
Reduce body mass index		
Lower/control blood pressure		
Lower blood cholesterol		
Lower low-density lipoprotein		
Glycaemic control		

1.3.3 Coronary artery disease.

Atherosclerosis is a disease of the large arteries, aorta, coronary and internal carotid arteries, and the circle of Willis, beginning in childhood where fatty streaks develop, progressing in some instances to atherosclerosis plaques in middle age (Aaronson, 2020). It is recognised as a largely inflammatory disease (Buja, 2015). The process of atherogenesis, whereby fatty deposits form in the arteries, is primarily attributed to (a) endothelial injury or dysfunction, (b) myocyte or macrophage accumulation, (c) influx of T lymphocytes, (d) platelet aggregation and attachment, (e) rapid smooth muscle production, (f) increase in plasma low-density lipoprotein (LDL), (g) increase in LDL through oxidation, (h) lipid accumulation in macrophages (foam cells) that localise to fatty deposits on vessel walls, (i) programmed death of foam cells, (j) lipid deposits outside the cells and (k) blood pressure and blood flow as influenced hemodynamically (Buja, 2015). Figure 1.2 outlines the progression of atherosclerosis (Libby, 2009).

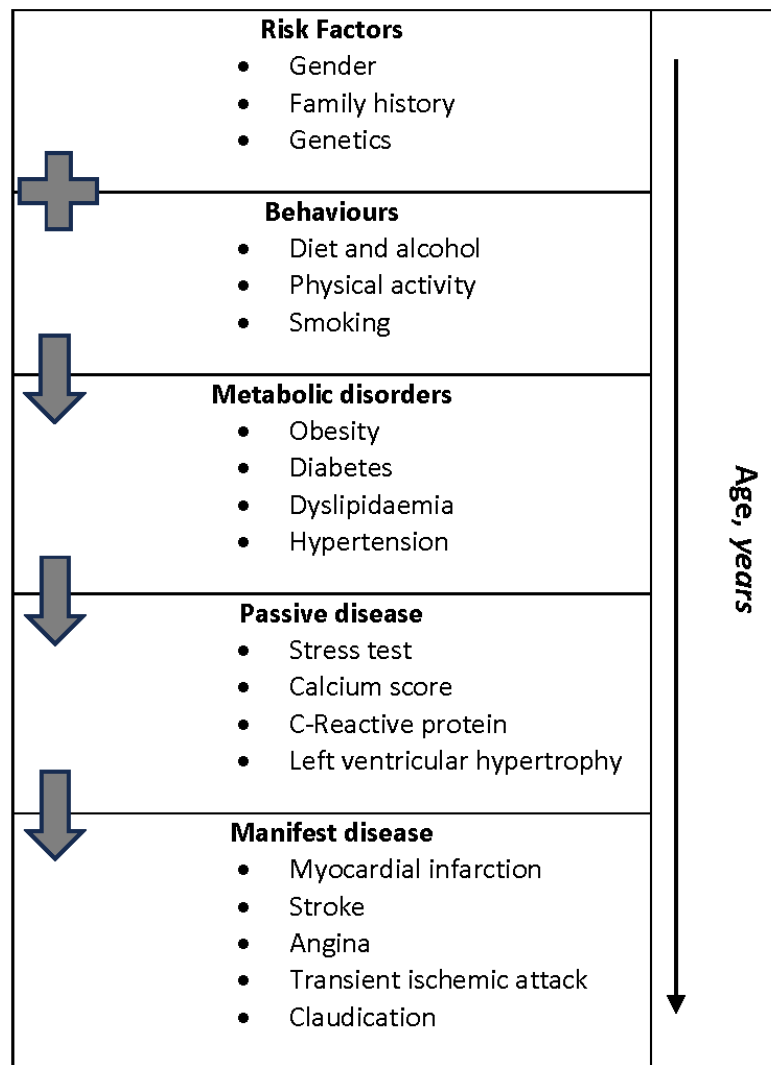


Figure 1.2. Atherogenesis.

1.3.3.1 Stable and variant angina.

Stable angina (exertional) is episodic pain in the chest precipitated by ischaemia to the myocardium, secondary to structural stenosis in one or more coronary arteries (Aaronson, 2020). This pain occurs during times of exertion. Variant angina is less common, occurs at rest and is caused by a transient occlusion due to spasming of one or more of the epicardial coronary arteries (Aaronson, 2020).

1.3.3.2 Unstable angina, non-ST-segment elevation and ST-segment elevation.

Acute coronary syndromes include unstable angina (non-ST-segment elevation) and ST-segment elevation MI, life-threatening conditions where there is an acute disruption to the flow of

blood in the coronary vessels (Aaronson, 2020). The most common reason for this is ruptured atherosclerotic plaque, leading to a thrombus within the coronary vessel, reducing or stopping blood flow (Aaronson, 2020). This disruption in blood flow to the myocardium and subsequent ischaemia can lead to permanent heart muscle damage (Aaronson, 2020).

The spectrum of acute coronary syndromes ranges from the ST-segment MI, from an abrupt occlusion with acute ischaemia leading to infarction to non-ST-segment MI, a non-occlusive thrombosis (Fox, 2000). ST-segment is evidenced on presentation by ST elevation, new bundle branch block, ECG changes of posterior MI and evolution of Q waves (Fox, 2000). Non-ST-segment presents with transient ST elevation, ST depression, T wave inversion, minor non-specific ECG changes and normal ECG (Fox, 2000).

1.3.4 Cerebrovascular disease.

Normal intracranial arteries are significantly altered with cerebrovascular atherosclerotic and hypertensive disease; this pattern of atherogenesis and hypertension increases the risk of stroke (Kim, Caplan & Wong, 2008). Stroke presents as either ischaemic, due to narrow or blocked arteries, or haemorrhagic, from bleeding blood vessels (Hennerici, 2012).

1.3.5 Peripheral artery disease.

The aorta or arteries of the limbs present with occlusion or stenosis, precipitated by atherosclerosis in peripheral artery disease (PAD) (Libby, 2009). While PAD poses a risk of death, MI and stroke, there are also functional limb implications, such as walking impairment, intermittent leg pain and limb pain at rest (Libby, 2009). In critical ischaemia, there is a risk of limb loss (Libby, 2009).

1.3.6 Heart failure.

Heart failure is categorised as a chronic and/or acute condition and is both multifarious and progressive (Aaronson, 2020). It is a multisystem condition causing circulatory changes affecting the myocardium structurally and functionally, reducing cardiac output and thus failing to

meet the body's physiologic demands (Hare, Felker & Mann, 2019). There is a plethora of precipitants to heart failure, some of which are ischaemic heart disease, hypertension and MI (Hare et al., 2019).

1.4 Burden of Cardiovascular Disease

1.4.1 Incidence and prevalence.

Cardiovascular disease is an unabating global epidemic, leading the way in disease burden. The lifetime risk factor for cardiovascular disease is > 30% in individuals with optimal risk factors in middle age. Both men and women with established modifiable risk factors for cardiovascular disease have similar overall lifetime risk factors for cardiovascular disease, 67.1% and 66.4% (Leening et al., 2014; Stenling, Häggström, Norberg & Norström, 2020; Wilkins et al., 2012). In the last 30 years, cardiovascular disease has increased globally by 50%, from 271 million in 1990 to 523 million in 2019 (Roth et al., 2020).

It is worth establishing cardiovascular disease prevalence as it relates to specific countries. Around 7 million people are living with cardiovascular disease in the United Kingdom (UK): 3.5 million men and 3.5 million women (British Heart Foundation, 2018). Although the burden of cardiovascular disease in Great Britain has declined over the last 20 years with constancy in prevalent cases, largely due to declining mortality, these positive outcomes do not reflect the increasing incidence of hospital admissions (Bhatnagar, Wickramasinghe, Wilkins & Townsend, 2016); thus, revealing more accurately cardiovascular prevalence and the negative impact living with cardiovascular disease has on both quality of life and the health economies (Bhatnagar et al., 2016). Further contributing to this conundrum of declining mortality, constancy in prevalence and increasing hospital admissions, is an ageing and growing population, improved survival rates from cardiovascular events, and the role this has in increasing the number of those living with cardiovascular disease (Bhatnagar et al., 2016; British Heart Foundation, 2018).

In the United States (US), 121.5 million people have cardiovascular disease, with numbers estimated to increase to 130 million by 2035 (Benjamin et al., 2019; Virani et al., 2020).

Cardiovascular disease prevalence is dominated by modifiable risk factors, with 39.6% of Americans considered obese, 46% with undiagnosed or treated hypertension and one in six smoking (Benjamin et al., 2019).

The European Society of Cardiology reported 11 million new cases of cardiovascular disease in the 47 European Society of Cardiology countries during 1990–2015, contributing to the current 83.5 million figure (Timmis et al., 2018). The predominant subsets of cardiovascular disease are peripheral vascular disease (35.7 million) and ischaemic heart disease (29.4 million; Timmis et al., 2018).

Approximately 1.2 million Australians have cardiovascular disease, with 4.8% having one or more heart or vascular diseases, including stroke, during 2017–2018 (Australian Bureau of Statistics, 2019a; Australian Institute of Health and Welfare, 2020). This number has remained relatively unchanged over the last 10 years, with 5.3% of the population living with heart and vascular disease during 2007–2008 (Australian Bureau of Statistics, 2018). Age increases the prevalence of cardiovascular disease; those aged < 55 years make up 5% of cases, increasing to 25.8% for those aged > 75 years (Australian Bureau of Statistics, 2019a). This current landscape highlights the need to target and inspire significant lifestyle changes in those at risk of and/or experiencing cardiovascular disease to reduce the incidence, prevalence and associated costs relating to morbidity and mortality.

1.4.2 Hospitalisation.

Cardiovascular disease was the most common cause of hospitalisation globally, with 23.9% of all hospital admissions attributable to cardiovascular disease (Dagenais et al., 2020). Of this percentage globally, low-income countries had a 22% admission rate, with middle-income countries at 27% and high-income countries at 17% (Dagenais et al., 2020). In Australia in 2019,

there were 1.2 million hospitalisations for cardiovascular disease, representing 11% of all hospitalisations (Australian Institute of Health and Welfare, 2020). In seven years (2001–2018), there was a 34% increase in the prevalence of cardiovascular disease hospitalisation, rising from 391,400 to 523,800 (Australian Institute of Health and Welfare, 2020). This increase was 30% higher again in regional, rural and remote Australia (Australian Institute of Health and Welfare, 2020). Indigenous populations have a hospitalisation rate that is 1.6 times higher than non-Indigenous populations when adjustments for age differences among the total population are taken into account (Australian Institute of Health and Welfare, 2020).

1.4.3 Mortality.

Cardiovascular diseases are the number one cause of death globally (Roth et al., 2020; World Health Organization, 2021). Since 1990, there has been an increase in cardiovascular disease mortality, rising from 12.1 million to 18.6 million in 2019 (Roth et al., 2020). Four out of five cardiovascular disease deaths are due to heart attacks and strokes, and one-third of these deaths occur prematurely in people under 70 years of age (World Health Organization, 2021).

It is the leading cause of death in Australia, with 21.5% of all deaths in 2019 attributed to cardiovascular disease (Australian Bureau of Statistics, 2019a). Total cardiovascular disease mortality in 2019 was 36,368, with the subset of this shown in Figure 1.3.

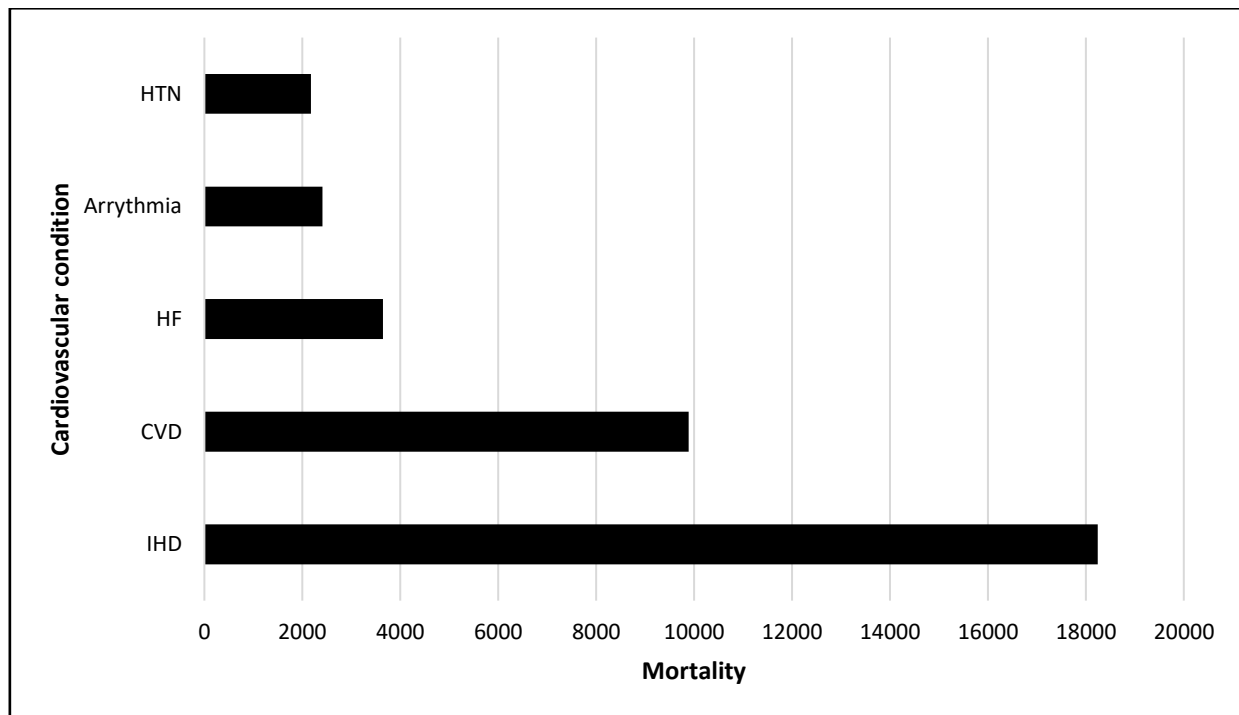


Figure 1.3. Cardiovascular disease mortality. Note. HTN = hypertension, HF = heart failure, CVD = cardiovascular disease, IHD = ischaemic heart disease.

Unsurprisingly, cardiovascular disease is also the leading cause of death in regional, rural and remote Australia (Australian Institute of Health and Welfare, 2019). However, age-standardised death rates are 1.5 times higher in very remote areas and 1.3 times higher for all of rural Australia compared to major cities (Australian Institute of Health and Welfare, 2019).

1.4.4 Economic burden.

The impact of cardiovascular disease on global economies is burdensome and increasing to astonishing levels (Benjamin et al., 2019). This upward spending trajectory is largely influenced by a reduction in mortality and an increase in cardiovascular disease survival. Figure 1.4 highlights the global forecast for cardiovascular disease spending by 2030, seeing costs spill over into the trillions (Benjamin et al., 2019).

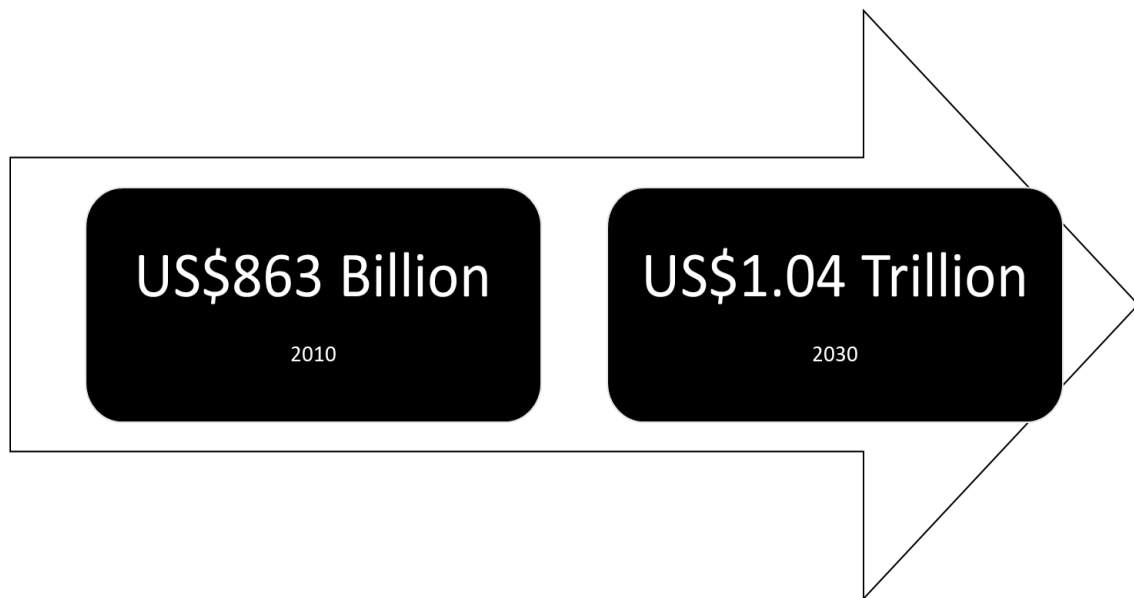


Figure 1.4. Global cardiovascular disease spending.

In Australia, 8.9% of the total disease expenditure from the Australian healthcare system is spent on cardiovascular disease, amounting to \$10.4 billion during 2015–2016 (Australian Institute of Health and Welfare, 2020). Figure 1.5 outlines the predicted increasing healthcare costs related to cardiovascular disease in Australia (Australian Institute of Health and Welfare, 2020). Improving how prevention and secondary prevention strategies impact health economies is key to future-proofing healthcare delivery.

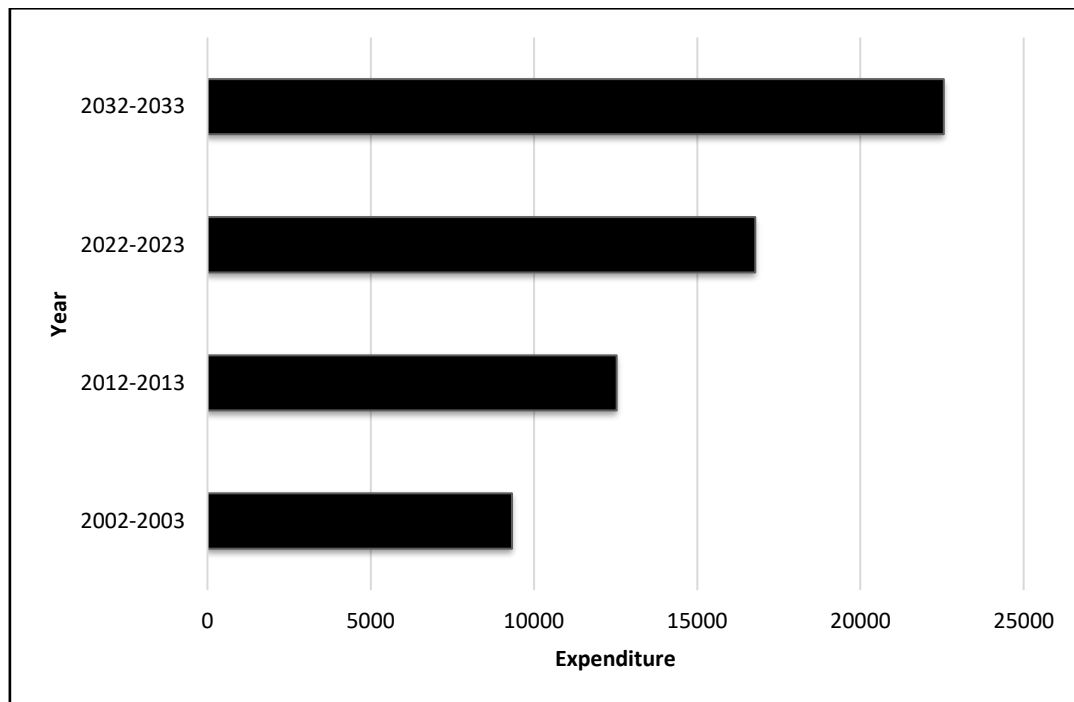


Figure 1.5. Predicted Australian economic cost of cardiovascular disease.

1.5 Cardiovascular Disease Management

Cardiac rehabilitation is offered as an outpatient program delivering education and secondary prevention interventions to people who have experienced acute coronary syndrome, including unstable angina, non-ST-segment elevation and ST-segment elevation MI, stable angina, coronary artery bypass surgery, percutaneous coronary interventions and heart failure (Abreu et al., 2020; National Heart Foundation of Australia, 2004). Other referral criteria are valve devices, replacement and repair, permanent pacemaker and implantable defibrillator insertion, heart transplant and arrhythmia patients (Abreu et al., 2020; National Heart Foundation of Australia, 2004). Traditionally, this service is delivered face-to-face or via a telephone, providing prescriptive secondary cardiovascular prevention support, including education around risk factor management and reduction, structured exercise and psychosocial interventions (Abreu et al., 2020; Grace et al., 2013). Cardiovascular disease secondary prevention is a holistic approach to reducing the likelihood of a recurrent cardiovascular event in patients with atherosclerotic cardiovascular disease, encouraging pharmacological adherence and behaviour change interventions.

These programs ensure the best physical, psychological and social outcomes for people, slowing the progression of cardiovascular disease and restoring quality of life (Abreu et al., 2020; Grace et al., 2013).

1.6 Cardiac Rehabilitation

1.6.1 History of cardiac rehabilitation.

1.6.1.1 Where it all began (1772–1953).

It is well established that physical activity is vital to preventative disease management and has long been incorporated into secondary prevention programs for cardiovascular disease. The first indication of this and the inception of *cardiac rehabilitation* as a concept was in 1772 when physician William Heberden outlined a program he developed for a patient who may have been experiencing unstable angina or had an MI (Heberden, 1772). This exercise program comprised 30 minutes of daily sawing for six months, with an improvement in anginal symptoms (Heberden, 1772).

English physician Caleb Hillier Parry also documented the benefits of physical activity in those patients with chest pain in 1799 (Lamer, 2005). Almost 100 years later, in 1854, Irish doctor William Stokes revisited this ‘pedestrian exercise’ phenomenon, finding a reduction in symptomatic cardiovascular disease when applied (Stokes, 1854). Despite these discoveries and their dissemination, current practices of prescribed sedentism persisted. In 1912, Herrick was able to apply definitions to the clinical symptoms of an acute MI, further informing the need for physical activity in post-event management (Mallory, 1939). However, past and current ideas around the importance of classifying and diagnosing cardiovascular disease persisted, with physical activity interventions misunderstood and feared; therefore, current practices persisted (DeTurk, 2018).

Since Heberden’s first account of exercise effectiveness on cardiovascular disease clinical outcomes and Herrick’s clinical accounts of MI and the positive impact of exercise on post-event

recovery, 140 years passed. During this period and for the following 40 years, the conservative treatment post-MI—six to eight weeks of bed rest—continued (DeTurk, 2018). Patients rarely returned to work (< 20%), had increased disability, endured a developing societal stigma and were seen as non-productive members of society (DeTurk, 2018).

Good news finally emerged from the 13th Scientific Session of the American Heart Association in 1953, where current research supporting physical activity as efficacious post-MI was presented and strongly recommended for inclusion in clinical management (DeTurk, 2018). After more than 180 years, the message could no longer be feared or ignored, preparing the way for the sweeping changes in the 1960s to manage cardiovascular disease (DeTurk, 2018).

1.6.1.2 What next? (1960–2013).

A lot has happened since 1960, as summarised in Table 1.2. Significant research paved the way for change, bringing an end to the debilitating practice of prescribed inactivity and bed rest, resulting in reduced functional capacity after just three weeks (DeTurk, 2018). Evidence from (Saltin et al., 1968) showed that patients who engaged in a twice-daily moderate-to-vigorous exercise program could achieve their pre-bed rest aerobic condition and improved their control condition at three months.

From 1960 onwards, the care of patients with cardiovascular disease advanced rapidly; people were better educated about the warning signs of a heart attack, pre-hospital care was improving with the availability of trained emergency health care personnel, widespread public training in basic life support and advanced life support emergency management of patients on presentation to hospital (DeTurk, 2018). Furthermore, diagnostic, medical, surgical and pharmacological interventions advanced, too, allowing for timely diagnosis and treatment (Dalen, Alpert, Goldberg & Weinstein, 2014). More people were surviving their cardiac events, with US cardiovascular disease mortality rates in 1965 at 466 per 100,000, reducing to 354 in 1980, a 26%

reduction. By 2008, there had been a staggering 64% reduction in cardiovascular disease mortality rates at 123 per 100,000 (Dalen et al., 2014).

Contemporary CR began emerging in the 1970s as outpatient, structured, physician-supervised exercise programs. Throughout the 1970s, CR programs comprised primarily of exercise training, seeking to avoid past practices and adopting much of the aforementioned research, reversing the current state of physical decline in patients from extended bed rest (Buckley, 2021). More inclusive programs for patients and content were established in the 1980s, providing the basis for current CR programs (Buckley, 2021). Significantly, CR programs were no longer exclusive but rather inclusive of gender, age and ethnicity, encompassing varied cardiovascular conditions.

Table 1.2

Timeline of Cardiac Rehabilitation

Dates	CR development phase
1970s–1980s	Randomised controlled trials show a reduction in morbidity and mortality outcomes based on exercise-based rehabilitation following myocardial infarction and coronary bypass surgery. Evidence to support the inclusion of educational and psycho-social components to programs.
Early-to-mid-1990s	Meta-analyses confirming significant mortality reductions. World Health Organization established a cardiac rehabilitation definition, focusing on patients' self-management and establishing quality of life. Rapid increase of guidelines and standards for cardiac rehabilitation in Australia, Canada, Europe, the UK and the US.
Late 1990s	An increasing body of evidence on how exercise independently influences myocardial and coronary health. Beginning of public health, emergency care and medical/pharmaceutical strategies in secondary prevention of heart disease established in Australia, Canada, Europe, the UK and the US.
2000–2010	Cardiac rehabilitation grows internationally, with many countries adopting and creating a hybrid of guidelines based on standards from Australia, Canada, Europe, the UK and the US. Preventative cardiology is advocated for in Europe and internationally.
2011–2013	The International Council of Cardiovascular Prevention and Rehabilitation was created within the World Heart Federation as an advocate and adviser to developing countries. Mortality is no longer accepted as an acceptable outcome, in part due to advances in medical management, with a new perspective accepted on chronic disease management and healthcare cost savings through reduced re-hospitalisation. Inclusive programs are representative of similar lifestyle risk factor management goals. Advances in telehealth and remote monitoring. COVID-19 stimulates the need to markedly expand the provision of remote/virtually supported home-based programs, supported by a large body of evidence favouring rehabilitation at home

Note. Adapted from Buckley, 2021.

1.6.1.3 What now? (2013–).

Evidence-based practice is based on guidelines that evaluate and summarise established clinical outcomes. Accordingly, these guidelines inform health professionals to propose and implement strategies and interventions for individual patients. Cardiac rehabilitation standardisation is the future and is possible at national policy level through to the individual program level, influencing health professionals' decision-making and daily practice through establishing such guidelines. Work around this began in 2013 with the World Health Organization's (2013) *Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013-2020*.

World Health Organization

Non-communicable diseases (NCDs), specifically cardiovascular diseases, as previously discussed in this chapter, are the world's biggest killers (World Health Organization, 2013). These NCDs are largely preventable, giving rise to hope that health systems can respond by providing effective and equitable healthcare interventions and influencing public health policy. Areas sympathetic to these influences are decreasing tobacco use, improving dietary choices, increasing physical activity and reducing harmful alcohol use (World Health Organization, 2013).

The World Health Assembly endorsed the World Health Organization's *Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013-2020* in May 2013, providing the mechanisms for it to become a reality. Thus, governments were urged to set national NCD goals for 2025, specific to nations, through multi-sectoral national NCD plans to decrease exposure to risk factors and enable health systems to respond, reach national targets and measure results.

European Society of Cardiology

The European Society of Cardiology was founded in 1950 by 14 National Cardiac Societies (now with 57 member countries; European Society of Cardiology, 2022). The first European Society of Cardiology 'Cardiovascular Disease Prevention Guidelines' were published in the *European*

Heart Journal in 1994 (European Society of Cardiology, 2022). The European Society of Cardiology continues to provide evidence-based recommendations developed by task forces of leading experts, using research to inform guidelines and education.

Critically for CR, the European Society of Cardiology has developed standardised quality indicators to inform accreditation standards for CR programs (Abreu et al., 2020). Table 1.3 reflects the current quality indicators for CR accreditation.

Table 1.3

European Society of Cardiology Quality Indicators for Accreditation

Quality indicators
% Patients eligible to CR referred after discharge to CR program (> 80%)
% Eligible patients to CR, enrolled after discharge (> 50%)
Median waiting time from referral to start of CR (within 14–28 days)
% CR uptake (minimal 24 sessions with an aim of 36 sessions)
% CR adherence (> 75% completes the program) % Drop-out (80%)
% Patients with a recorded assessment after starting CR (> 80%)
% Pharmacological adherence improvement (> 80%)
% Weight reduction in obese and overweight (> 5%)
% Functional capacity improvement (> 5%)
% Muscle strength improvement (> 5%) % Quality of life score improvement (> 10%)
% Anxiety/depression score improvement (> 10%)
% Smoking cessation (> 50%)
% BP control in hypertension (> 50%)
% Lipids control in dyslipidaemia (> 50%)
% Glycaemic control in diabetes (> 50%)

Note. Adapted from Abreu et al., 2020.

National Heart Foundation (Australia)

Cardiac rehabilitation in Australia has developed organically, with models often replicated from other sites, limited in terms of standardisation and confined to health organisational levels (Cartledge, Thomas, Hollier & Maddison, 2019). Another issue around past and current practice is the heterogeneity among programs (Cartledge et al., 2019). Considering the World Health Organization's *Global Action Plan*, Australia has contributed to progressing these directives by

establishing a framework for CR program standardisation. Table 1.4 outlines the timeline for these actions.

Table 1.4

Timeline of Australian Standardisation of Cardiac Rehabilitation

Dates	Development phase
2004	The National Heart Foundation and Australian Cardiac Rehabilitation Association developed the document <i>Framework for Cardiac Rehabilitation</i> . ^a
2012	The Heart Foundation developed an expert guide to clinical practice for secondary prevention of coronary heart disease, <i>Reducing Risk in Heart Disease</i> . ^b
2014	The <i>Framework for Cardiac Rehabilitation</i> and <i>Reducing Risk in Heart Disease</i> were expanded upon by the Australian Cardiac Rehabilitation Association to include a set of core components, including five elements of CVD secondary prevention and CR.
2019	The <i>National Cardiac Rehabilitation Quality Indicators</i> ^c were published, replacing the 2004 <i>Framework for Cardiac Rehabilitation</i> . Standardised program content for Phase II CR programs in Australia: <i>A Pathway to Cardiac Recovery: Standardised Program Content for Phase II Cardiac Rehabilitation</i> , ^d was developed and released.

Note. ^a ^b (Cartledge et al., 2019). ^c (National Heart Foundation of Australia, 2019a). ^d (National Heart Foundation of Australia, 2019b).

1.6.2 Delivery of cardiac rehabilitation.

1.6.2.1 Face-to-face programs.

These programs are conducted individually (1:1) or in group settings, provided by experienced CR nurses and allied health professionals (e.g., dietician, pharmacist and exercise physiologist or physiotherapist). Participants have a physical assessment that can include weight, blood pressure, wounds and blood results. Ensuing sessions deliver education tailored to cardiovascular disease diagnosis and referral criteria. This education focuses on cardiovascular disease risk factors, including medications, heart disease information, exercise and activity, healthy eating, resuming daily living activities and health behaviour change strategies.

1.6.2.2 Telephone programs.

Telephone CR programs are coaching services experienced CR nurses and allied health professionals provide via scheduled telephone calls. The first phone call introduces the program, discusses the participant's individual needs and schedules future telephone sessions.

1.6.2.3 Remote and digital programs.

Digital CR web applications delivered remotely are interactive, populated with standardised CR program content and clinically managed and monitored. Cardiac rehabilitation web applications are defined as clinically managed, adhering to clinical guidelines for standardised CR programs accessed through computers (e.g., desktop or laptop), smartphones, tablets, virtual world (VW) and remote exercise monitoring. An interactive program requires a patient to log into a password-protected portal, is tailored to the patient and requires them to complete tasks to progress through the program. Other features that can reflect interactivity are patients' ability to communicate with their clinician, with clinicians having administrative access to respond and monitor overall progress. A web application is software that is accessible using any web browser or server, uniformly responsive to being viewed on a computer, smartphone, tablet, VW or remote exercise monitoring. From henceforth, all forms of digital programs will be referred to as web based.

1.7 Attendance and Completion Rates of Cardiac Rehabilitation

Attendance at CR is defined as presenting to ≥ 1 CR program session and completion is defined as having achieved at least 75% of the total number of sessions required (Abreu et al., 2020). Globally, programs vary in duration, number of sessions offered and frequency of sessions. Furthermore, CR remains poorly attended, with referral and non-attendance rates being suboptimal; worldwide, the range of CR attendance rates is 20–50% (Astley et al., 2020; Dalal, Doherty & Taylor, 2015).

1.7.1 Barriers to attendance and completion rates of cardiac rehabilitation.

Non-attendance at CR is complex and multifaceted, as summarised in Table 1.5. First, some physicians recommend not attending a program (Neubeck et al., 2012). Contradictory advice provided by healthcare professionals during hospitalisation may create confusion and uncertainty in patients after a cardiac event. Second, physical and emotional distress after a cardiac event may

prevent patients from attending the CR program following discharge (Neubeck et al., 2012). Third, people believe CR to be a purely exercise-based program (Neubeck et al., 2012). These personal beliefs are fuelled by a lack of understanding about coronary heart disease, leading to embarrassment around attendance and misconceptions of the cohort of CR attendees being only frail older people (Neubeck et al., 2012).

CR attendance issues are further exacerbated for rural and remote patients who experience the tyranny of distance and report concerns relating to work responsibilities and transportation (Hamilton, Mills, McRae & Thompson, 2018). Some CR programs require full-day attendance, which may affect the participant's ability to work, causing a financial burden (Neubeck et al., 2012). Following on from (Neubeck et al., 2012) systematic review and meta-analysis a more recent scoping review echoes these sentiments, with barriers of greater age, being female and perceptions of health care needs and CR itself being reported (Sugiharto, Nuraeni, Trisyani, Putri & Armansyah, 2023). These disablers to successful CR program attendance and completion are further reported by (Chong, Sit, Choi, Suhaimi, Chair, 2023; Fraser, Leslie, Gorely, Foster & Walters, 2022), stating age, health status, waiting time to start their program, work commitments, travel distance and time, comorbidities, and lack of social support all contributors.

Around 7 million people, 28% of the Australian population, live in rural and remote areas, including various locations and populations (Australian Bureau of Statistics, 2019b). People living in rural and remote areas have higher rates of hospitalisation, death and injury and poorer access to and use of primary healthcare services compared to those living in major cities (Australian Bureau of Statistics, 2019b). A mixed-methods in-depth study of CR services in Australia found that only 50% of rural and 33% of remote programs had face-to-face multidisciplinary support, and only 27% of CR programs provided education (Hamilton et al., 2018). From their findings, Hamilton et al. (2018) highlight the need for greater flexibility in CR programs to address these inequities and barriers for those living in rural and remote areas.

Table 1.5

Barriers to Cardiac Rehabilitation

Barriers to CR
Poor referral rates
✓ Women
✓ Ethnic minority
✓ Elderly
✓ Rural populations
✓ Low socioeconomic populations
Poor adherence to CR programs (low enrolment/ ↑ attrition)
Lack of endorsement by cardiologist/doctor (GP)
Obesity
Multimorbidity (↓ functional capacity)
Poor exercise habits
Smoking
Depression
Transport issues
Lack of social support
Lack of leave from work to attend centre-based programs

1.8 Co-Design of Web Application Cardiac Rehabilitation Programs

Person-centred care is respectful of and responsive to what patients and consumers want and consider important to their health and wellbeing (Australian Commission on Safety and Quality in Health Care, 2020). This process improves their healthcare experience, increasing patient satisfaction and reducing governmental spending (Australian Commission on Safety and Quality in Health Care, 2020). Design relies on three components to create a successful product: how things work, what is required to control them and how people interact with them (Norman, 2013). Accordingly, McKercher (2020) describes the co-design process as an approach to developing a product for individuals, groups or communities as *with* them, not *for* them. In doing so, their lived experience contributes to the product they will use.

Elevating person-centred program development and care through the co-design process contributes to understanding the relationship between engagement with digital innovation and the behaviour change required to be effective. The literature supports both co-design in the development phase of digital programs and continued engagement to assess acceptability and usability (Brewer et al., 2017; Devi, Powell & Singh, 2014; Norman, 2013; O'Shea et al., 2020; Rawstorn, Gant, Meads, Warren & Maddison, 2016; Walsh et al., 2019; Yardley et al., 2016). Design components and effectiveness of these programs should be measured before, during and after their development through collaboration with end users and stakeholders.

1.9 Interactive Web Application Cardiac Rehabilitation Programs

A web application or 'web app' is a software program that runs on a web server. Unlike traditional desktop applications launched by an operating system, web apps must be accessed through a web browser (Christensson, 2017, 17 February).

Web application CR program design varies, including programs delivered through a smartphone app (Varnfield, Karunanithi, Lee et al., 2014), websites (Brough, Boyce, Houchen-Wolloff, Sewell & Singh, 2014; Devi et al., 2014; Duan et al., 2018; Houchen-Wolloff et al., 2018), phone text messaging (Dale et al., 2015), remote exercise monitoring (Maddison et al., 2019) and VW (Brewer et al., 2017). Regardless of the individual differences among the programs reported, they all positively impact CR attendance.

However, interactive web application delivery of CR programs is limited to date. Many web applications are not clinician-monitored and serve as repositories of educational information or mechanisms for remote activity monitoring (Dale et al., 2015; Rawstorn, Gant, Direito, Beckmann & Maddison, 2016). The other component missing in this space is clinical integration with minimal cost to the patient (Varnfield, Karunanithi, Lee et al., 2014).

1.10 Implementation Research

Implementation science is comparatively new and advancing quickly as an appropriate approach to addressing gaps in current evidence-based interventions (Peters, Tran & Adam, 2013). Implementation research strives to understand and work within existing conditions instead of controlling these conditions and the influence of causation on outcomes (Peters et al., 2013). It requires identifying a problem or deficiency and reviewing the current evidence base to ensure a targeted and prescriptive response is applied (Peters et al., 2013). Users—employees, policymakers, consumers and others—who need to use the intervention in question are integral to implementation research and intimately involved in the intervention development continuum (Peters et al., 2013). Doing so informs researchers about their behaviours, thus contextualising what influences an intervention’s adoption, effectiveness and sustainability.

1.10.1 Definition of terms.

Implementation project assessment is multidimensional, reporting on how well an intervention was delivered, what happened during the implantation process, who was involved, and how they behaved (Hwang, Birken, Melvin, Rohweder & Smith, 2020). Table 1.6 provides definitions for the term implementation science and research.

Table 1.6

Implementation Definitions

Term	Definition
Implementation science	The term 'implementation science' refers to the field of study 'implementation research' in reference to the act of studying implementation(Hwang et al., 2020). 'The study of methods to promote the adoption and integration of evidence-based practices, policies, research findings and evidence into healthcare policy and practice'(Bauer, Damschroder, Hagedorn, Smith & Kilbourne, 2015). 'The scientific study of methods to promote the systematic uptake of research findings and other evidence-based practice into routine practice and, hence, to improve the quality and effectiveness of health services' (Eccles & Mittman, 2006).
Implementation research	The term 'implementation research' refers to the act of studying implementation (Hwang et al., 2020). 'The scientific study of the use of strategies to adopt and integrate evidence-based health interventions into clinical and community settings to improve individual outcomes and benefit population health'(Health, 2019).

Implementation research investigates characteristics that impede or help implementation and aims to address them (Peters et al., 2013); it is best contextualised along a continuum. It can be outlined in four steps: (a) exploration, an examination of the needs of the population, health service, intervention and barriers or facilitators; (b) installation, preparation for the process by readying organisations, staff and populations; (c) initial implementation, arrange systems, iterate cycles of improvement, manage any changes; and (d) full implementation, assess/achieve fidelity and measure outcomes (Fixsen, Blase, Naoom & Wallace, 2018).

Clinical interventions take 17–20 years to reach practice, of which less than 50% are integrated; closing this gap is a complex, time-consuming and challenging task (Bauer et al., 2015). Furthermore, 80% of medical research funding fails to make a public health impact, is an enduring problem, and failure to address implementation challenges costs lives and money (Peters et al., 2013). A historical example of the lag in nexus between integrated research is age-old, with reports dating back as early as 1601, when it was discovered that citrus addressed the incidence of scurvy. However, change in practice was not realised till 1795, thus highlighting the engrained and

enduring nature of impotence of implementation research in the clinical setting (Bauer et al., 2015).

This study is primarily an implementation study that the intervention endures. Usually, within the research landscape, an intervention is trialled in practice for a period of time, such as three months, for testing. This study, however, launched the website for active and ongoing use, with researchers present at the implementation phase, then no longer present at the adoption phase.

1.11 The Country Heart Attack Prevention Project

The Country Heart Attack Prevention (CHAP) Project is a National Health and Medical Research Council-funded project that is developing, implementing, and evaluating a model of care and clinical pathway for translating CR and secondary prevention guidelines into practice for rural and remote patients in Australia (Beleigoli et al., 2022; Nesbitt et al., 2023). Four areas were identified as barriers to attending CR from the CHAP projects' preliminary research: limited clinician recommendation, reliable electronic auto referral systems, individualised choice of programs and sustainable lifelong commitment to CR supported by primary care. This project was conducted across rural and remote South Australia via the Integrated Cardiac Clinical Network. This service was conceived to support general practitioners and nurses in rural and remote areas. The Country Access to Cardiac Health (CATCH) program was developed in partnership with South Australian Health, providing a central referral process and a telephone CR program, and essential to the implementation of the web-based CR program, integrating it into their current service.

This study was a part of the CHAP study, with the main aim of increasing attendance to and completion of CR, and as a strategy, a co-designed, interactive clinician-led web-based CR program was developed to increase flexibility and provide choices to patients. This study has added a web-based choice for patients to complete their CR program, as indicated here in the CHAP model of care, under the expansion of CR delivery modes (Figure 1.6).

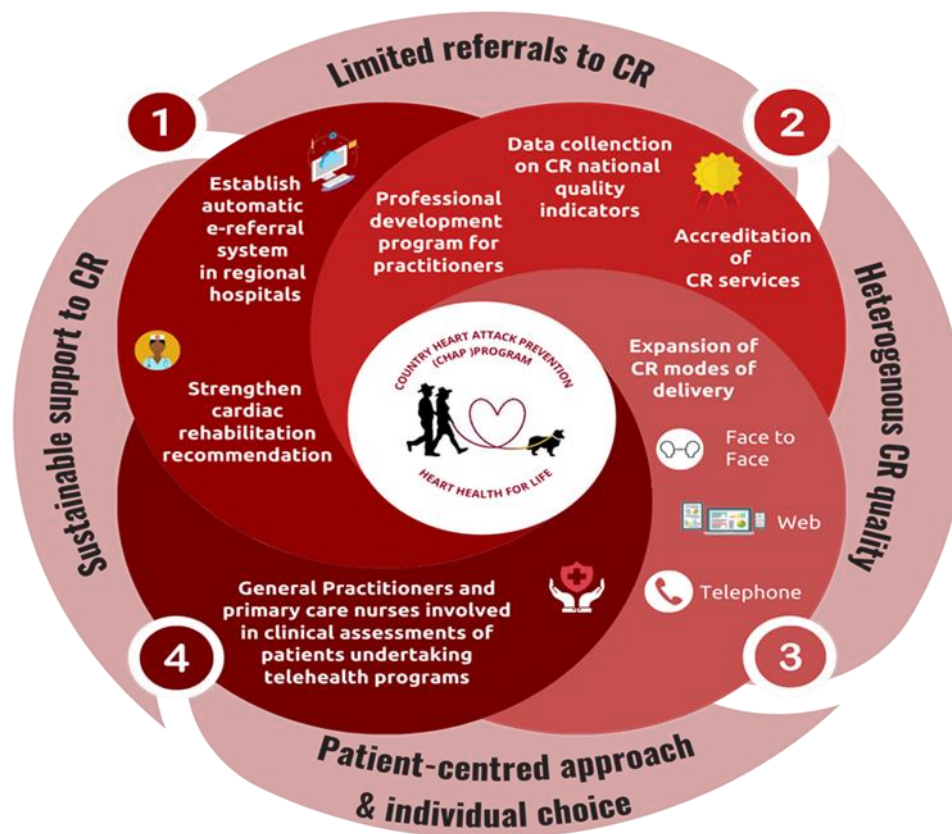


Figure 1.6. Country Heart Attack Prevention model of care.

Based on the evidence discussed in this Chapter and Chapter 2, time is of the essence in addressing the complex nature of secondary cardiovascular disease events. Cardiac rehabilitation is an established and clinically efficacious intervention for those with cardiovascular disease, and the web-based program to deliver CR contributed to new knowledge regarding program delivery through co-design development, implementation and evaluation.

1.12 Aims of this PhD Project

This project aimed to develop, implement and evaluate a web-based CR program to improve access for populations living in rural and remote areas through a web-based delivery model, thus increasing attendance at and completion of CR.

1.12.1 Objectives.

This project had three objectives, shown in Figure 1.7

1. To systematically examine evidence on design components and effectiveness of existing web-based CR programs
2. To co-design and implement a web-based CR program for patients with cardiovascular disease
3. To evaluate the effectiveness of implementing the web-based CR program, its reach, effectiveness, adoption, implementation and maintenance.

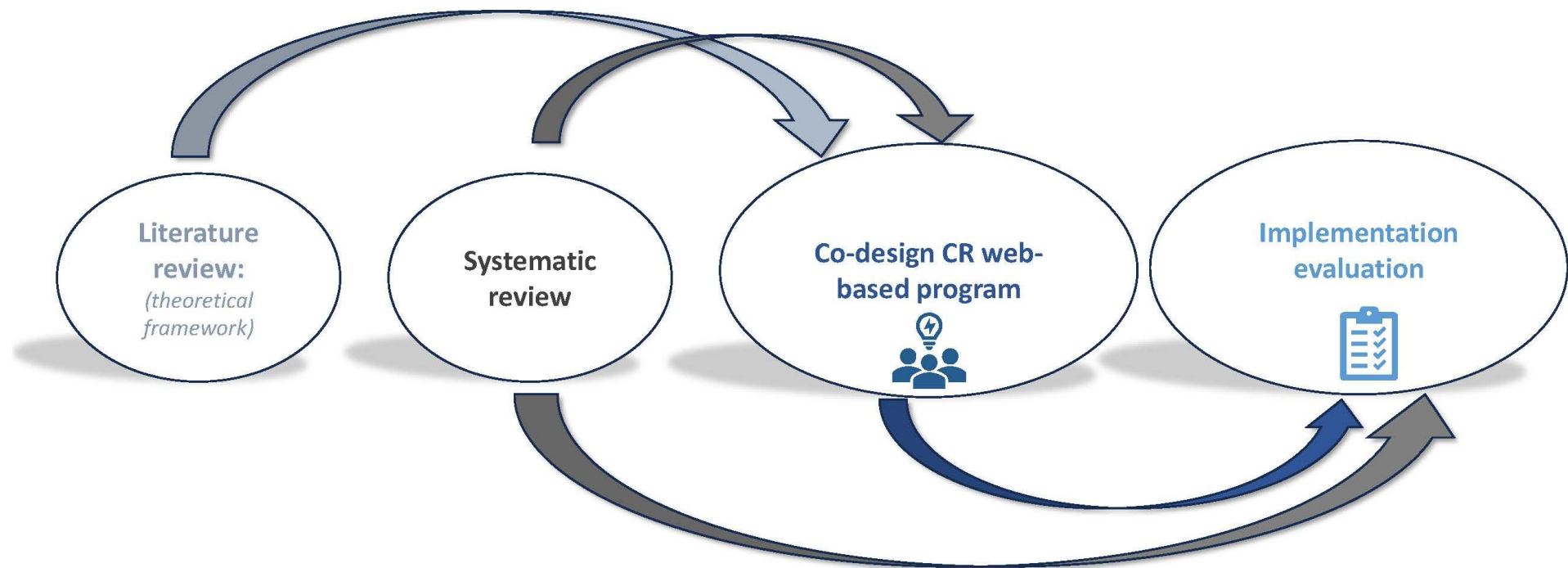


Figure 1.7. Study cycle.

Thesis flowchart	Publication
Chapter 1	
Background and significance of the study:	
Why is cardiac rehabilitation important?	
What is its purpose and impact?	
Chapter 2	Nesbitt, K., S. Champion, V. Pearson, L. Gebremichael, H. Dafy, J. Ramos, O. Suebkinorn, M.A. Pinero de Plaza, H. Du, J. A. Guyliani, R.A. Clark and A. Beleigoli, and on behalf of the NHMRC CHAP Partnership Project Team. The effectiveness of interactive cardiac rehabilitation web-applications versus usual care on program completion in patients with cardiovascular disease: a systematic review and meta-analysis. <i>Journal of Telemedicine and Telecare</i> .
Literature review:	
Does web-based CR positively impact on program attendance and completion?	
What is the best theoretical framework for the thesis?	
Systematic review:	
Does web-based CR impact positively on program completion?	
Chapter 3	
Methodology:	
What research design is best suited to co-design a website to deliver CR?	
What research design is best suited to evaluating the effectiveness of the implementation of a web-based CR?	
Chapter 4	Nesbitt, K., Beleigoli, A., Champion, S., Gebremichael, L. G., Bulamu, N., Tirimacco, R. & Clark, R. A. (2023). Development and evaluation of a co-designed website for delivering interactive self-directed cardiac rehabilitation. <i>European Journal of Cardiovascular Nursing</i> . doi:10.1093/eurjcn/zvad026
Results:	
How can consumers (patients and clinicians) co-design a web-based CR program?	
What do patients report about the web-based programs usability?	
What is the effectiveness of the implementation of the web-based CR program?	Nesbitt, K, S. Champion, L. Gebremichael, Foote, R.A. Clark, and A. Beleigoli and on behalf of the NHMRC CHAP Partnership Project Team. 'Evaluation of a clinically integrated interactive web-based CR program'. <i>Journal of Telemedicine and Telecare</i> .
Chapter 5	
Conclusions and implications:	
What are the findings and conclusions?	
What are the limitations of the study?	
What are the implications for policy, practices, and research?	

Chapter 2: Review of the Literature, Theoretical Framework and Systematic Review and Meta-Analysis

2.1 Chapter Overview

This chapter reviews the existence, integration and effectiveness of web-based CR programs, including websites, phone apps and remote monitoring, highlighting patients' attendance and completion of their CR program. This literature review also identifies the theoretical framework(s) for developing the web-based CR program, highlighting the appropriate approach for adoption in this study.

The literature review is followed by a systematic review that examines the effectiveness of interactive web-based CR programs on attendance and completion of programs. A systematic review thoroughly synthesises quality, available evidence regarding a specific research question (Aromataris & Pearson, 2014). Defining features of a systematic review include a clear objective and question(s), inclusion and exclusion criteria, a comprehensive search study appraisal, assessment and reporting, analysis of extracted data, presentation and synthesis of findings and explicit reporting of the methodology used to conduct the review (Aromataris & Pearson, 2014).

2.2 Literature Review Introduction

The rapid development of information technology is driving the evolution of healthcare services. Internet online interventions have shown encouraging results in improving patients' self-care and quality of life (Wonggom et al., 2020). The internet is an extremely powerful tool for accessing information and communication. However, the question is whether and how this technology can effectively provide CR to people living in rural and remote areas. The involvement of patients in the development of such an intervention is crucial. There is increasing research into this area, and a similar program exists overseas. This literature review of remote CR programs

using digital platforms was undertaken to determine the implications for CR attendance and the use of any co-design approaches adopted in their development; the review underpins the methodology used to develop, deliver and evaluate the web-based CR program.

2.3 Review Structure

This review will be reported by technology groups previously discussed in Chapter 1; specifically, this review identified two predominant groups: web applications and phone apps, with subgroups indicated by the studies and their primary and secondary outcomes. Finally, an outline of consumer engagement will be offered based on the presenting literature and its relationship to the outcomes from the literature reviewed in a discourse format. This review will establish the theoretical framework applied to the study based on the most effective and commonly used in the literature. This review is a chronological account of the most recent and relevant research.

Various combinations of the following terms were used to search for the literature in this chapter: 'cardiac rehabilitation', 'cell phones', 'mobile phones', 'app', 'application', 'mobile app', 'smartphone', 'virtual world', 'web', 'web-based', 'website' and 'internet'. The databases searched were *Medline*, *CINAHL* and *Google Scholar*.

Table 2.1 shows the 11 randomised controlled trials (RCTs), three co-design, one prospective observational trial, one sequential analysis and one mixed-methods study that were identified for inclusion in this review (Brewer et al., 2017; Brough et al., 2017; Dale et al., 2015; Devi et al., 2014; Duan et al., 2018; Houchen-Wolloff et al., 2018; Johnston et al., 2016; Kayser et al., 2017; Maddison et al., 2015; Maddison et al., 2019; O'Shea et al., 2020; Rawstorn et al., 2016; Rawstorn et al., 2018; Varnfield, Karunanithi, Lee et al., 2014; Walsh et al., 2019; Yudi et al., 2017).

2.4 Web Applications

The literature review identified six studies that assessed the effectiveness of a web-based or internet-enabled CR program delivery model (Brough et al., 2014; Claes et al., 2020; Kayser et al., 2017, Devi et al., 2014; Duan et al., 2018; Houchen-Wolloff et al., 2019).

2.4.1 Brough et al., 2014.

Activate Your Heart (AYH) is an interactive web-based program that offers comprehensive secondary prevention education complemented by a private messaging system connecting clients to a CR specialist (Brough et al., 2014). It is password protected, allowing patients to record and monitor their exercise and participate with interactive, secondary prevention advice (Brough et al., 2014). Brough et al. (2014) sought to evaluate *AYH* for CR patients using a prospective observational trial study design and recruited 41 participants, with 33 completing the program. The primary outcome of this study was measures of exercise, exercise capacity, dietary habits and psychosocial wellbeing (Brough et al., 2014).

2.4.1.1 Primary outcomes.

Brough et al. (2014) report significant improvements in incremental shuttle walk test (mean change 49.69 metres, $SD=68.8$, $p<.001$).

2.4.1.2 Secondary outcomes

There was an improvement in Quality of Life (mean change 0.28, SD 0.4, $P<.001$) and dietary habits with a proportion of patients consuming at least five serves of fruit and vegetables per day, (22,71%]to 29, 94% $P=.01$) and an increase of two serves of oily fish per week (14, 45% to 21, 68%, $P=.01$).

2.4.2 Devi et al., 2014.

As outlined by Brough et al. (2014), *AYH* is an intervention delivered via the internet; it is a secure password-protected site designed for patients to undertake their CR program from home (Devi et al., 2014). This intervention examined the effectiveness of a web-based CR program for

those with angina. It aimed to improve patients' cardiovascular disease risk profile within four stages to be completed within six weeks (Devi et al., 2014). The authors recruited 94 participants for their RCT with a primary outcome of a daily average step count change at the six-week follow-up review.

2.4.2.1 Primary outcome.

There was an increase in daily average step count at the six-week follow-up of + 497 steps in the intervention group compared to -861 in the control group (95% CI 263–2451, $p = .02$).

2.4.2.2 Secondary outcomes.

For the intervention group as compared to the control there were significant improvements in energy expenditure (Effect size (ES)=0.62, 95% CI 43.93-309.98, $P=.01$), daily sedentary activity (ES=0.59, 95% CI -55.01 to -7.01, $P=.01$) and daily moderate activity (ES=0.58, 95% CI 6.01-51.20, $P=.01$). They also reported improvements in weight (ES=0.52, 95% CI -1.78 to -0.15, $P=.02$), self-efficacy (ES=0.52, 95% CI 0.30-4.79, $P=.03$), emotional Quality of life score (ES=0.48, 95% CI 0.01-0.54, $P=.04$), and angina frequency (ES=0.77, 95% CI 8.57-35.05, $P=.002$) in the intervention group compared to the control group at the six-week follow-up. This study had an 89% completion rate at six weeks in both the intervention and control groups (Devi et al., 2014).

2.4.3 Duan et al., 2018.

During this pilot RCT, a web-based intervention for multiple behaviour changes in patients with coronary artery disease in home-based rehabilitation was evaluated. This intervention recruited and enrolled 114 participants who were randomised to either usual care or the intervention, whereby the intervention group were encouraged to access the web-based program via their home computer. They completed an online pre-test and post-test questionnaire. The primary outcome was the effect the web-based program had on physical activity and fruit and vegetable consumption (Duan et al., 2018).

2.4.3.1 Primary outcome.

The web-based intervention was more successful than usual care for physical activity and fruit and vegetable consumption. There were self-reported improvements in physical activity and fruit and vegetable consumption with 40% (18/44) of the intervention group adopting a healthy lifestyle at eight weeks compared to 10% (4/39) of the control group. (Duan et al., 2018).

2.4.3.2 Secondary outcome.

There was an overall non-completion rate of 27%, while the intervention group showed a 73% completion rate (Duan et al., 2018).

2.4.4 Houchen-Wolloff et al., 2018.

As previously described by Brough et al. (2014) and Devi et al. (2014), the web-based intervention AYH was further tested in an RCT as an alternative to those declining or dropping out of traditional CR (Houchen-Wolloff et al., 2018). The primary outcome of this study was the feasibility of recruiting and retaining people who had dropped out of or declined traditional CR.

2.4.4.1 Primary outcome.

Houchen-Wolloff et al., 2018 report that 82% completed all three assessment visits and 78% of the web group completed the programme. Patients who dropped out or were lost to follow-up from the web intervention group were (n=7) compared with four in the control group at 6 months. Retention rates by the eight week and six-month assessment were excellent with 54 patients attending the eight-week assessment (90%; 95% CI 79% to 96%) and 49 patients attended the six-month assessment (82%; 95% CI 70% to 90%). (Houchen-Wolloff et al., 2018).

2.4.4.2 Secondary outcomes.

Quality of life improved in the web group (0.5 ± 1.1 units vs 0.2 ± 0.7 units: control) (Houchen-Wolloff et al., 2018). Other results of note were patients' low use of phone calls and emails to staff and lack of use of the group forum (Houchen-Wolloff et al., 2018).

2.4.5 Kayser et al., 2019.

Kayser et al. (2019) evaluated the web-based tailored nursing intervention TAVIE en m@rche in their RCT, which aimed to increase walking after an acute coronary syndrome. The main feature of TAVIE en m@rche is prerecorded videos of a nurse who presents the tailored intervention content based on the patient's baseline assessed motivation, competence and current walking (Kayser et al., 2017). This study recruited and enrolled 39 participants and measured changes in daily steps between randomisation and 12 weeks as the primary outcome.

2.4.5.1 Primary outcome.

There were no significant outcomes in daily steps in either the intervention or control group from baseline to 12 weeks (Kayser et al., 2017) .

2.4.5.2 Secondary outcome.

There were no effects in either the intervention or control group for angina frequency, emergency department visits, hospitalisations and program attendance (Kayser et al., 2017). Engagement (i.e. $\geq 75\%$ use of active content) with the entire intervention was only (5, 17%) of the participants (Kayser et al., 2017).

2.4.6 Claes et al., 2020.

Claes et al.'s (2020) RCT assessed the feasibility, acceptability and clinical effectiveness of a technology-enabled CR platform, *Physical Activity Toward Health-I (PATHway-I)*, an internet-enabled and sensor-based home exercise platform. This platform constitutes the core component of a personalised, comprehensive lifestyle intervention program (Walsh et al., 2019). They recruited 120 participants, 60 in both intervention and control, with a primary outcome of total physical activity at moderate and moderate-to-vigorous intensity per day.

2.4.6.1 Primary outcome.

Moderate-to-vigorous intensity physical activity increased in the intervention group (127 SD 58 min to 141 SD 69min), compared to usual care (146 SD 66 min to 143 SD 71 min), $P=.04$. (Claes et al., 2020).

2.4.6.2 Secondary outcomes.

System use decreased over time and system usability was average with a score of 65.7 (SD 19.7; range 5-100).(Claes et al., 2020).

2.5 Phone Apps

From the literature reviewed, six studies were identified that assessed the effectiveness of a phone app-enabled CR program delivery model (Dale et al., 2015; Johnston et al., 2016; Maddison et al., 2015; Maddison et al., 2019; Varnfield, Karunanithi, Lee et al., 2014; Yudi et al., 2020).

2.5.1 Varnfield, Karunanithi, Lee et al., 2014.

This study investigated the effect of a smartphone-based home service delivery (Care Assessment Platform) of CR-on-CR use (Varnfield, Karunanithi, Lee et al., 2014; Walters et al., 2010). The researchers developed a care model that uses mobile phones, the internet and communication technologies to deliver CR rehabilitation services to patients in a six-week program (Walters et al., 2010). The primary outcomes measured were program uptake, adherence and completion.

2.5.1.1 Primary outcome.

Uptake was 1.3 times higher in the intervention group (48/60, 80%) than in the control (37/60, 62%) (RR 1.30; 95% CI 1.03 to 1.64; $p<0.05$). Adherence was 94% (45/48) in the intervention group and 68% (25/37) in the control group. Those randomized into the intervention group were 1.4 times more likely to adhere to the program (RR 1.4; 95% CI 1.13 to 1.70; $p<0.05$).

CR completion in the intervention group (48/60) was 33% higher than the control group (28/60) (RR 1.71; 95% CI 1.30 to 2.27; $p < 0.05$). (Varnfield, Karunanithi, Lee et al., 2014).

2.5.1.2 Secondary outcome.

No secondary outcomes were significant for either the intervention or the control group. (Varnfield, Karunanithi, Lee et al., 2014).

2.5.2 Dale et al., 2015.

The effectiveness of a text message and internet support for coronary heart disease self-management was measured by Dale et al. (2015) in this RCT. The mHealth intervention delivered core components of CR via text messages, short messaging service (SMS) and a supporting website over 24 weeks (Dale et al., 2015). The intervention was delivered primarily by SMS. The primary outcome was patient adherence to recommended health guidelines, smoking, fruit and vegetable intake, alcohol intake and physical activity (Dale et al., 2015).

2.5.2.1 Primary outcome.

A significant treatment effect in the intervention group was reported for adherence to recommended healthy lifestyle behaviours at three months (Adjusted odds ratio (AOR) 2.55, 95% CI 1.12-5.84; $P = .03$), but not at 6 months (AOR 1.93, 95% CI 0.83-4.53; $P = .13$). (Dale et al., 2015).

2.5.2.2 Secondary outcome.

The intervention group reported significantly greater medication adherence score (mean difference: 0.58, 95% CI 0.19-0.97; $P = .004$) (Dale et al., 2015).

The majority of intervention group reported reading all their text messages (52/61, 85%). The number of visits to the website per person ranged from zero to 100 (median 3) over the six-month intervention period. (Dale et al., 2015).

2.5.3 Maddison et al., 2015.

Maddison et al. (2015) sought to evaluate the effectiveness and cost-effectiveness of a mobile phone intervention to improve exercise capacity and physical activity behaviour in people

with ischaemic heart disease. The intervention was a personalised automated program of SMS text messages delivered over six months via mobile phone, supported with a personalised website to which participants can log on (Maddison et al., 2011). Participants received individualised commentary on their progress based on their goals, information on other types of exercise, links to other websites and CR secondary prevention educational information (Maddison et al., 2011). The primary outcome measured was exercise capacity via maximal oxygen uptake at 24 weeks (Maddison et al., 2011).

2.5.3.1 Primary outcome.

Significant treatment effects for the primary outcome were reported in the intervention group for leisure-time physical activity with a group difference of 426 MET (Metabolic equivalent) min/week (95% CI 16,836, P D0.04) and walking group difference of 500MET-min/week (95% CI 91,908, P D0.01) at 24weeks. (Maddison et al., 2015).

2.5.3.2 Secondary outcome.

Change in task self-efficacy significantly improved the treatment effect on physical activity(P =0.021) with a 13% group difference and 369MET-min/week (95%CI-37, 775, P =0.07). (Maddison et al., 2015).

2.5.4 Johnston et al., 2016.

This randomised study tested the effects of an interactive patient smartphone support app on drug adherence and lifestyle changes in MI patients (Johnston et al., 2016). This interactive patient support tool was installed on participants' smartphones, containing a drug adherence diary and secondary prevention educational modules (Johnston et al., 2016). The control group received a simplified version. The primary outcome was to test treatment adherence to ticagrelor.

2.5.4.1 Primary outcome.

The use of the interactive patient support tool improved patient drug adherence in the intervention group (16.6 v. 22.8, p = .025) (Johnston et al., 2016). .

2.5.4.2 Secondary outcome.

Uptake was 1.3 times higher in the intervention group (48/60, 80%) than in the control (37/60, 62%) (RR 1.30; 95% CI 1.03 to 1.64; $p < 0.05$). Adherence was 94% (45/48) in the intervention group and 68% (25/37) in the control group. Those randomized into the intervention group were 1.4 times more likely to adhere to the program (RR 1.4; 95% CI 1.13 to 1.70; $p < 0.05$). CR completion in the intervention group (48/60) was 33% higher than the control group (28/60) (RR 1.71; 95% CI 1.30 to 2.27; $p < 0.05$).

2.5.5 Maddison et al., 2019.

This randomised controlled non-inferiority trial (Maddison et al., 2019) compared the effects of remotely monitored exercise-based cardiac telerehabilitation (REMOTE-CR) with traditional programs in adults with coronary artery disease. The REMOTE-CR program is a commercially available Android-based smartphone mobile phone and wearable sensor, a custom smartphone with web-based apps and an application platform middleware (Rawstorn et al., 2016). This product allows CR clinicians to monitor the exercise in real time while also providing behaviour change and social support (Rawstorn et al., 2016). Between-group differences in VO_2 maximums at 12 weeks were measured for the primary outcome (Maddison et al., 2019).

2.5.5.1 Primary outcome.

VO_2 max. was comparable in both groups at 12 weeks, with REMOTE-CR being non-inferior to traditional CR.

2.5.5.2 Secondary outcome.

There were positive small between-group differences in waist and hip circumference in the control group, with a small difference in improved sedentary time for the intervention group (Maddison et al., 2019). All other outcomes did not differ between the groups.

2.5.6 Yudi et al., 2020.

Yudi et al. (2020) tested the effect of a smartphone-based coronary heart disease prevention (SBCHDP) program on awareness and knowledge of coronary heart disease, stress and cardiac-related lifestyle behaviours. Care4Heart is a smartphone app that is downloaded onto smartphones delivering a four-week CR mHealth program (Wang et al., 2015; Yudi et al., 2020). The primary outcome measured was awareness of coronary heart disease.

2.5.6.1 Primary outcome.

At 8-week follow-up, the intervention group had a clinically significant improvement in the 6-minute walk test, (117 ± 76 vs. 91 ± 110 m; $P = 0.02$). (Yudi et al., 2020).

2.5.6.2 Secondary outcome.

Patients in the intervention group were more likely to participate (87% vs. 51%, $P < 0.001$) and adhere (72% vs. 22%, $P < 0.001$) to a cardiac rehabilitation program. (Yudi et al., 2020).

2.6 Conclusions

Regarding the primary outcome of CR program completion for this PhD, five studies in this review, (Claes et al., 2020; Kayser et al., 2017, Devi et al., 2014; Duan et al., 2018; and Houchen-Wolloff et al., 2019), report on program completion, adherence and/or engagement using a web application. Three of these five report equal to or greater than completion, adherence and engagement when compared to usual care (Devi et al., 2014; Duan et al., 2018; and Houchen-Wolloff et al., 2019). Only two report considerable attrition or low engagement (Kayser et al., 2017 and Claes et al., 2020). Of the six studies using phone apps as a mode for delivering a CR program four report their positive effect on completion, adherence, and engagement (Dale et al., 2015; Johnston et al., 2016;; Varnfield, Karunanithi, Lee et al., 2014; Yudi et al., 2020).

Finally but importantly for this PhD study (Claes et al., 2020; and Houchen-Wolloff et al., 2019) assessed patient satisfaction with their web applications delivering cardiac rehabilitation program using the System Usability Scale (Brooke 1996). Based on these findings this tool is used

later in Chapters Three and Four to assess and report on our own web-based CR program patient satisfaction levels.

2.7 Consumer Engagement, Co-Design and Behaviour Change

Person-centred care is respectful of and responsive to what patients and consumers want and think is important to their health and wellbeing (Australian Commission on Safety and Quality in Health Care, 2020). This process improves their healthcare experience, increasing patient satisfaction and reducing governmental spending (Australian Commission on Safety and Quality in Health Care, 2020). Design relies on three components to create a successful product: how things work, what is required to control them and how people interact with them (Norman, 2013). Accordingly, McKercher (2020) describes the co-design process as an approach to developing a product for individuals, groups or communities as *with* them, not *for* them. In doing so, their lived experience contributes to the product they will use.

Brewer et al. (2017), Devi et al. (2014), Rawstorn et al. (2016), Walsh et al. (2019) and O'Shea et al. (2020) all conducted acceptability and feasibility testing that explored patients' perceptions of products co-designing digital programs before, during and after their testing of CR platforms.

Devi et al. (2014) explored patients' views of the *AYH* website through semi-structured interviews after patients completed the CR program. They received feedback from participants about the program's relevance, usability and barriers to using it while also finding overall acceptance of web-based CR.

Another medium for CR is VW technology. Brewer et al. (2017) also evaluated patients' overall experience with their platform, including topics on physical activity, diet, cardiovascular risk factors and lifestyle. They sought feedback on the logical flow of information and its utility using a survey with open and closed questions. Patients responded with ideas for expanding the VW platform and its curriculum.

Rawstorn et al., 2018 evaluated user experience after 12 weeks of using the REMOTE-CR program. Patient perception of usability and acceptability was evaluated with a survey that included dichotomous, categorical and open-ended questions (Rawstorn et al., 2018). Patients reported on ways to improve REMOTE-CR, suggesting optimisation options for specific patient groups. Study participants suggested in both (Brewer et al., 2017; Rawstorn et al., 2016; Rawstorn et al., 2018) further engagement with specific groups relating to ethnicity, older age, geographical isolation and economic disadvantage to ensure it has nuanced content.

The PATHway project developed a physical activity health platform through a co-design approach (Walsh et al., 2019). This engagement process included exploring people's use of technology, captured with the technology use questionnaire, one to one interview with healthcare professionals and stakeholders and four focus groups with cardiac patients using the program (Walsh et al., 2019). This process allowed for three rounds of iteration, where participants responded to the user interface and content and expressed views on remote and social isolation and technical support (Walsh et al., 2019). This co-design process yielded insight into how the program should be further developed and refined. Following this iterative development phase, O'Shea et al. (2020) undertook usability and feasibility testing of the PATHway platform (Walsh et al., 2019). They debriefed patients six months after completing the RCT, using Braun and Clarke thematic analysis, reporting five themes: platform components, motivation, barriers, enabler to use and post-program reflection (O'Shea et al., 2020). This output further emphasises the importance of patients being well-orientated to eHealth systems and the role of the usability and acceptability evaluative process.

Table 2.1

Literature Review Study Characteristics

Number	Author/date/ country	Type of CR	Study design/size	Outcome	Limitations
1	Brewer et al., 2017	Virtual world	Mixed methods	- Positive perceptions of virtual world experience >80% report improvement in health behaviour/habits	- Small sample size - High socioeconomic status
2	Brough et al., 2014	Website: Activate Your Heart	Prospective observational design	Improvement in incremental shuttle (mean change 49.69 meters, SD 68.8, $P<.001$)	- Program was not offered to high-risk patients - Participants recorded low anxiety and depression scores/high ISWT at baseline
3	Claes et al., 2017	PATHway (eHealth)	- RCT 100 (53/47)	- Physical activity increased (127 SD 58 min to 141 SD 69min), compared to usual care (146 SD 66 min to 143 SD 71 min), $P=.04$. - System use decreased over time/system usability was average with a score of 65.7 (SD 19.7; range 5-100).	Larger sample size needed to detect differences in secondary outcomes Technical errors occurred
4	Dale et al., 2015	Text/Website	- RCT 123 (61/62)	- Adherence to recommended healthy lifestyle behaviours-three months (AOR 2.55, 95% CI 1.12-5.84; $P=.03$). 6 months (AOR 1.93, 95% CI 0.83-4.53; $P=.13$). - Intervention group greater medication adherence score (mean difference: 0.58, 95% CI 0.19-0.97; $P=.004$).	- Outcome assessors were not blinded - Primary outcome was self-reported

Number	Author/date/ country	Type of CR	Study design/size	Outcome	Limitations
5	Devi et al., 2014	Website: Activate Your Heart	• RCT • 94 (148/46)	• Visits to the website per person zero to 100 (median 3) over 6m. • Steps +497 intervention v -861 control • EE +43.94kcal, DSA-7.79min, DMA +6.31min	• Researcher who collected outcome measures also delivered intervention (potential bias)
6	Duan et al., 2018	Website	• Pilot RCT • 114 (60/54)	• Intervention group adopting a healthy lifestyle at eight weeks compared to 10% (4/39) of the control group	• Small sample • Self-report variables • Only BMI for physical health outcomes
7	Houchen-Powell et al., 2018	Website: Activate Your Heart	• Feasibility RCT • 60 (60%/40%)	• ↑ QOL 0.5±1.1 v 0.2±0.7 • Ex time ↑50% • 82% completed all three assessment visits. 78% of the web group completed the programme.	• None stated
8	Johnston et al., 2016	Phone app	• Randomisation • 174 (91/83)	• ↑ drug adherence, activity, smoking cessation & QOL in • Adherence to ticagrelor was achieved in the intervention group vs the control group with a nonadherence score of (16.6 vs 22.8, P = .025)	• Multiple
9	Kayser et al., 2017	Website (TAVIE en m@rche)	• RCT • 60 (30/30)	• No sig effects • 12 weeks ↑ steps/energy exp in I	• Small sample • Not generally representative sample

Number	Author/date/ country	Type of CR	Study design/size	Outcome	Limitations
				Engagement (i.e. ≥75% use of active content) with the entire intervention was only (5, 17%) of the participants.	- Attrition bias - Self-report
10	Maddison et al., 2015	Website	- RCT 171 ('85/'86)	Improvements physical activity with a group difference of 426 MET min/week (95% CI 16,836, P D0.04)	Self-reported measure of physical activity
11	Maddison, et al., 2019	Telerehabilitation platform (including phone app) REMOTE-CR	- RCT non-inferiority trial 162 ('82/'80)	↑ in all REMOTE_CR outcomes - VO2max was comparable in both groups at 12 weeks and the 95% CI indicated REMOTE-CR was non-inferior to usual care.	- High attrition - Declined participation due to preference for I - Non-blinded treatment allocation
12	O'Shea et al., 2020	PATHway (e-Health)	Brauns and Clarke's thematic analysis	- Motivation - Engagement variable - Greater patient familiarisation with eHealth systems	Five themes, feedback on the components, motivation, barriers, enabler to use
13	Rawstorn et al., 2016	REMOTE-CR	- Iterative process - Design and content development	- Builds on past ex-CR platforms. - Include BCT	Use of REMOTE-CR potential barrier to patients
14	Rawstorn et al., 2018	REMOTE-CR	Secondary analysis of a parallel group	- Easy to use - Satisfaction with technology platform and content	- Small sample size - Predominately male

Number	Author/date/ country	Type of CR	Study design/size	Outcome	Limitations
			Users experience of REMOTE-CR		
15	Varnfield, Karunanithi, Lee et al., 2014	App	- RCT 120 (60/60)	- CR uptake 1.3 higher in CAP-CR (80% v 62%) - Adherence CAP-CR 94% v 68%	- Small sample size - Short recovery time
16	Walsh et al., 2019	Co-design PATHway (eHealth)	- Survey 310 - Interview 21 - Focus group 30 - Stakeholder panel 10	Facilitates evaluation and effectiveness of PATHway	Selection of policy-level categories
17	Yudi et al., 2017	App	- RCT 168 (85^l/83^c)	- Improvement in 6 min walk test distance in ^l - More likely to uptake CR (85%) in ^l	Not listed

Note. CR = cardiac rehabilitation, RCT = randomised controlled trial, CAP-CR = care assessment platform of CR, BCT = behaviour change techniques, BMI = body mass index, ISWT = incremental shuttle walk test.

2.8 Recommendations

In looking at the effectiveness of web-based CR, this review has highlighted a variety of platforms, all of which seek to engage the person enrolled in the program. When comparing these results to the primary outcome of this study, CR attendance, it can be argued that these alternate methods are equal to or greater in their effectiveness in improving CR attendance compared to traditional CR. Other outcomes measured also support the value-adding alternative that internet-based models of CR can bring. Furthermore, the fact that some studies recruited participants who had refused traditional CR or had not completed a program also supports the argument that not all cardiovascular disease patients would choose a traditional CR program and, therefore, internet-based CR programs may appeal to their preferences (Houchen-Wolloff et al., 2018; Varnfield, Karunanithi, Lee et al., 2014).

2.8.1 Recommendations for practice.

Australia has only one standardised CR phone or web-based application available through private health funds, with a significant cost to users (Varnfield, Karunanithi, Ding, Bird & Oldenburg, 2014). Furthermore, the effectiveness evaluation of this program has been limited due to its uptake because of cost (Varnfield, Karunanithi, Ding et al., 2014). *AYH* from the UK is similarly the only web-based program of its kind clinically integrated for use in the UK, and as described above, it has had positive outcomes on CR attendance, completion, symptom improvement and reduction in modifiable risk factors (Brough et al., 2014; Devi et al., 2014; Houchen-Wolloff et al., 2018). Otherwise, the literature highlights models of CR delivery that remain in the realm of research and are not clinically integrated for patient use. This situation provides a unique opportunity in Australia to develop a novel CR program that is undertaken remotely through a widely available and cost-effective website to address inequities in access for people in rural and remote settings while providing consumers with an alternative to traditional CR models.

2.8.2 Recommendations for research.

Elevating person-centred program development and care through the co-design process contributes to understanding the relationship between engagement with digital innovation and the behaviour change required to be effective (Yardley et al., 2016). However, it is not explicitly used in designing such interventions, with inconsistencies and brevity in reporting methods and outcomes undermining development evaluation (Green et al., 2020; Slattery, Saeri & Bragge, 2020).

The literature supports both co-design in the development phase of digital programs and continued engagement to assess acceptability and usability. Design components and the effectiveness of these programs should be measured before, during and after their development through collaboration with end users and stakeholders. The purpose of the current study is to examine the effectiveness of the co-designed web program for those eligible for CR. Accordingly, this novel, interactive and self-directed program can contribute to the landscape of consumer choice and opportunity to reduce the reported barriers to attendance and completion of CR.

2.9 Theoretical Framework of the Study

Human behaviour change, fuelled by intrinsic motivation, is complex and variable and often responsible for determining the success of healthcare interventions (Ryan, Legate, Niemiec & Deci, 2012). Poor compliance to recommended changes, particularly long-term, is common among those prescribed these significant adaptations to current practices. For effective, long-term change to occur, a person must initiate and maintain this new health-related behaviour (Ryan et al., 2012). This phenomenon is best understood and addressed by exploring how a person's experiences influence their behaviour and their motivators to change (Ryan et al., 2012).

Based on the literature reviewed, the most commonly and effectively used behaviour change theory and techniques were the self-determination theory and the taxonomy of behaviour change (Brough et al., 2014; Claes et al., 2020; Deci, 1985; Devi et al., 2014; Houchen-Wolloff et

al., 2018; Kayser et al., 2017; Kayser et al., 2019; Maddison et al., 2019; Michie et al., 2013; Rawstorn et al., 2016; Walsh et al., 2019). Additionally, Duff et al. (2017) identify the taxonomy of behaviour change as the most commonly used behaviour change technique (BCT) in web application development in a systematic review of BCTs.

2.9.1 Self-determination theory.

Self-determination theory focuses on how a patient acquires the motivation to set in motion a new health-related behaviour and its impact on change longevity; it focuses on three key features: autonomy, competence and relatedness (see Figure 2.1; Deci, 1985). *Autonomy* reflects the values a patient places on the change; *competence* is a sense of confidence that they can change via education, tools and strategic enablers; and *relatedness* is where a patient perceives support and respect from the healthcare system, increasing intervention engagement (Deci, 1985).

To this effect, the ethos surrounding the co-design development of a web-based CR model, engaging consumers in the design process influenced by their lived experience, aligns with self-determination theory's key features. Furthermore, using a web-based program enables and requires a level of self-reliance, instilling confidence in change capabilities and increasing user satisfaction, placing it in line with the attributes of self-determination theory and maximising attendance, completion and risk modification behaviour from the study's development.

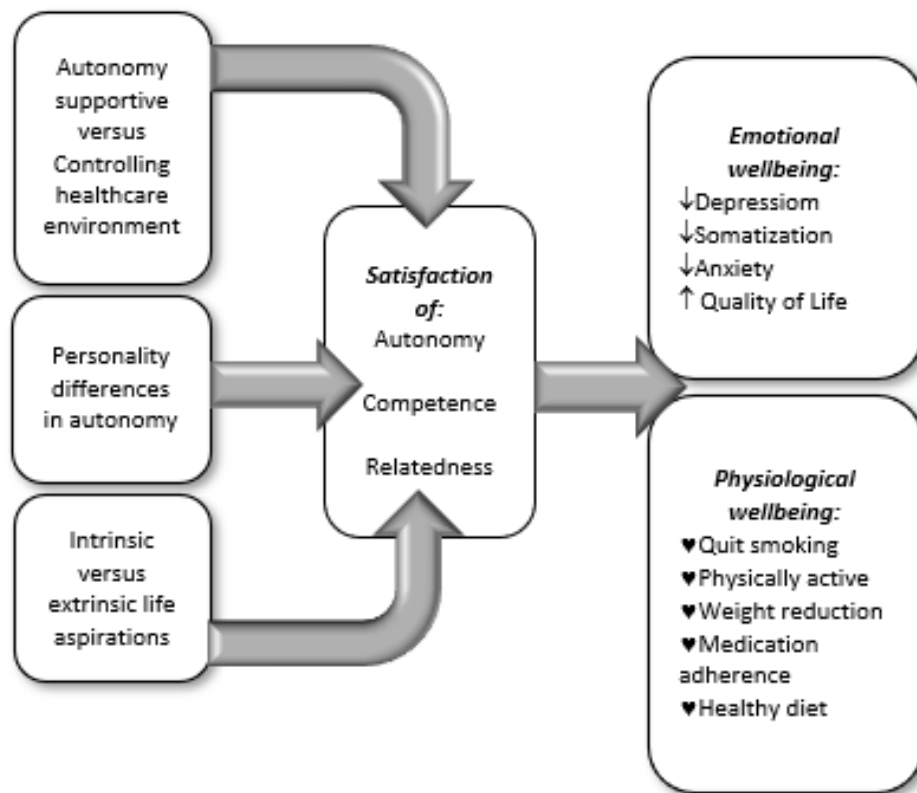


Figure 2.1. Self-determination theory.

2.9.2 Taxonomy of behaviour change theory.

The taxonomy of behaviour change, a method of characterising and defining interventions relating to behaviour change techniques, facilitates the creation and replicability of interventions that are effective and enduring (Michie et al., 2013). Successful behaviour change techniques are visible, reproducible and permanent, increasing physical activity, improving eating habits, promoting smoking cessation and safe alcohol intake (Michie et al., 2013).

2.9.3 Theoretical framework of a web-based cardiac rehabilitation program.

The self-determination theory and taxonomy of behaviour change align with the intrinsic motivation a web-based CR program delivered remotely needs to achieve positive program outcomes and effect lifelong lifestyle changes. Cardiac rehabilitation programs should be transcendental, effecting lifelong change and personal empowerment over health, impacting persistent cardiovascular disease mortality and increasing morbidity. Accordingly, this study applies the self-determination theory to underpin the development of the web application, with

practical techniques guided by the taxonomy of behaviour change (Deci, 1985; Michie et al., 2013). Framed by self-determination theory, the taxonomy of behaviour change's 19 domains and 93 techniques provide the *how-to* for web-based CR clients, enabling effective engagement with their program and positively changing necessary behaviours. The theoretical framework shown in Figure 2.2 reflects their application to this study.

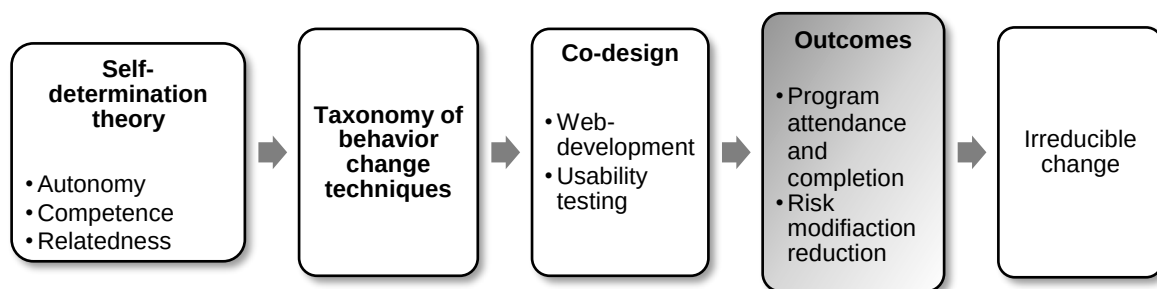


Figure 2.2. The framework of a web-based program.

2.10 Literature Review Summary

The literature review findings showed that web-based CR programs are an effective alternative mode of delivery for those referred for CR who cannot attend a traditional service. While several studies support its effectiveness, a paucity of interactive web applications has been clinically integrated for patient use. An interactive, integrated web-based CR program can contribute to an improvement in patients attending and completing CR. The theoretical framework of a web-based CR program, based on the self-determination theory and the taxonomy of behaviour change, will guide the website development and is now followed by the systematic review of interactive CR web applications versus usual care on program completion in patients with cardiovascular disease.

2.11 Systematic Review Manuscript

2.11.1 Citations.

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2.11.2 Authorship and guarantor.

Effectiveness of interactive cardiac rehabilitation web- Applications on program adherence rates in patients with cardiovascular disease: A systematic review and meta-analysis.

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Robyn Clark	Concept and design Editing
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Candidature Katie Nesbitt

Signed



1 August 2023

Guarantor: I certify the fidelity of the authorship and act as guarantor for all data.

2.11.3 Abstract.

Introduction.

Although available evidence demonstrates positive clinical outcomes for patients attending and completing CR, the effectiveness of interactive CR web applications on program completion has not been systematically examined.

Methods.

This JBI systematic review of effects included studies measuring the effectiveness of interactive CR web applications compared to telephone and centre-based programs. Outcome data were pooled under program completion and clinical outcomes (body mass index, low-density lipoproteins and blood pressure). Databases including *MEDLINE* (via Ovid), *Cochrane Library*, *Scopus* (via Elsevier) and *CINAHL* (via *EBSCO*) published in English were searched. Articles were screened and reviewed by two independent reviewers for inclusion, and the JBI Critical Appraisal Tool and Grading of Recommendations Assessment, Development and Evaluation tool were applied to appraise and assess the certainty of the findings of the included studies. A meta-analysis of the primary and secondary outcomes used random effects models.

Results.

Nine studies involving 1175 participants who participated in web-based CR to usual care were identified. The mean critical appraisal tool score was 76 ($SD = 9.7$), with all (100%) studies scoring $> 69\%$ and certainty of evidence low. Web-based programs were 43% more likely to be completed than usual care [RR 1.43; 95% CI: 0.96, 2.13]. There was no difference between groups for clinical outcomes.

Discussion.

Despite the relatively small number of studies, high heterogeneity and limited outcome measures, the results appeared to favour web-based CR with regard to program completion.

2.11.4 Introduction.

Cardiovascular disease is a term used to describe various conditions affecting the heart and blood vessels (Aaronson, 2020). It is an established public health burden, with cardiovascular disease prevalence rising (World Health Organization, 2021). Over the last 30 years, the global prevalence has increased by 50%, from 271 million in 1990 to 523 million in 2019 (Roth et al., 2020). It continues to be the leading cause of death worldwide, with a reciprocal effect on burgeoning healthcare costs (Roth et al., 2020; World Health Organization, 2021). Structured prevention strategies such as CR programs are urgently required to reduce the burden.

Cardiac rehabilitation is offered as an outpatient program delivering education and secondary prevention interventions to people who have experienced acute coronary syndrome, including unstable angina, non-ST-segment elevation and ST-segment elevation MI. Other eligibility criteria are stable angina, coronary artery bypass surgery, percutaneous coronary interventions, heart failure, replacement and repair of heart valves, permanent pacemaker and implantable defibrillator insertion, heart transplant and cardiac arrhythmias (National Heart Foundation of Australia, 2004).

Secondary prevention for cardiovascular disease is a holistic approach aimed at reducing the likelihood of recurrent cardiovascular events in patients with atherosclerotic cardiovascular disease (Abreu et al., 2020). This strategy includes pharmacological adherence, completion and lifestyle interventions (Abreu et al., 2020). Traditionally, CR is delivered face-to-face or via the telephone, providing prescriptive secondary cardiovascular prevention support, including risk factor management and reduction education, structured exercise and psychosocial interventions. These programs ensure the best physical, psychological and social outcomes for people, slowing the progression of cardiovascular disease and restoring quality of life (Grace et al., 2013). Involvement in CR programs has significantly reduced death, reoccurring cardiac events and hospital admissions while improving quality of life (Anderson & Taylor, 2014). However,

attendance and completion are generally poor globally, with suboptimal referral and attendance rates ranging from 20–50% (Astley et al., 2020; Dalal et al., 2015).

Non-attendance and completion of CR programs are complex and multifaceted. Physicians may not refer to a program or recommend not attending a program (Neubeck et al., 2012). Contradictory advice provided by healthcare professionals during hospitalisation may create confusion and uncertainty in patients after a cardiac event (Neubeck et al., 2012). Physical and emotional distress following a cardiac event may prevent patients from attending the CR program following discharge (Neubeck et al., 2012). People may believe CR to be a purely exercise-based program (Neubeck et al., 2012). These personal beliefs are fuelled by a lack of understanding about coronary heart disease, leading to embarrassment around attendance and misconceptions that CR programs are intended for frail older people (Neubeck et al., 2012). Cardiac rehabilitation program attendance and completion issues are further exacerbated for rural and remote patients who experience the tyranny of distance and concerns relating to work responsibilities and transportation (Hamilton et al., 2018). Some CR programs require full-day attendance, which can affect the participant's ability to work, with financial implications (Neubeck et al., 2012). People living in rural and remote areas have higher rates of hospitalisation, death and injury and poorer access to and use of primary healthcare services compared to those living in major cities (Australian Institute of Health and Welfare, 2019). This situation highlights the need for greater flexibility in CR programs to address inequities and barriers for those living in rural and remote areas (Australian Institute of Health and Welfare, 2019; Cross et al., 2020).

A preliminary search identified reviews that included randomised control trials, non-randomised control trials, qualitative studies on digital CR program effectiveness on clinical outcomes and gaps in sustainable and scalable digital CR interventions (Anderson et al., 2017; Chong, Sit, Karthikesu & Chair, 2021; Jin et al., 2019; Ramachandran, Jiang, Tam, Yeo & Wang, 2022; Turan Kavradim, Özer & Boz, 2020; Wongvibulsin et al., 2021; Xu et al., 2019). However,

there is a scarcity of reviews explicitly and primarily reporting digital CR programs' impact on attendance and completion (Munro, Angus & Leslie, 2013; Xu et al., 2019).

Accordingly, this systematic review aims to summarise the evidence on the effectiveness of interactive web CR programs on program completion, informing future research to address poor attendance and completion of CR.

Review question.

What is the effectiveness of interactive web-based CR programs versus standard care on program completion in patients with cardiovascular disease?

2.11.5 Methods.

The JBI systematic review of effects methodology was used to develop the protocol for the current study (Aromataris & Munn, 2020) and is registered at PROSPERO (registration number: 288690; Appendix 1).

2.11.5.1 Definitions.

Web-based CR.

A web application is a software accessible using any web browser or server, uniformly responsive to being viewed on a computer, smartphone or tablet. Web-based CR is defined as clinically managed, adhering to clinical guidelines for standardised CR programs accessed through computers (e.g., desktop or laptop), smartphones and tablets, undertaken remotely from the service and clinician (Dalal, Doherty, McDonagh, Paul & Taylor, 2021). Regarding the concerns raised about the potentially heightened risks associated with cardiovascular telerehabilitation, a recent systematic review found that home-based cardiac programs presented no additional risk compared to usual care (Stefanakis, Batalik, Antoniou & Pepera, 2022).

Interactive programs.

For this review, an interactive program required a patient to log into a password-protected portal tailored to the patient to complete tasks and progress through the program. Other features

reflecting interactivity are patients' ability to communicate with their clinicians and clinicians having administrative access to respond and monitor overall progress.

Attendance and completion.

Attendance is defined as ≥ 1 session, and completion is $\geq 75\%$ of the sessions required of the program (Abreu et al., 2020). Programs vary in duration, the number of sessions offered and the frequency of sessions; therefore, this review will measure attendance and completion with at least 75% of the program sessions of each included study. Standard care, as a comparison, is defined as a non-web-based CR program (e.g., telephone or centre-based CR programs).

2.11.5.2 Search strategy.

A master search strategy was created by a research librarian (SB), translated by the primary author (KN) and approved by (SB), using a combination of controlled terms and keywords and then executed in *Ovid-Medline*, *Scopus*, *CINAHL*, *Cochrane Library* and *Clinicaltrials.gov*. Detailed information about the search terms used is available in Appendix 2. The search was completed on 7 September 2022.

2.11.5.3 Study selection.

The PRISMA flow diagram was used to summarise the study selection process (Page et al., 2021). Eight reviewers (KN, SC, VP, LG, HD, JR, OS and AP) independently screened titles, abstracts and keywords from the electronic searches. Any discrepancies were resolved through discussion with a third reviewer (AB). Full texts of potential studies were reviewed, and their reference lists were hand-searched for additional trials.

Inclusion criteria.

We included articles that (a) were original articles published in peer-reviewed journals, (b) included participants eligible for CR (i.e., those with unstable angina, non-ST-segment elevation and ST-segment elevation MI, stable angina, coronary artery bypass surgery, percutaneous coronary interventions, heart failure, replacement and repair of heart valves, permanent

pacemaker and implantable defibrillator insertion, heart transplant and cardiac arrhythmias), (c) were adults ≥ 18 years, (d) RCTs, (e) assessed the effectiveness of web-based CR program interventions and (f) were written in English.

Exclusion criteria.

We excluded (a) abstracts, conference proceedings, data sets, reviews, protocols, duplicates and non-English articles; (b) articles featuring participants not eligible for CR; (c) non-RCT studies; (d) articles that did not involve web-based CR program interventions; (e) articles that did not explicitly mention interactive components; and (f) articles that did not assess the effectiveness of a web-based CR program intervention.

In the case of multiple publications arising from the same study, we selected the most current or the one with enough statistical information to analyse the effect sizes of the intervention. This information included risk ratio, means, standard deviation and sample size.

2.11.5.4 Assessment of methodological quality, data extraction and synthesis.

Two reviewers appraised all studies using the JBI Critical appraisal tool, as shown in Appendix 3 (Barker et al., 2023). The appraisal process aims to assess a study's methodological quality and determine the extent to which the study has addressed the possibility of bias in its design, conduct and analysis. All papers selected for inclusion in the systematic review have been subjected to rigorous appraisal by two critical appraisers, with a third reviewer resolving any conflicts. The results of this appraisal inform the synthesis and interpretation of the study results. The appraisal tool is a 13-question scale, answering yes (score = 1), no (score = 0) or not applicable. The results are calculated as a sum of all and then presented as a percentage. High-quality studies are represented by scores $> 70\%$, medium-quality scores between 50–70% and low quality with $< 50\%$ (Barker et al., 2023).

Data were extracted from studies included in the review by two independent reviewers (KN, SC, VP) using the standardised JBI data extraction tool. The data extracted includes specific

details about the population, study types and methods and outcomes of significance to the review question. These outcomes were the *completion* of the web-based interactive CR program as the primary outcome. Based on the quality indicators for CR program accreditation, included clinical outcomes were changes in body mass index (BMI), LDL levels, and systolic blood pressure (SBP) and diastolic blood pressure (DBP) as secondary outcomes (Abreu et al., 2020; Grace et al., 2013). Reviewer disagreements were resolved through discussion or a third reviewer (AB).

2.11.5.5 Study outcome measures.

Study outcomes were the total (*n*) or % of participants who completed their CR program and the mean and standard deviation for clinical outcomes.

2.11.5.6 Statistical analyses.

When possible, a statistical meta-analysis of included studies was pooled using RevMan version 5.4.1 (Copenhagen: The Nordic Cochrane Centre, Cochrane). A random-effect meta-analysis model was used to measure the effect of intervention across studies, considering within-sample variability. The effect size was presented in risk ratio (RR; for dichotomous) or weighted or standardised mean difference (for continuous) with their 95% confidence intervals. Patient characteristics were analysed using IBM SPSS Statistics version 27 (Chicago, USA). The heterogeneity of studies and test of overall effects was presented. Where pooling of studies for statistical meta-analysis was not possible, results were presented narratively. Caution is warranted in interpreting the I^2 statistic, as their power to detect due to heterogeneity and small number of trials (< 10) is low. No tests of funnel plot asymmetry were performed due to the low power of this test with a small sample of studies.

2.11.5.7 Assessing certainty in the findings.

Certainty of findings assessment was conducted (KN and AB) and presented using the Grading of Recommendations, Assessment, Development and Evaluation approach using GRADEpro GDT (McMaster University, ON, Canada; Guyatt et al., 2008).

2.11.6 Results.

2.11.6.1 *Study selection.*

The database search identified 3,872 citations. Duplicates were removed ($n = 933$), and the title and abstracts of the remaining 2,939 were screened, with 130 papers considered for full-text review. Figure 2.3 summarises the review process and reasons for exclusion.

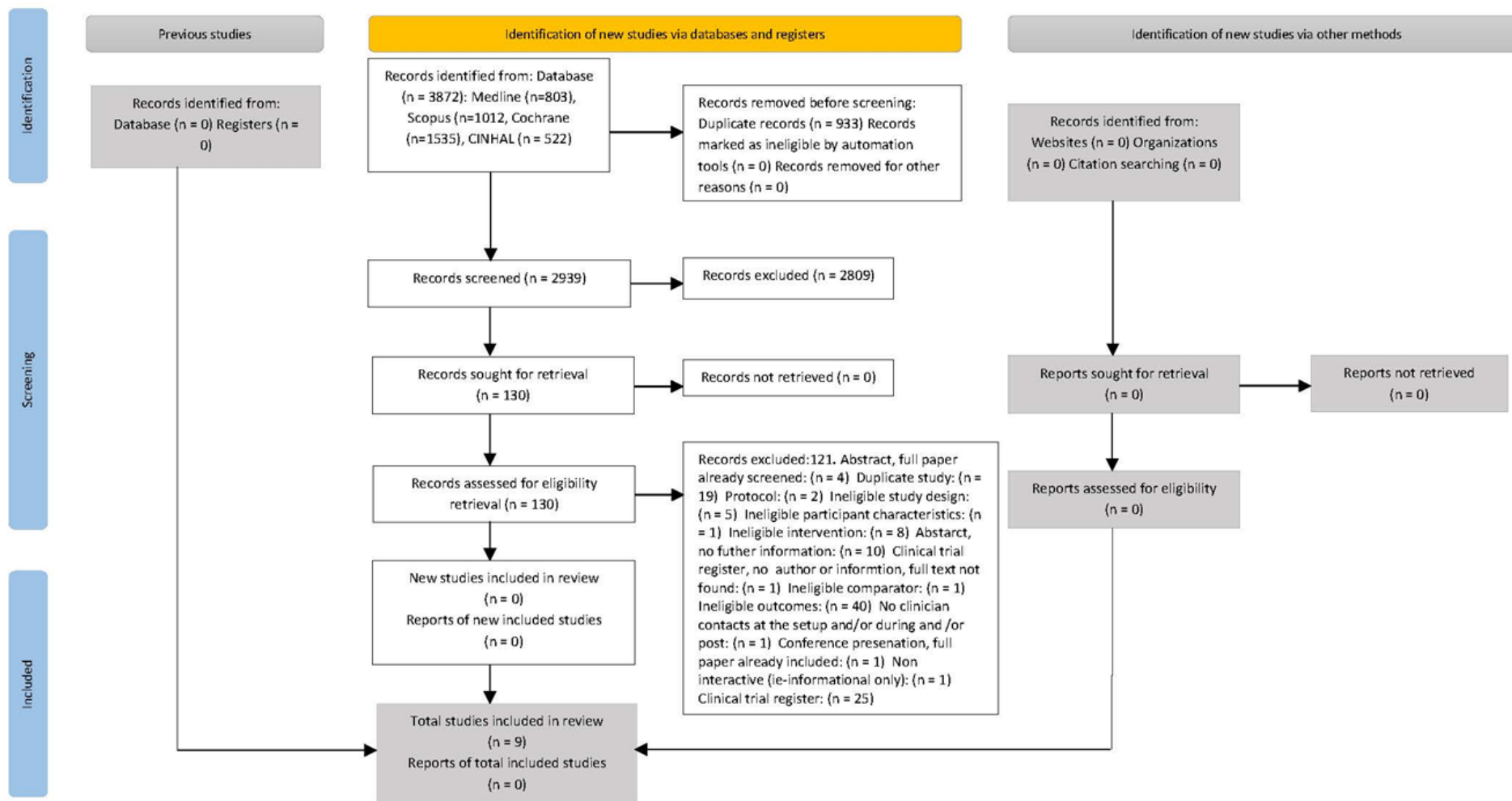


Figure 2.3. Preferred reporting items for systematic review and meta-analyses flow diagram.

We included nine studies for systematic review and eight for meta-analysis for the primary outcome. One study was excluded from the meta-analysis for completion due to missing data (Houchen-Wolloff et al., 2018), seven studies were excluded for BMI (Antypas & Wangberg, 2014; Indraratna et al., 2021; Kamel, Hafez Mohamed & Bastawy, 2021; Rosario et al., 2018; Varnfield, Karunanithi, et al., 2014b; M. Yudi et al., 2017), five from the LDL (K. Antypas & S. C. Wangberg, 2014; Indraratna et al., 2021; Kamel, Hafez Mohamed & Bastawy, 2021; Rosario et al., 2018), and five for SBP and DBP (Antypas & Wangberg, 2014; Indraratna et al., 2021; Kamel et al., 2021; Rosario et al., 2018), as these clinical outcomes were not measured or reported.

2.11.6.2 Study characteristics.

Table 2.2 summarises the characteristics of the nine included studies. Cardiac web applications included a website ($n = 2$), text messaging ($n = 3$), a smartphone with a peripheral device for exercise and clinical monitoring ($n = 3$) and video consultation ($n = 1$). Of these web applications, focus groups and health behaviour theory (Antypas & Wangberg, 2014), social cognitive theory (Dale et al., 2015), co-production (Houchen-Wolloff et al., 2018) and collaborative approaches (Indraratna et al., 2022) were applied to increase uptake and engagement. Only four studies monitored physical activity (Indraratna et al., 2022; Rosario et al., 2018; Varnfield, Karunanithi, Lee et al., 2014; Yudi et al., 2021). Cardiovascular conditions were re-vascularisation procedure ($n = 3$), cardiovascular disease ($n = 2$) and heart failure ($n = 1$). Almost half the studies were conducted in Australia ($n = 4$). There were 1,175 participants with sample sizes ranging between 60–200, reporting a median sample size of 149 (IQR = 117.5); specifically, median sample sizes of 79 (IQR = 64.5) for usual CR and 72 (IQR = 47) for web-based CR were reported. The mean age for usual CR was 58.65 ($SD = 2.3$) and 58.85 ($SD = 2.6$) for web-based CR. The length of interventions varied across the studies, ranging from six weeks to 14 months. Interventions included a smartphone ($n = 5$), websites ($n = 2$), text messaging and website support ($n = 1$) and web conferencing ($n = 1$).

Table 2.2

Systematic Review Study Characteristics

Study	Country	Diagnosis	Total population (n)	Total population (n)		Age years (SD)		Male (n) %		Intervention type/s	Settings	CR completion measurement	Follow up
				C	I	C	I	C	I				
Antypas & Wangberg, 2014	Norway	CVD	67	38	29	58.8	59.5	30	22	Website: - The tailoring process is in emulating face-to-face patient counselling. - The patient's answers to the questionnaires create an individualised path through the intervention, including feedback and follow-up questions based on predefined algorithms. - Different answers to the same questions over time generate changes in the treatment or behaviour change plan that reflect the changes in a patient's characteristics.	Remote	The days between the first and the last log-in defined 'quit event' as not having used the website for the past month before the data retrieval.	3 months
Dale et al., 2015	New Zealand	Myocardial infarction, angina, re-vascularisation	123	62	61	59.5 (11.8)	59 (10.5)	52	48	Text message with a supporting website: - Fully automated daily short message service (SMS) text messages. - A supporting website.	Remote	Fidelity to intervention was assessed using an author-derived questionnaire and calculating website and response text message usage statistics	6 months

Study	Country	Diagnosis	Total population (n)	Total population (n)		Age years (SD)		Male (n) %		Intervention type/s	Settings	CR completion measurement	Follow up
				C	I	C	I	C	I				
Houchen-Wolloff et al., 2018	United Kingdom	CHD, angina, post MI, post PCI	60	23	37	61 (8)	62 (10)	21	33	Website: - An online intervention designed for participants to use self-directed at home, facilitated with remote support from the CR team. - The intervention is an interactive, password protected, tailored CR program contained in a website.	Remote	Total web usage statistics for patients assigned to the web-based program were monitored, along with emails sent to the expert CR team	6 months
Indraratna et al., 2022	Australia	Heart failure, ACS	162	79	83	61.7 (12.6)	61.3 (12.3)	65	65	Smartphone with bluetooth connectivity to peripheral devices: Three weekly educational push notifications plus alerts/monitoring from clinicians where participants would be contacted if there was an issue identified in the data.	Remote	Completion was defined as presence during at least one session.	6 months
Kamel et al., 2021	Egypt	Acute STEMI→PCI	200	100	100	55.8 (11.2)	56.2 (9.3)	70	73	Video conferencing consultations: - Free-of-charge videoconferencing teleconsultations. - Monthly videoconferencing teleconsultation using a smartphone application for three months, starting one week after discharge.	Remote	Achieved at least 80% coverage of the mean proportion of days of the program.	4 months

Study	Country	Diagnosis	Total population (n)	Total population (n)		Age years (SD)		Male (n) %		Intervention type/s	Settings	CR completion measurement	Follow up
				C	I	C	I	C	I				
Michelsen et al., 2022	Sweden	Within 2 weeks of MI	149	100	49	60 (8.9)	61.1 (8.6)	36	84	Web-based mobile phone app: • The software contained two separate interfaces: one for the patient and one for the treating healthcare professionals. • Patient interface (patients could log information about diet, physical activity, exercise, weight, heart rate, BP and smoking). • Symptoms and intake of medication. • The patient could compare their data to guideline-recommended targets. • Receive automated positive feedback on healthy lifestyle choices and general recommendations on exercise, daily physical activity and healthy diet. • The medical interface ranked patients by clinical need. • The medical interface was reviewed twice a week by a nurse.	Remote	Completion was defined as patients registering data at least twice per week every week throughout the 25-week intervention period	14 months

Study	Country	Diagnosis	Total population (n)	Total population (n)		Age years (SD)		Male (n) %		Intervention type/s	Settings	CR completion measurement	Follow up
				C	I	C	I	C	I				
Rosario et al., 2018	Australia	Cardiac-related diagnosis	66	33	33	NA	NA	NA	NA	Smartphone app and portable medical devices: • Android smartphone (pre-installed app). • Personalised text messages weekly. • Maintained engagement between CRP sessions. • An activity classification algorithm analysed measurements from a smartphone tri-axial accelerometer, tri-axial gyroscope and barometric pressure to estimate physical activity.	Remote	The proportion of participants who completed 12 supervised exercise sessions	2 years (2011-2013)
Varnfield, Karunanithi, Lee et al., 2014	Australia	Post MI	200	103	97	56.2 (10.1)	54.9 (9.6)	34	48	Smartphone platform with supporting website weekly consultations: • Exercise monitoring • Delivery of educational/motivational material via text message • Pre-installed audio/video files • Web portal for mentors to provide weekly consultations	Remote	Usage statistics	6 weeks

Study	Country	Diagnosis	Total population (n)	Total population (n)		Age years (SD)		Male (n) %		Intervention type/s	Settings	CR completion measurement	Follow up
				C	I	C	I	C	I				
Yudi et al., 2021	Australia	ACS, CAD on angiography (Coronary artery stenosis >50%)	168	85	83	56.2 (10.2)	56.8 (9.9)	71	71	Smartphone app: • Multifaceted, patient-centred smartphone-based secondary prevention program • Physical activity tracking through the smartphone's accelerometer • Interactive feedback • Goal setting • Dynamic dashboard to review and optimise cardiovascular risk factors, educational messages delivered twice weekly, a photographic food diary, pharmacotherapy review. • Support through a short message service.	Remote	Completion was defined as showing attendance and completion to cardiac rehabilitation and attending the 8-week assessment session.	8 weeks

Note. MI = myocardial infarction, BP= blood pressure, ACS= acute coronary syndrome, CAD = coronary artery disease.

2.11.6.3 Methodological quality.

All nine studies reported a quality score of > 69%, according to the JBI critical appraisal tool. The mean appraisal score was 76 ($SD = 9.7$). Blinding to treatment groups was not performed in ($n = 5$) studies; participants not blinded to treatment were ($n = 7$) studies, those studies unblinded delivering the treatment were ($n = 5$), and studies with unblinded assessors were ($n = 2$; see Table 2.3). The overall risk of bias in included trials was low (see Table 2.4).

Table 2.3

Critical Appraisal Table

No.	Citation	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Y%
1	Antypas 2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
2	Dale 2015	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	69.2
3	Houchen-Wolloff 2018	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	76.9
4	Indraratna 2022	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	76.9
5	Kamel 2021	Y	N	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	69.2
6	Michelsen 2022	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	76.9
7	Rosario 2018	Y	N	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	69.2
8	Varnfield 2014	Y	U	Y	U	U	U	Y	Y	Y	Y	Y	Y	Y	69.2
9	Yudi 2021	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	76.9

Note. Y = yes, N = no, U = unclear, N/A= not applicable.

Table 2.4

Certainty Evidence Table

Certainty assessment							No. of patients		Effect	Certainty	Importance	
No. of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Web-based CR	Usual care CR	Relative (95% CI)	Absolute (95% CI)		
Completion (follow-up: range 6 weeks to 14 months)												
8	Randomised trials	Serious ^a	Serious ^b	Serious ^c	Not serious ^d	None	308/546 (56.4%)	198/528 (37.5%)	RR 1.43 (0.96 to 2.13)	161 more per 1,000 (from 15 fewer to 424 more)	⊕○○○ Very low	Important
Body mass index												
2	Randomised trials	Serious ^a	Serious	Serious	Serious	Publication bias strongly suspected	110	162	-	SMD 0.04 higher (0.76 lower to 0.83 higher)	⊕○○○ Very low	Important
Low-density lipoprotein												
4	Randomised trials	Serious ^a	Serious	Serious	Serious	Publication bias strongly suspected	277	224	-	SMD 0.1 lower (0.28 lower to 0.08 higher)	⊕○○○ Very low	Important
Systolic blood pressure												
4	Randomised trials	Serious ^a	Serious	Serious	Serious	Publication bias strongly suspected	290	224	-	SMD 0.07 higher (0.11 lower to 0.25 higher)	⊕○○○ Very low	Important
Diastolic blood pressure												
4	Randomised trials	Serious ^a	Serious	Serious	Serious	Publication bias strongly suspected	290	224	-	SMD 0.09 lower (0.3 lower to 0.12 higher)	⊕○○○ Very low	Important

Note. CI = confidence interval, RR = risk ratio, SMD = standardised mean difference, CR = cardiovascular rehabilitation.

^a Inadequate concealment of the allocation sequence and outcome assessment variability. ^b Inconsistency was high, I^2 92%. ^c Inadequate concealment of the allocation sequence and outcome assessment variability. ^d Randomised trials met eligibility criteria but address a restricted version of the main review question in terms of intervention outcome.

2.11.6.4 Completion.

Figure 2.4 shows the impact of CR program choice on completion favouring web-based programs. The overall risk ratio is 1.43 (95% CI: 0.96, 2.13; $p = 0.08$), showing that web-based CR programs are 43% more likely to be completed than the usual care program; however, the results are not statistically significant ($p = 0.08$). The overall heterogeneity, $I^2 92\%$, shows the variability in effect size estimates due to between-study differences.

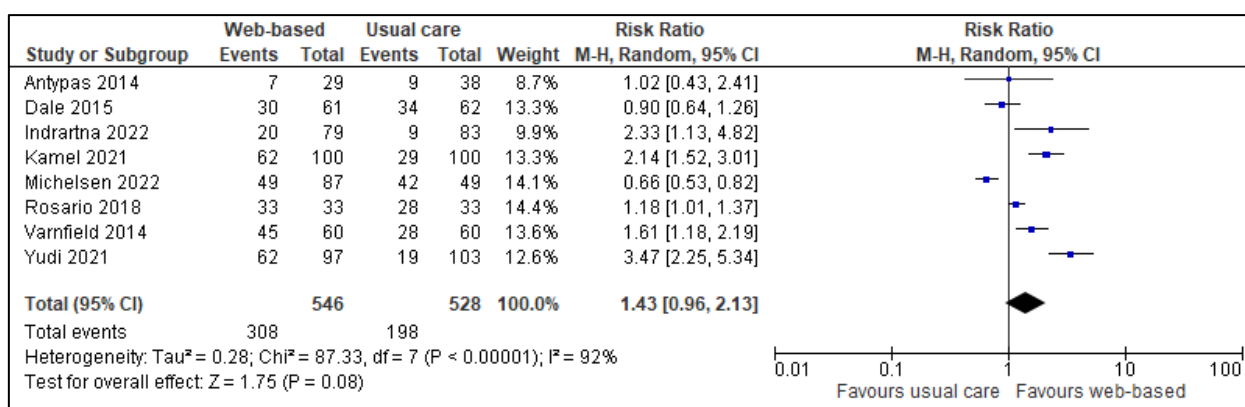


Figure 2.4. Cardiac rehabilitation program completion forest plot.

2.11.6.5 Clinical outcomes.

In terms of analysis of clinical outcomes, there was no significant difference in BMI, LDL, SBP and DBP among patients who attended a web-based CR program compared to those who attended a usual care program. The overall standardised mean difference of BMIs between web-based and usual programs is 0.04 (95% CI: -0.76, 0.83; $p = 0.93$; see Figure 2.5). The mean LDL-level was reduced by -0.10 (95% CI: -0.28, 0.08; $p = 0.28$) among patients who attended a web-based program, but the results are not significant (see Figure 2.6). The overall standardised mean difference of SBP was 0.06 (95% CI: -0.19, 0.32; $p = 0.63$; see Figure 2.7). The DBP overall standardised mean difference, too, was non-significant, -0.09 (95% CI: -0.30, 0.12; $p = 0.40$; see Figure 2.8).

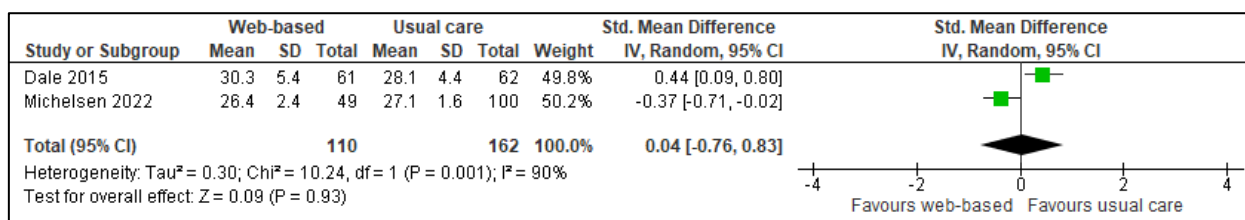


Figure 2.5. Body mass index forest plot.

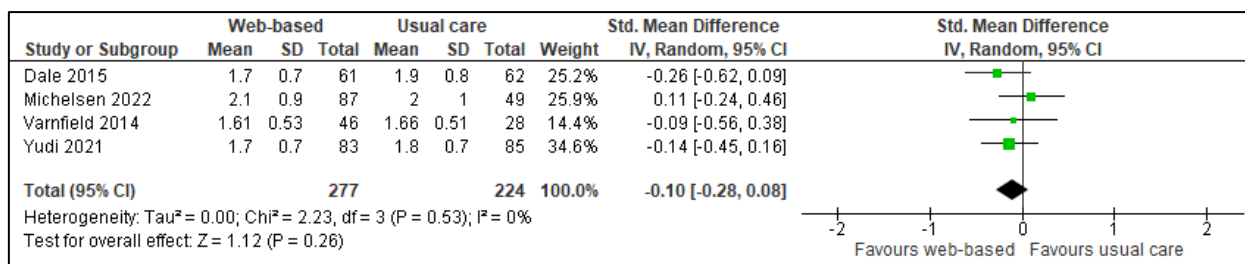


Figure 2.6. Low-density lipoprotein forest plot.

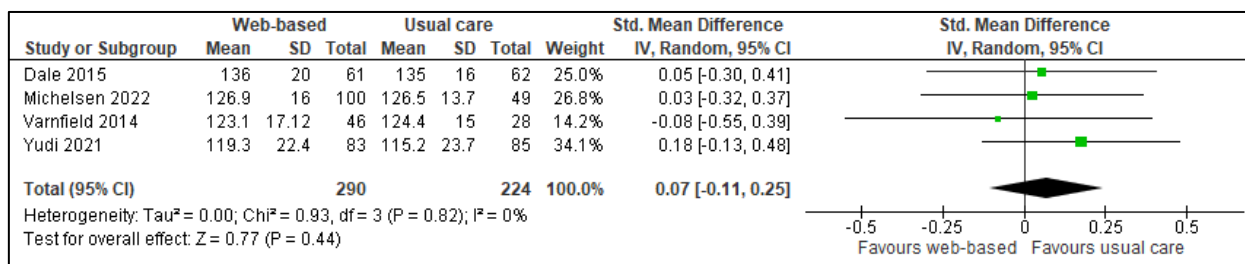


Figure 2.7. Systolic blood pressure forest plot.

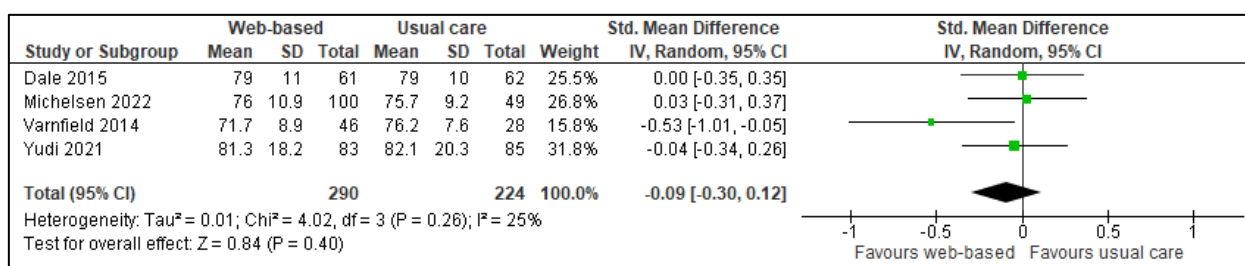


Figure 2.8. Diastolic blood pressure forest plot.

2.11.7 Discussion.

Our systematic review assessed the effectiveness of interactive web-based CR programs versus usual care on program completion in patients with cardiovascular disease. Although web-based programs are intended to overcome known barriers to completion of CR, the effectiveness of web-based modes of delivery on program completion was not well established. Our systematic

review is one of few, with one previously undertaken in 2013 (Munro et al., 2013). The other only retrieved eight studies, of which four were non-randomised (Xu et al., 2019), to primarily assess and show that web-based CR programs are as effective as usual care in contributing to improving completion and reducing clinical outcomes. This review included websites, text messaging, smartphones with peripheral devices for exercise and clinical monitoring and video consultations as web-based CR programs. The primary outcomes measured ranged from maintaining or improving physical activity, adherence to healthy lifestyle behaviours, the feasibility of reducing program declination and dropout, 30-day readmission and program adherence and/or completion.

In concordance with current and established research, this review has reported that web-based CR can contribute to improving program completion and clinical outcomes (Anderson & Taylor, 2014), highlighting the importance of patient choice and maximising opportunities to undertake and complete a CR program where otherwise not possible (Beatty et al., 2023).

2.11.7.1 Completion.

Our findings suggest that web-based CR programs effectively contribute to program completion; however, high heterogeneity was observed in the studies measuring the completion of CR programs. The definitions used within these studies to quantify completion were variable, ranging from uptake (Michelsen et al., 2022; Varnfield, Karunanithi, Lee et al., 2014), attendance (Indraratna et al., 2021), adherence (Antypas & Wangberg, 2014; Kamel et al., 2021; Michelsen et al., 2022; Yudi et al., 2021) and completion (Antypas & Wangberg, 2014; Dale et al., 2015; Kamel et al., 2021; Rosario et al., 2018; Yudi et al., 2021). Only two studies (Houchen-Wolloff et al., 2018; Varnfield, Karunanithi, Lee et al., 2014) report attendance, completion, uptake and adherence as the primary outcome. These were measured by the number of average logins by patients (Houchen-Wolloff et al., 2018) or the uploading of data and attendance at the six-week assessment (Varnfield, Karunanithi, Lee et al., 2014). The remaining studies varied considerably in

how uptake, attendance, adherence and/or completion were measured, contributing to high heterogeneity in the meta-analysis of program completion.

As highlighted by intervention completion outcome heterogeneity in this review, robust assessment requires a standardised approach, specifically establishing program completion parameters. There are guidelines defining how to measure and outcome parameters for centre-based and telephone CR programs, as developed by the Heart Foundation of Australia (Gallagher et al., 2020; National Cardiac Rehabilitation Measurement Taskforce, June 2021.), the European Society of Cardiology (Aktaa et al., 2022) and The International Council of Cardiovascular Prevention and Rehabilitation (Grace et al., 2016) to develop national and international accreditation standardisation. Such guidelines can influence similar standardisation for web-based CR programs. Furthermore, validated measures reflect the emerging state of implementation science projects and clinically integrated programs (Glasgow, Vogt & Boles, 1999). However, the aforementioned vortex of adherence and completion definitions and standardisation in web-based CR still needs to be defined for implementation evaluations to be valid and reproducible.

2.11.7.2 Clinical outcomes.

The clinical outcomes from this review, while not significant, report that the web is neither inferior nor superior in reducing clinical risk factors; however, positive outcomes are abundant in the literature (Chong et al., 2021; Munro et al., 2013; Rawstorn et al., 2016; Turan Kavrakdim et al., 2020). Furthermore, the low number of studies in this review assessing adherence to physical activity and exercise suggests the need for more research on adherence and engagement with exercise for web-based programs. Although not measured in this review, it is important to note that a number of the studies in this review further support the case for web-based CR program through their feasibility (Houchen-Wolloff et al., 2018; Indraratna et al., 2022), acceptability when

compared to usual care (Kamel et al., 2021; Varnfield, Karunanithi, Lee et al., 2014) and cost-effectiveness (Indraratna et al., 2022).

In order to improve clinical outcomes, strategies to facilitate attendance and completion must be addressed through patient program choice and flexible options (Chindhy, Taub, Lavie & Shen, 2020). Similarly, measuring an increase in patients' knowledge and meaningful behaviour change much later than current study follow-ups will establish program effectiveness and assist with integrated program evolutions.

We know that web-based CR programs are effective in addressing program completion and assisting with clinical risk modification. Yet, the unrelenting issue of cardiovascular disease mortality and increasing morbidity begets the need to prioritise collaborative, patient-designed and clinically implemented web-based CR programs focused on achieving program completion (Ambrosetti et al., 2021) and enduring meaningful lifestyle modifications (Buckley et al., 2013). This need can be achieved by shifting the lens to prioritising intervention implementation, assessing patient and system-level outcomes and sustainability for web-based CR program services and patients (Chindhy et al., 2020; Taylor, Dalal & McDonagh, 2022). Research into establishing a valid standardised tool to assess service and patient outcomes from web-based CR programs needs to be undertaken to address this triad. From a future research perspective, making adherence measures part of the gold standard measures for RCTs while simultaneously focusing on moving towards more research on integrating interactive web-based programs within workflows and with other technology systems and making them more attractive and engaging for participants, thus enabling the implementation and integration of web-based CR options for patients at policy and health service levels.

This review had a few limitations, contributing to the inability to report significant outcomes. First, the small sample size does not allow tests of funnel plot asymmetry to be

performed. Second, there was a high heterogeneity of interventions and their outcome measures, given that completion was a primary outcome in only two studies. Although expected, given the number of criteria for referral to CR, there was high heterogeneity of cardiovascular conditions within the studies reviewed.

2.11.8 Conclusion.

Notwithstanding the impact of web-based CR on program completion and clinical outcomes compared to usual care CR, this review has illuminated several issues that can be explored and addressed. Program completion is not prioritised in measuring service outcomes, heterogeneity in measuring program model outcomes and an enduring focus on RCT, overlooking the plethora of neutral and positive study outcomes. However, low attendance at CR continues. Standardisation of completion terminology and measurement and patient-centred web-based CR programs are essential for addressing this.

2.11.9 Acknowledgments.

Flinders University Caring Futures Institute, Better Care (College of Nursing and Health Sciences) and clinical leaders Alison Kitson and Raymond Chan for funding and facilitating the Systematic Review Club. Flinders University librarian Shannon Brown for supporting the development of our search strategy and providing feedback on the content of the study protocol.

2.11.10 Declaration of conflicting interests.

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

2.12 Chapter Summary

This chapter has reviewed the existence, integration and effectiveness of web-based CR programs, including websites, phone apps and remote monitoring, highlighting patients' attendance and completion of their CR program. This literature review also identified the

theoretical framework(s) for developing the web-based CR program, specifically the behaviour change theory and the taxonomy of behaviour change, thus enabling an appropriate approach for this study to be utilised. The literature review was followed by a systematic review examining the effectiveness of interactive, web-based CR programs on attendance and completion of programs. Chapter 3 will describe the chosen methodology for co-designing the web-based CR program and evaluating the implementation process.

Chapter 3: Methodology

3.1 Chapter Overview

This project aimed to develop, implement and evaluate the web-based CR program to improve attendance and completion of CR while also improving risk modification behaviours. This aim was achieved synergistically by applying a multi-method design to collect qualitative and quantitative data. This chapter presents the research methodology for both the co-design of the web-based CR program and the evaluation of the implementation of the web-based CR program. The co-design and implementation of the web-based CR program applied the user design (UX) framework to design the workshops, guiding workshop activity, data collection and outcome reporting. Meanwhile, the evaluation of the implementation of the web-based CR program assessed the implementation process of the previously co-designed website through program reach, effectiveness, adoption, implementation and maintenance based on the RE-AIM evaluation model and a prospective observational descriptive study design.

3.2 Introduction

Co-design and collaboration with consumers, organisations, health professionals and information technology (IT) developers are recommended to develop all digital solutions (Cowie et al., 2016). Co-design is a range of principles and practices applied to understand problems and create solutions (Blomkamp, 2018). Since design relates to how things work, what is required to control them and how people interact with technology, workshops can utilise collective creativity, collaboration and innovation, helping the design process (Norman, 2013; Sanders & Stappers, 2008). This process creates more effective and efficient products for the

creators and end users (Steen, Manschot & de Koning, 2011). UX design workshops are collaborative sessions where problem-solving and project progression occur through the generation of ideas and interaction with products (UIUXTrend, 2020). The workshops undertaken achieved such outcomes for researchers, clinicians and patients.

3.3 Co-design of Web-Based CR Program

3.3.1 Rationale for UX design.

The UX design theoretical and conceptual framework, shown in Figure 3.1, aims to create a positive UX, resulting in consumer-ready products involving the end users' holistic engagement with the project at any one point or all points on a continuum (UIUXTrend, 2020). The theoretical framework for UX design helps to highlight the differences between the user and the system interactions, while the conceptual framework outlines the various forms of UX evaluation, the standard used to establish the quality of the system and clarifies the evaluative process (Rico-Olarte, López & Kepplinger, 2018).

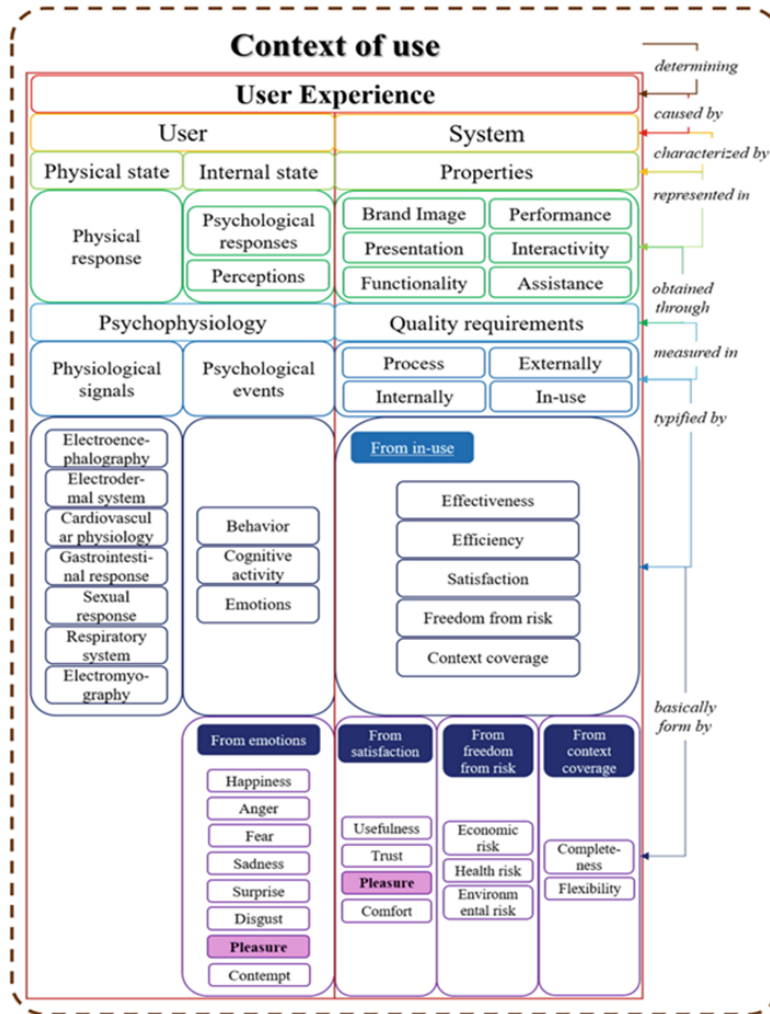


Figure 3.1. UX design theoretical and conceptual framework. Note. Reprinted with permission from Springer Nature.

3.3.2 Aim.

This study aimed to develop and implement a website to deliver CR to populations living in rural and remote areas to improve program access.

3.3.3 Objectives.

1. To co-design a web-based program for CR for patients living with cardiovascular disease.
2. To evaluate the usability of the web-based program for CR.

3.3.4 Participants.

Participants were eligible for inclusion if they had been or were enrolled in a CR program and had experienced unstable angina, non-ST-segment and ST-segment elevation MI, stable angina, a history of cardiothoracic surgery, percutaneous coronary interventions or heart failure (National Heart Foundation of Australia, 2004). Further inclusion criteria were valve device insertion, permanent pacemaker and implantable defibrillator insertion, heart transplant, spontaneous coronary artery dissection and arrhythmia patients (National Heart Foundation of Australia, 2004).

3.3.5 Setting.

The web-based program development workshops were conducted across six regional Local Health Networks (LHNs): Eyre and Far North LHN, Yorke and Northern LHN, Barossa Hills Fleurieu LHN, Riverland Mallee Coorong LHN, Flinders and Upper North LHN and the Limestone Coast LHN. Six usability testing workshops were conducted at Whyalla, Wallaroo, Nuriootpa, Berri, Murray Bridge, Port Lincoln and Mount Gambier.

3.3.6 Sample size.

Eyles et al. (2016) highlight a wide range in participant recruitment and sample size in qualitative studies, ranging from 10 to 1,000. Qualitative studies seek 'rich' data that is not dependent on specific sample sizes; however, the literature supports a sample size range of 12–26 (Issacs, 2014). This study used the UX design method, with formal usability studies requiring 10–12 participants and less formal usability studies requiring 4–5 participants (Sova & Nielsen, 2003). Usability studies have found that 80% of problems and actionable feedback are found

from the first four participants (Sova & Nielsen, 2003). We recruited 6–10 participants per workshop, overrecruiting by two participants and allowing for attrition.

3.3.7 UX design plan in this study.

3.3.7.1 Study design.

This study used a multi-method approach to measure the desired outcomes. The workshops used a qualitative and quantitative approach for the co-design process with the UX design theoretical framework, gaining critical feedback and insights from participants. The conceptual framework for UX design highlights the evaluative process, which comprises an observational assessment (the user's perspective on the design), psychometric scales (user self-evaluation) and psychophysiological measures (the body response when interacting with the design) (Rico-Olarte et al., 2018).

This approach was framed by social constructionism using a phenomenological approach involving two rounds of six co-designed workshops for the web-based program development and usability testing. UX workshops are guided by three main components: goal setting, questions and activities, with step one focused on goal setting, step two on questioning and steps three to five on the action tasks (Nielsen Norman Group, 2020; Kaplan, 2018). Workshops under the UX design method use principles and practices that allow researchers to identify problems or themes and create solutions and innovation. The workshops provided feedback on the prototype web-based program's development phase using iterative, parallel and competitive processes (Nielsen, 2011).

3.3.7.2 Development of the web application: UX design.

3.3.7.2.1 Step one: Content development.

The web-based program content was created from the *My Cardiac Rehab Program CHAP Clinician Manual* released as a part of the translation phase of the National Health and Medical Research Council Partnership Grant (GNT 1169893). Further guidance on content was obtained from the Heart Foundation of Australia's *Australian National Quality Indicators for CR* and a *Pathway to Cardiac Recovery Standardised Program Content for Phase II CR* and European Society of Cardiology Quality Indicators for CR accreditation (Abreu et al., 2020; Aktaa et al., 2022; Gallagher et al., 2020; National Heart Foundation of Australia, 2019a, 2019b).

3.3.7.2.2 Step two: Web application development.

Participants worked with researchers iterating high-fidelity computer-generated prototypes using iterative, parallel and competitive processes (Nielsen, 2011). A prototype is a working model created to develop and test design ideas (Walker, Takayama & Landay, 2002). Fidelity refers to how easily prototypes can be distinguished from the final product and can be utilised to highlight design aspects (Walker et al., 2002). These prototypes can consist of low-fidelity prototyping using paper, pen and whiteboards in the format of sketches and sticky notes to reflect design ideas (Walker et al., 2002). High-fidelity prototypes consist of desktop publishing programs to produce high-quality paper representations and high-fidelity computer prototypes representing something close to the finished product (Babich, 2017; Walker et al., 2002). Usability testing can be approached using iterative, parallel and competitive processes to achieve a high-quality user interface to inform final product development (Nielsen, 2011). The iterative process is conducted using low or high-fidelity prototypes repeated at least two times

(Nielsen, 2011). This process allows for the first design draft with two redesigns. Usability can improve by 38% for each iteration (Nielsen, 2011). The parallel process compares two or more designs simultaneously with a single merged design emerging (Nielsen, 2011). Finally, the competitive process consolidates the previous processes by comparing your design against three to four existing designs (Nielsen, 2011).

Workshops were two hours, with activities enabling participants to share their design ideas on the format within the web-based program, their preferences for receiving education and the language used to deliver the CR modules. Set cues were used to guide the discussion:

1. Could you use it without help?
2. Is the navigation of the website clear?
3. Is the language clear and easy to understand?
4. Does it look good?

The prototypes were revised based on participants' comments, and then specifications or design requests were given to the website developer. The redesigned prototypes were then reviewed at the following workshop; this sequential process continued from workshop one to six.

3.3.7.2.3 Step three: Usability testing.

The web-based program usability workshop activities facilitated data collection. They included focused discussion about the format within the web-based program, the delivery modes for education, particularly the video, animation and hyperlinks, font size and general aesthetics. Usability testing also sought to elicit participants' perceptions of the web-based programs' relevance and applicability as a CR program. The website's usability was explored

through access to the website, with a demonstration and user-direct access, using iPads or Samsung tablets, guided by set tasks to complete within the web-based program. The outcomes from these workshops influenced further improvements to functionality.

3.3.8 Study procedure.

3.3.8.1 Instruments.

The following questionnaires were administered during the co-design workshops: Demographic, clinical and technology use questionnaires, and the System Usability Scale (see Appendix 4).

3.3.8.1.1 Demographic and clinical.

Participants were asked to fill in the demographic questionnaire at the workshop, including their age, gender, country of birth, education level, occupation, heart condition and attendance at CR.

3.3.8.1.2 Information technology use.

Participants were also asked about their relationship with IT, including their social media platform, internet connection and most used device.

System Usability Scale.

Psychometric evaluation of web-based program development and usability testing was collected using the validated product satisfaction survey, the System Usability Scale (SUS; Appendix 4). The SUS assesses the patient's perception of the product regarding audio, visual, content, usefulness and user-friendliness (Brooke, 1996). The SUS assesses the three core components of the product usability: effectiveness, efficiency and satisfaction according to the user and context of use, using a 10-question Likert scale (Brooke, 1996; Fordham, 2021; Lewis &

Sauro, 2009; Mol et al., 2020). It is a valid instrument with good reliability ($\omega = 0.91$) (Mol et al., 2020). The total SUS score correlated moderately with the Client Satisfaction Questionnaire (CSQ-3; CSQ1 $rs = .49$, $p < 0.001$; CSQ2 $rs = .46$, $p < 0.001$; CSQ3 $rs = .38$, $p < 0.001$) indicating convergent validity (Mol et al., 2020). Participant's preferences are closely represented by their performance during SUS testing. The SUS is scored from 0–100, with a score of 68 indicating okay usability, 68–80.3 good usability and > 80.3 excellent usability (Brooke, 1996).

3.3.9 Data analysis.

3.3.9.1 Quantitative.

The survey and SUS data were analysed using the IBM SPSS Statistics 28.0.0.0. Descriptive statistics were used for continuous measures, including numbers and percentages for participant demographic, clinical characteristics and technology use. The SUS was used to measure objective feedback. Mean scores were compared between the workshops' web development and usability testing rounds with the independent t -Test. SUS score categories were compared between the workshops through the chi-squared test of independence.

3.3.9.2 Qualitative.

This study was underpinned by a phenomenological methodological foundation from a social constructionism approach. Using descriptive phenomenology to apply inductive thematic analysis (TA). This process was guided by Braun and Clark's six-step TA and the UX design framework (see Figure 3.2; Braun, 2022; Rosala, 2019). A professional transcribing service transcribed workshop audio recordings. The de-identified workshop transcripts were entered into NVivo with an electronic record saved of both the transcripts and code books (QRS International Pty Ltd, 2020). Braun and Clark's (Braun, 2022) inductive TA guided the coding of

workshop audio recordings. KN, SC, LG and NB met twice to establish the analysis approach and assign tasks. Familiarisation with the topic was established through organic and subjective coding by KN, SC, LG and NB individually. Nodes were established independently and then examined collaboratively by the researchers involved with the coding to identify themes. KN, SC, LG and NB, along with others in the research team, met once after identifying recurrent themes to confirm the final themes. Verbatim quotes were extracted to illustrate themes and sub-themes.

Reporting bias was mitigated with coders from different research disciplines: nursing, pharmacy, health science and health economics. Furthermore, not all researchers involved with the coding had attended all or some of the workshops. Finally, TA was completed in NVivo, with an electronic record saved of both the transcripts and code books.

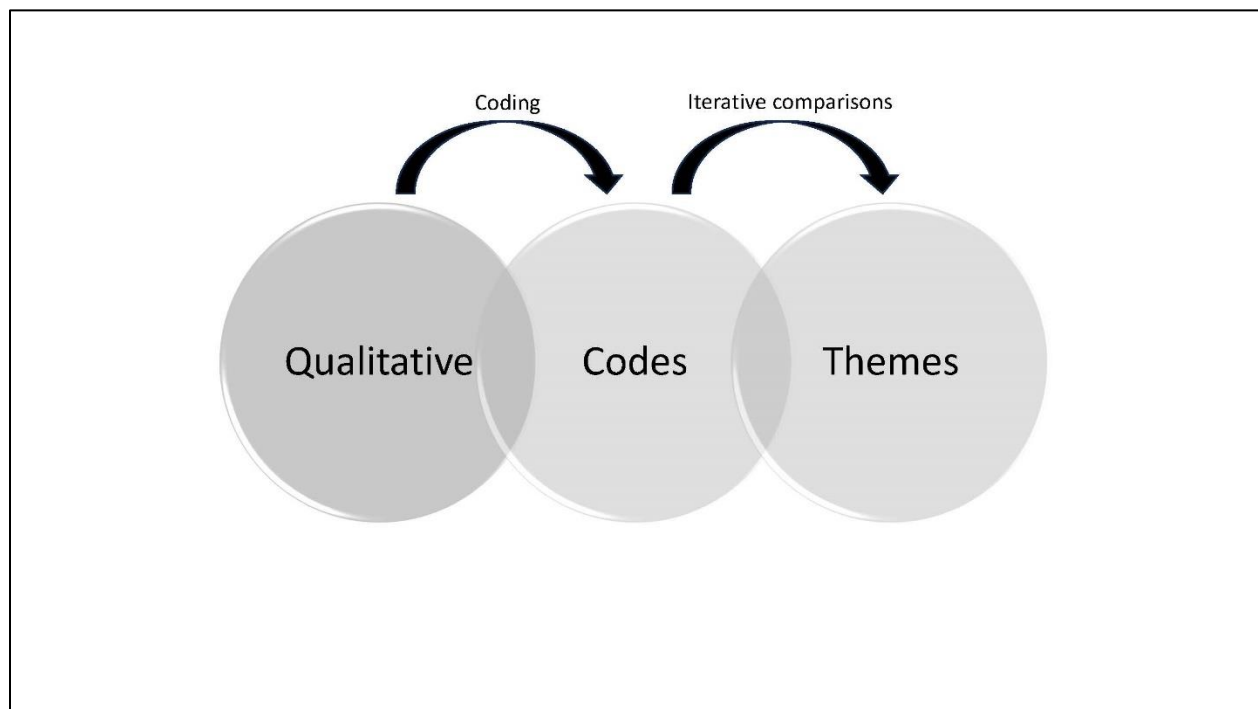


Figure 3.2. UX design thematic analysis.

3.3.10 Ethical considerations.

This study adhered to the ethical principles of the National Health and Medical Research Council's National Statement on Ethical Conduct in Human Research 2007 (updated 2018). Ethical approval was obtained from the Southern Clinical Human Research Committee (SA HREC) and the Southern Adelaide Local Health Network Director, Office for Research (266.20), from 23 October 2020 until 23 October 2023 (see Appendix 5). Site-specific approval was also granted (EGR/20/RSS/15-19; see Appendix 6). This study was managed by the College of Nursing and Health Sciences at Flinders University and adheres to the principles outlined in the Declaration of Helsinki. All eligible participants provided informed written consent before the workshop (see Appendix 7).

The ethical issues identified for this study were participant coercion and confidentiality of participants. The researcher liaised with the CR clinician in each region to minimise coercion, who approached participants to participate in the workshop. The researcher then provided the CR clinician with a workshop outline and invitation for participants, which they sent or gave to participants. From here, participants were told the workshop's date, time and location. Participants were advised that they were free to withdraw at any time, with no impact on current or future treatment with their service. Researchers met participants for the first time at the workshops, with the organising CR clinician in attendance. At this point, participants were allowed to read and sign the study consent.

Confidentiality was maintained by all workshop documents with a number corresponding to the participant. Therefore, the questionnaires and scales were grouped according to their number. All audio recordings were downloaded and saved in the university's

secure drive, to which only the researchers have password-protected access. These audio recordings were transcribed by a transcription service sanctioned by Flinders University. These same transcripts only identified participants as male or female.

The researchers have published and presented the results in high-impact peer-reviewed journals, conferences and research seminars. Only de-identified data was used, with audio recordings and transcriptions not being made available, providing a data availability statement at publication.

3.4 Evaluation of the Implementation of the Web-Based CR Program

3.4.1 Rationale *RE-AIM*.

Research methods are needed to evaluate the significance of health interventions in the public space (Glasgow et al., 1999; Health Economics Research Group, 2008; Selby & Slutsky, 2014). Too often, effectiveness-based research models are limiting, inappropriate for real-world applications, intensive and expensive (Glasgow et al., 1999; Starfield, 1998). Implementation project assessment is multidimensional, reporting on how well an intervention was delivered, what happened during the implantation process, who was involved and how they behaved (Hwang et al., 2020). RE-AIM can be used to evaluate randomised controlled studies and studies with other designs, and it is compatible with evidence-based health interventions.

The RE-AIM evaluation model includes:

- *Reach* the total number, percentage and representativeness of those patients participating in the intervention. In this model, representativeness describes the patients included as reflecting the larger population who will use the intervention.

- *Effectiveness* refers to the influence of the intervention on outcomes, such as patient-reported experience, clinical and service level outcomes, defining homo and heterogeneity of the population using the service.
- *Adoption* measures the total number, percentage and representativeness of staff and service setting participating in establishing the program.
- *Implementation* is undertaken at the setting level and considers the fidelity of intervention user, including consistency of use and delivery, any adaptations made to the intervention or implementation itself and program costs.
- *Maintenance* reflects how the program will endure and, if so, how it is integrated into routine service practices and policies (Glasgow et al., 1999).

The web-based CR delivery model was implemented in rural and remote South Australia in this phase. The research team worked closely with our clinical partner, the Integrated Clinical Cardiac Network (iCCnet), to translate and implement the web-based CR program.

iCCnet was developed to support general practitioners and nurses in rural and remote areas, providing expert case management of web-based CR participants. It is a state-wide provider clinical network that supports the practice of evidence-based cardiac care and continuous quality improvement in managing cardiovascular disease. Currently, iCCnet delivers CR via telephone and face-to-face programs and is available to all rural and non-metropolitan patients in South Australia (see Appendices 8 and 9). iCCnet routinely collects data from CR programs across the state and undertakes six- and 12-month follow-ups for rural and remote patients.

The evaluation of this project was guided by the Heart Foundation of Australia, the European Society of Cardiology, The International Council of Cardiovascular Prevention and Rehabilitation Guidelines for CR (Abreu et al., 2020; Aktaa et al., 2022; Grace et al., 2016; National Heart Foundation of Australia, 2019a, 2019b).

3.5 Methods

3.5.1 Study design.

This study reports on the outcomes from the evaluation of the implementation process utilising a descriptive observational prospective study design guided by the RE-AIM framework and Standards for Reporting Implementation Studies (StaRI) checklist (Glasgow et al., 1999; Pinnock et al., 2017). A descriptive observational study is designed to describe the distribution of one or more variables, not seeking to establish causation or hypotheses (Aggarwal & Ranganathan, 2019). Cross-sectional studies are descriptive, where disease and exposure are measured concurrently. Cross-sectional studies provide a *snapshot* of the frequency and characteristics of a disease in a population at a particular point in time. Despite data being used to assess the prevalence of acute or chronic conditions in a population, it is not possible to determine whether the exposure preceded or followed the disease since exposure and disease status are measured at the same point in time; thus, cause and effect relationships are not certain (Grimes & Schulz, 2002). They are often longitudinal, for which the ensuing outcomes of interest occur after the study commencement (Aggarwal & Ranganathan, 2019; Centre for Epidemiology and Evidence, 2019). Therefore, the chosen study design for this study is descriptive, observational, analytic and cross-sectional (see Figure 3.3).

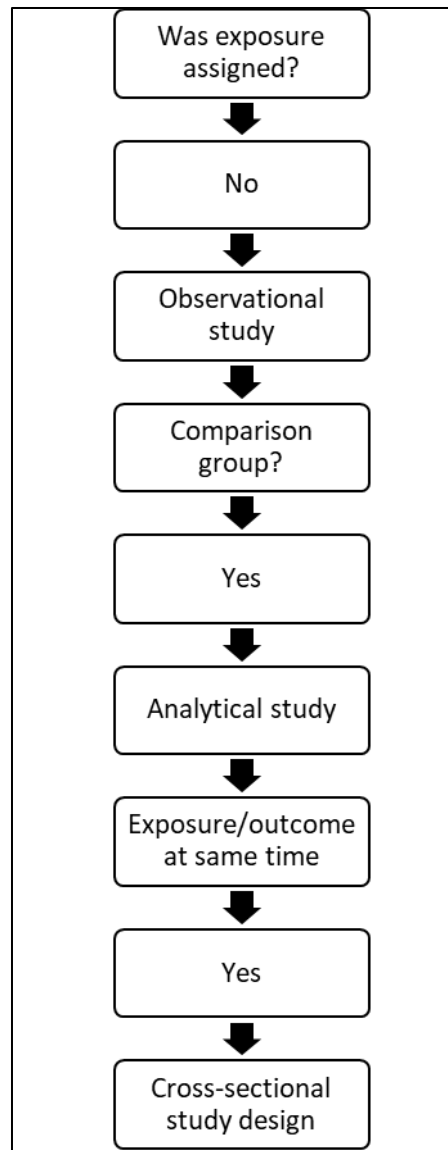


Figure 3.3. Study design flowchart.

The methodology applied to the development and evaluation of the implementation of a web-based CR program emanates from the Model for Large Scale Knowledge Translation. This framework seeks to engage, educate, execute and evaluate the implementation process of this program, including assessing its effectiveness on attendance, completion and improvements in clinical risk factors (Pronovost, Berenholtz & Needham, 2008).

3.5.2 Aim.

To implement a web-based CR program for clinical use to improve attendance and completion of CR.

3.5.3 Objective.

To evaluate the implementation process of the web-based CR program for use in clinical practice.

3.5.4 Participants.

Participants who were eligible for CR and living in rural and remote areas were included in this project. In this study, the choice of treatment was made by the patients along with the CR clinician at the point of referral to a CR service (see Figure 3.4). The implementation period was from 1 July 2021 to 30 June 2022. Eligible participants were categorised according to current guidelines by diagnostic-related groups (DRG) based on ICD-10 associated with acute MI (121, 121.0, 121.1, 121.2, 121.3, 121.4 121.9), hypertensive heart disease (111.0, 111.9, 113, 113.0, 113.2, 113.9), ischaemic heart disease (120–125), arrhythmias (148, 148.0, 148.2, 148.3, 148.4, 148.9, 149.9) and/or heart failure (150, 150.0, 150.1, 150.9 (Chew et al., 2016). Eligibility was also based on DRG codes for coronary bypass graft, percutaneous coronary intervention and ventricular assist devices (Independent Hospital Pricing Authority, 2019).

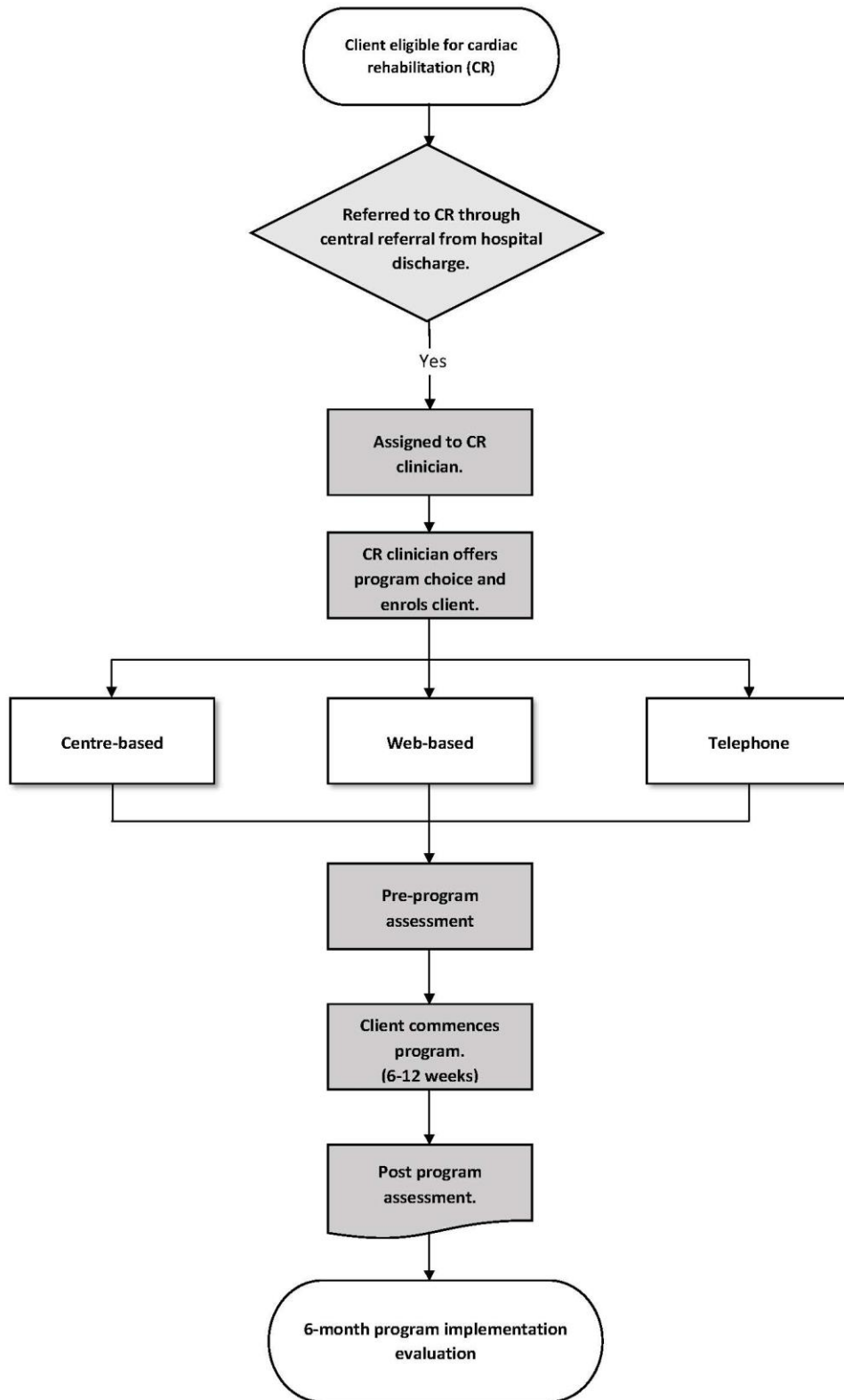


Figure 3.4. Participant referral process.

3.5.5 Data collection.

On average, 2,000 patients are referred annually to iCCnet for CR through the Country Access to Cardiac Health (CATCH) program in rural and remote SA (see Appendices 8 and 9). The CATCH database collects data systematically across rural and remote South Australia. The data include electronic data capture of patients moving through face-to-face, telephone and web-based CR services (Tideman et al., 2015).

3.5.6 Setting.

South Australia's regional, rural and remote population comprises around 7 million people—about 29% of the population (Australian Bureau of Statistics, 2019). This study provided web-based CR to a broad cross-section of regional, rural and remote South Australians. There were six regional, rural and remote LHNs included in the implementation of this study: Barossa Hills Fleurieu, Eyre and Far North, Flinders and Upper North, Limestone Coast, Riverland Mallee Coorong, Yorke and Northern, and patients referred for a telephone CR service.

Data was collected from the iCCNet CATCH database from 1 July 2021 to 30 June 2022. The CATCH database collects data systematically across remote, rural and metropolitan South Australia. These data include electronic data capture of patients moving through the public CR services (Tideman et al., 2015).

3.5.7 Recruitment and consent.

All consecutive patients eligible for CR were included according to the recommended DRG codes and referred for CR (Woodruffe et al., 2015). A waiver of consent for CR participants was applied for and approved; given that the development of alternative models of CR is a

quality improvement activity for iCCnet, the research is a negligible risk, and it is impractical to obtain consent from the expected large volume of CR participants. ICCnet provided all data in a coded, de-identified format via a secure transfer system.

3.5.8 Sample size.

This research is a sub-study of the CHAP project, and a sample size calculation has been reported for the larger study (Beleigoli et al., 2022); however, the sample size for this sub-study was insufficient for a powered effectiveness study. Therefore, it measured implementation outcomes sufficient to meet the objectives of this study.

3.5.9 Study procedure.

Data was extracted from the iCCnet database. Reach, effectiveness, adoption, implementation and maintenance were reported on, addressing CR attendance, CR completion, CR modalities used (web versus usual care), demographic characteristics, clinical outcomes, patient and clinician-reported experience measures survey (see Appendices 10 and 11) and program fidelity.

3.5.9.1 Variables, data sources and measurements.

The variables assessing and describing the implementation process are defined by RE-AIM and come under reach, effectiveness, adoption, implementation, and maintenance, as shown in Table 3.1. These variables and outcomes measure are specific to this study.

Functionality and stability have been previously assessed through usability testing and patient and clinician beta testing.

Table 3.1

RE-AIM Variables, Measures and Outcomes

	Variables/measures/outcomes
Reach	
Per cent individuals who participate	• Enrolments-among the eligible or the referred. • CR sites participating
Demographic characteristics of Web-based CR patients compared to non-web-based	• Demographic and clinical characteristics
Effectiveness	
Measure of primary outcome attendance and completion of Web-based CR (Measure of short-term attrition (%) and differential rates by patient characteristics (gender, age <65 or ≥65 y, source of referral) or treatment condition and comparisons across the modes of delivery	• Descriptive
Measure of clinical outcomes	• BP • BMI • Weight • LDL • HbA1c
Measure of subgroups gender, age	• Descriptive
Patient and clinician-reported experiences.	• Qualtrics survey
Waiting time to commencement across the groups	• Descriptive
Adoption	
Per cent of staff invited that participate	• CR participating sites (reported in REACH)
Patient and clinician participation	• Demographics • In REACH/effectiveness, enrolments per site
Implementation	
Completeness of data entry by patient	• Fidelity (data completion, modules completed)
Maintenance – Individual Level	
Measure of primary outcome (with or w/o comparison) at ≥ 6mo follow-up after final intervention contact	• Logistic regression
Maintenance- Setting Level	
If program is still ongoing at ≥ 6-month post-study funding	• Narrative
If and how program was adapted long-term (which elements were retained after program was completed)	• Narrative
Some measure/discussion of alignment to organisation mission or sustainability of business model	• Not measured or reported.

3.5.9.1.1 Program attendance, completion demographic and clinical data.

We reported attendance, completion, demographic and clinical data obtained from iCCnet. Attendance was achieved by completing ≥ 1 module or attending ≥ 1 session and completion of $> 75\%$ of modules or program sessions. Clinical outcomes included BMI, weight, LDL, glycated haemoglobin A1C (HbA1), SBP and DBP.

3.5.9.1.2 Survey.

It is well established that patient-reported experience measures are key healthcare quality indicators collected through surveys informing service improvement (Song, 2019). They reflect the impact of the process of the care received by a patient, such as their experience with communication, treatment timelines and outcomes. We sought to understand patient and clinician experience with the web-based program to address *adoption*. Patient and clinician-reported experiences were sought via an online Qualtrics survey that was developed through an iterative process involving clinicians, consumer representatives and SA coalition members, with it being endorsed by SA coalition members. Semi-structured surveys were developed by consensus among researchers with expertise in CR and implementation. The survey contained 36 questions (eight open-ended, 16 flexible multiple choice and eight multiple choice) and was offered online (see Appendix 10). Clinicians were invited via email and postal mail with a prepaid envelope. Their survey contained 11 questions (one open-ended and 10 multiple choice; see Appendix 11).

3.5.9.1.3 Fidelity.

A critical factor in moving the area of web-based CR forward is the measurement of fidelity during the comparison of interventions (An, Dusing, Harbourne, Sheridan & Consortium,

2020). Fidelity's origin meaning is 'faithfulness'; thus, applied to this study, it means the measurement of the faithful and correct implementation of the core components of a web-based CR intervention (An et al., 2020). It can protect against deviating from the intended form of delivery, the process of which itself is necessary for evaluating the effectiveness of web-based CR.

The fidelity of patients to the web-based program was obtained from their modules completed, defined as *dose* (number of sessions completed). *Patient responsiveness* indicates how participants respond to or are engaged by the intervention (completeness of data entry).

Clinicians' uptake of the web-based program was measured from the web-based program data, reporting monthly and cumulative enrolments by the CR service site.

3.5.9.2 Data analysis.

Descriptive and inferential statistics were applied to the analysis of data. First, a descriptive statistical analysis of each variable was performed (univariate analysis), calculating absolute and relative (%) frequencies and means and standard deviations (*SD*) for demographic variables. Subsequently, a bivariate analysis was performed to assess the association between the study variables and the chi-square test. For the clinical variables studied, the unpaired *t*-test was used. Lastly, binominal logistic regression was adjusted for sociodemographic and service-related factors associated with program completion. The 95% confidence intervals were calculated using the Wilson method for small sample sizes for outcomes and interpretation of the study results to address the small sample size of the web-based patients (Brown, Cai & DasGupta, 2001). The *p*-value was significant at ≤ 0.05 . Data were analysed using the IBM SPSS Statistics 28.

3.5.10 Ethical considerations.

Overall project coordination was undertaken at the College of Nursing and Health Sciences at Flinders University. The investigation conforms with the principles outlined in the Declaration of Helsinki. iCCnet provided all data in a coded, de-identified format via a secure transfer system. Consent included a data-sharing permission statement and future long-term follow-up. The researchers provide feedback to key stakeholders such as the Department of Health South Australia by presenting outcomes in publications, seminars and conferences.

3.6 Chapter Summary

This chapter has presented the methodology for co-designing the web-based CR program utilising a multi-method approach based on the UX design framework. This approach sought to co-design the website and evaluate its usability. It has also presented the methodology for evaluating the implementation of the web-based CR program utilising a prospective observational descriptive study design. This approach aimed to evaluate the implementation process of the previously co-designed web-based program through program reach, effectiveness, adoption, implementation and maintenance based on the RE-AIM evaluation model. The purpose of our prospective descriptive observational study was to describe the implementation process of the web-based CR program into clinical use. The results of these studies will be reported in Chapter 4.

Chapter 4: Results

4.1 Chapter Overview

This chapter reports the findings of a study developing, implementing and evaluating a co-designed website for delivering interactive, self-directed CR. It initially outlines the practical steps the researchers took to plan, develop and implement the web-based program for clinical use. It then reports on the results of the web-based program development and usability testing workshops via the published manuscript reporting of the co-design of the web-based CR program. This is then followed by evaluating the implementation of the web-based CR program in a manuscript that has been submitted and is under peer review.

4.2 Introduction

This newly developed web-based program is novel and requires a description of implementation strategies to facilitate answering the question, 'How was this co-designed web-based program developed and implemented into practice?'

4.3 Study Framework

4.3.1 The model for large-scale knowledge translation.

This study utilised the Model for Large Scale Knowledge translation framework, to engage, educate, execute and evaluate, combined with the RE-AIM framework, previously discussed in Chapter 3 (Glasgow et al., 1999; Pronovost et al., 2008). These frameworks proffer a clear methodology for knowledge translation and a collaborative approach for far-reaching dissemination into clinical practice, whereby the overarching problem in a healthcare

intervention can be addressed through local and intimate collaboration (Pronovost et al., 2008).

As shown in Figure 4.1, Stage 4 was pertinent to the web-based CR program implementation study (Pronovost et al., 2008).

Implementing the CHAP model applied in the fourth stage ensures all patients receive the intervention, translating CHAP into practice (Pronovost et al., 2008). Using this framework, we sought to *engage* clinicians and clients in developing the web-based program, provide *education* in its use, and execute this program by launching in conjunction with the ICCNet and CR clinicians. Finally, we *evaluated* the implementation process of this web-based program, including assessing its effectiveness on attendance, completion, and improvements in clinical risk factors. This evaluation is reported later in this chapter.

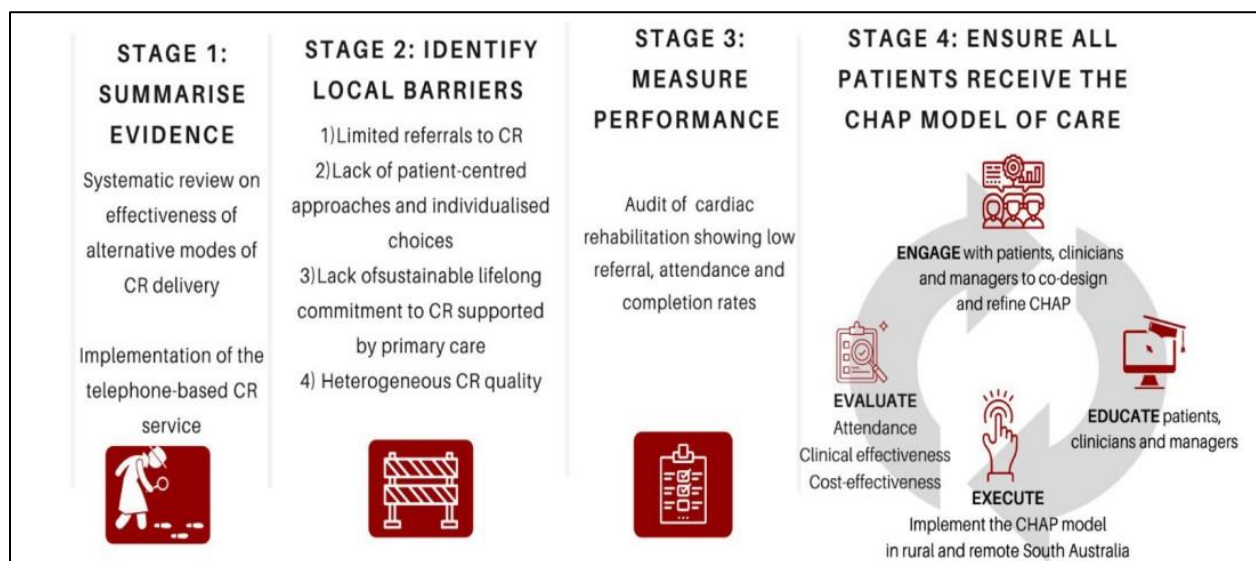


Figure 4.1. The model for large-scale translation. Note. Reproduced with permission (Beleigoli et al., 2022; Pronovost et al., 2008)

4.3.1.1 Engage.

We engaged with ethics, consumers and clinicians involved in CR and IT developers to produce a completed web-based program for CR.

4.3.1.1.1 Ethics.

As previously stated, the study was granted ethical and governance approval (EGR/20/RSS/15-19) by the SA HREC. Participants were identified and approached by CR clinicians in the LHN and completed a consent before commencing the workshop.

4.3.1.1.2 Planning.

Planning began early in 2020, seeking support from the CR clinicians in regional LHNs in South Australia. This contact was initially made via email, with communication examples in Appendix 12. We required their signatures and assistance obtaining the Executive Director Community and Allied Health signatures for site-specific approval in each region. We also sought their willingness to recruit participants and to host us on the day of the workshops.

Table 4-1 outlines the workshop timelines, including locations, number of participants, dates and type of workshop.

Table 4.1

Workshop Locations, Numbers, Dates and Type of Workshop

Site name	Number participants	Date	Workshop (web-development/usability testing)
Mount Gambier	7	November 2020	Website-development
Mount Gambier	5	September 2021	Usability testing
Berri	6	April 2021	Website-development
Berri	6	September 2021	Usability testing
Murray Bridge	6	February 2021	Website-development
Murray Bridge	6	September 2021	Usability testing
Port Lincoln	7	October 2021	Usability testing
Whyalla	6	February 2021	Website-development
Whyalla	6	September 2021	Usability testing
Wallaroo	6	March 2021	Website-development
Nurioopta	8	February 2021	Website-development
Tanunda	4	September 2021	Usability testing

4.3.1.1.3 Execution.

An explicit web-based program-development workshop structure is reported later in this chapter in the form of the published manuscript. Photos from these workshops can be seen in Figure 4.2.

Figure 4.2. Web development workshops.

Prototypes and completed web-based program pages from workshops are shown in Appendix 13. The project commenced with early high-fidelity prototypes provided by the website developers for presentation, and further design input from consumers during workshops evolved these for final design specification. Usability testing workshop structure is also reported in the published manuscript; the photos from these workshops can be seen in Figure 4.3.



Figure 4.3. Usability testing workshops.

The completed web-based program was reviewed by consumers who engaged with the program using Android or IOS tablets, providing structured feedback based on the prompts provided by Appendix 14. Beta testing was conducted via an online Qualtrics survey after an invitation to use the web-based program. Reports for both clinician and patient beta testing are included in Appendices 15 and 16. We beta-tested with participants from the web-based program development workshops through a survey emailed to them. The testing period was from 2 to 11 June 2021. Twelve invites were sent, including to our research pharmacist. There

were three incorrect emails; nine were delivered successfully, with two responses to the Qualtrics survey.

Clinicians in the LHN who had facilitated our workshops participated in beta testing. Sixteen invites were sent on 19 May, with testing closing on 27 May. Reminders were sent on Monday 31 May. Eight clinicians logged into the test web-based program, and four completed the Qualtrics survey.

4.3.1.2 Educate

We applied several strategies to educate about the web-based program and its use, including backup support from the web developer and the clinician-researcher, self-help sheets (see Figures 4.4 and 4.5) and a systematic induction process for eligible CR sites. The intensive induction process occurred from 12 July to 18 August 2021, with ongoing inductions to staff as required. This process took one hour via Microsoft Teams, with the procedure explained using a flowchart, as shown in Figure 4.6. Using a test patient, we then used the web-based program to step clinicians through the procedure for enrolling and setting up patient access and other functions to use the program successfully (see Figure 4.7).

CATCH WEB



Checklist for clinicians

 Referral received from CATCH		1. Check email for new patients from CATCH referral 2. Call patient to confirm engagement with the CATCH CR WEB program. 3. Ensure email address is obtained and confirmed.	☐ ☐ ☐
 Access CATCH web-patient management		 4. ACCESS HERE: https://www.chapproject.com.au/pm/	☐
 Access PATIENT tab		5. Create new patient - complete details and save.	☐
 Access PROGRAM tab and assign to a clinical stream		6. Choose program type (you can choose more than 1): - FACE TO FACE - WEB - COMBINATION 7. Assign to clinical stream (you can choose more than 1): - ACS - HEART FAILURE - CARDIOTHORACIC SURGERY - ARRHYTHMIA	☐ ☐
 Send portal invite to patient		8. Confirm that the email invitation was received by patient (could take a few hours)	☐
 Pre Assessment		9. Contact patient and arrange a face to face or appointment to complete pre- assessment.	☐
 Patient monitoring		10. Check CATCH Web weekly while patient is on their program. To do this: Access CATCH web - click on "Modules" tab; select "self-managed web portal" as Patient view.	☐
 Patient monitoring		11. Monitor progress and respond to messages. Follow up as required.	☐

Figure 4.4. Clinician self-help sheet.



Figure 4.5. Patient self-help sheet.

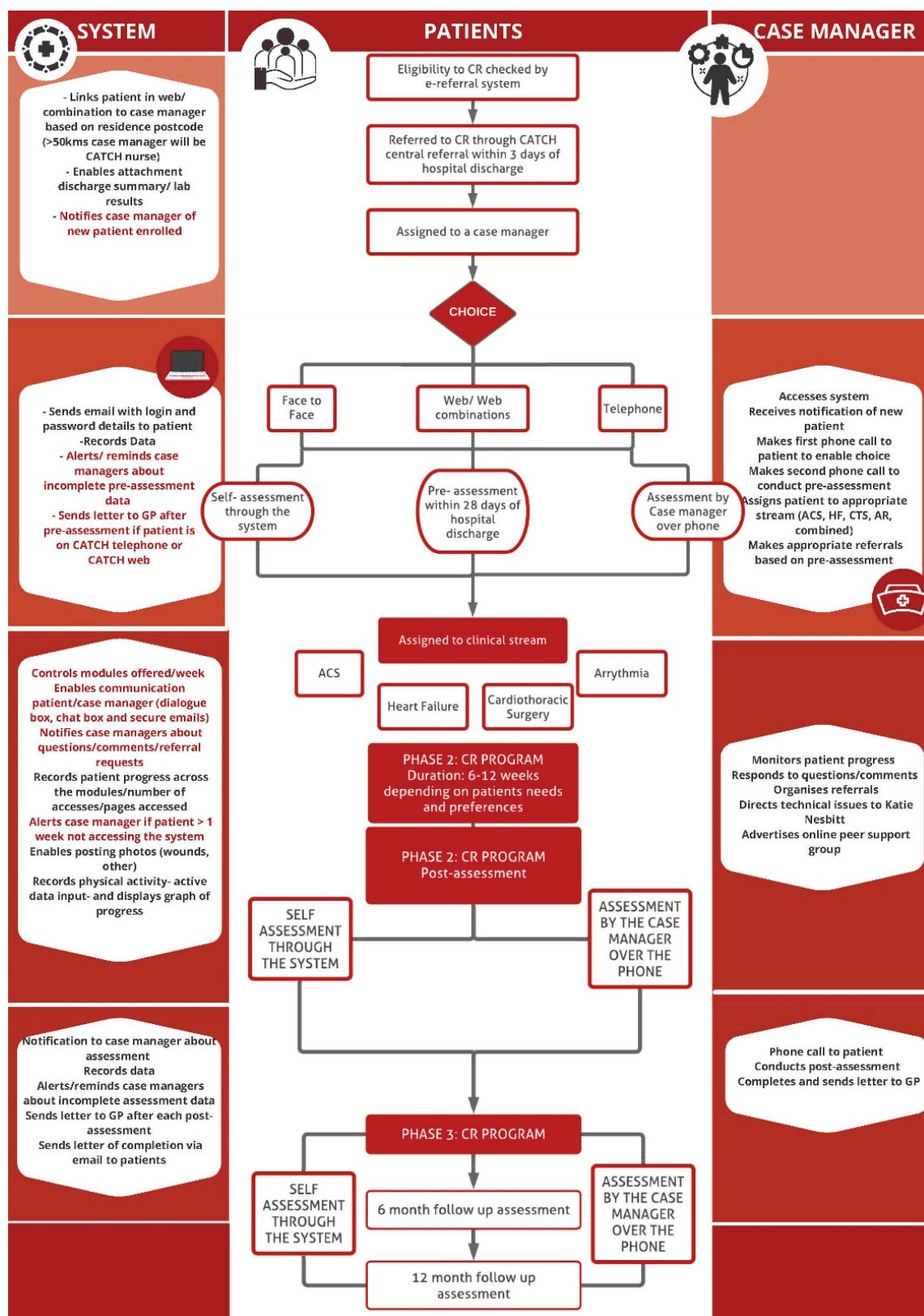
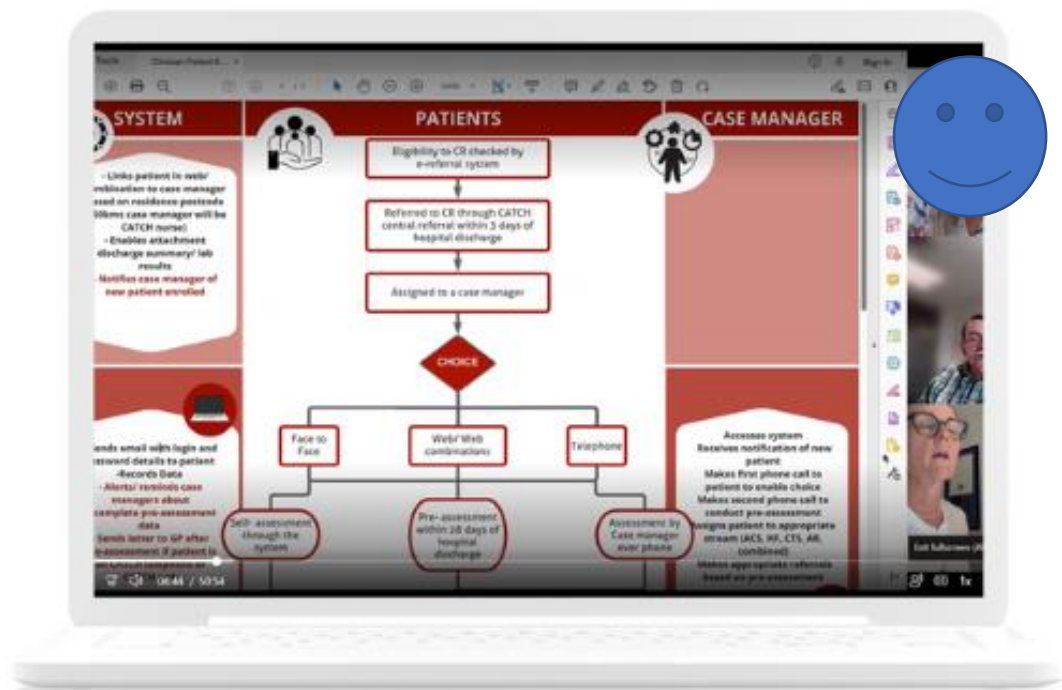


Figure 4.6. Flowchart for induction sessions.



The screenshot shows a patient data entry form titled "A 1000 TEST". The form includes the following fields:

- Title: Mr
- Last Name: A TEST
- Given Names: TEST
- Preferred Name: (empty)
- Date of Birth: 20/01/1980
- Gender: Male
- Region: Eastern SA
- Residential Address: (empty)

At the bottom of the form, there are buttons for "Save", "New Patient", "Cancel/Cancel", and "Print".

On the right side of the laptop screen, there is a video call interface with a blue smiley face icon and a list of participants.

Figure 4.7. Screenshots of induction in progress.

4.3.1.3 Execute.

All components of the web-based program were co-created with consumers using the Australian quality indicators for cardiac rehabilitation, A Pathway to Cardiac Recovery Standardised program content for Phase II cardiac rehabilitation and the European Society of Cardiology Quality Indicators for cardiac rehabilitation accreditation (Abreu et al., 2020; National Heart Foundation of Australia, 2019a, 2019b)

During referral, all patients were given a choice of what modes of delivery they wished to use to complete their CR program, as shown in Figure 4.8. During the referral process, the nurse coordinator reinforced the importance of CR at that point of contact.

Patients could choose how they wished to complete CR from a menu, allowing them to receive CR in any mode or combination of modes they wish. The web-based program mode delivers standardised, evidence-based practice and standardised data collection with online forms for reporting outcomes. This web-based program was co-designed to address the needs of the identified low CR attendee groups, including low socioeconomic, women, disabled, rural and remote, culturally and linguistically diverse populations and patients who wish to return to work early.

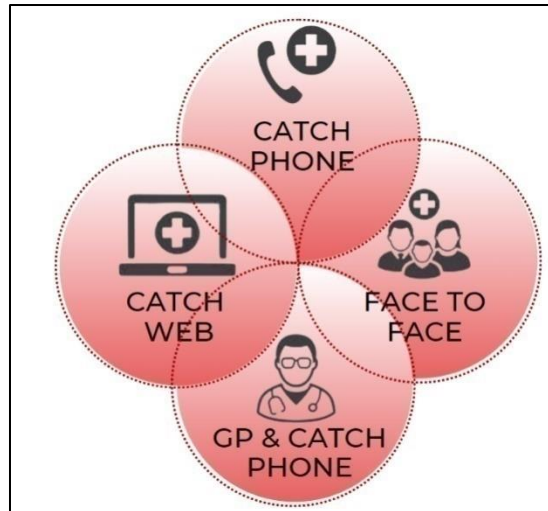


Figure 4.8. Patient program choice.

The web-based program was launched for regional local health network clinician and patient use on 1 July 2021 in collaboration with iCCnet and their CATCH program. The email sent to these sites is shown in Figure 4.9. Clinician induction was undertaken simultaneously, addressing the components of *education* and *execute* from the Model for Large Scale Knowledge Translation framework.

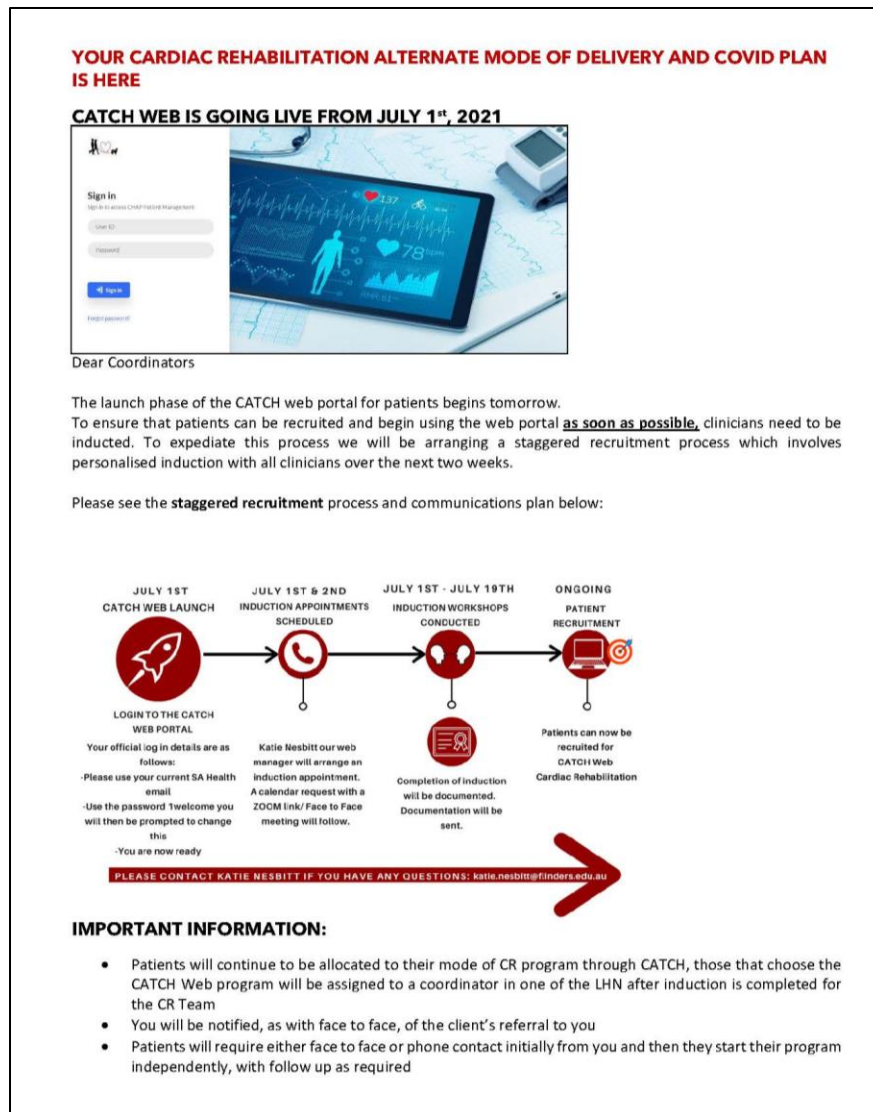


Figure 4.9. Web-based cardiac rehabilitation program launch.

The project delivered a website for CR for both clinician and patient management; the login portal page is shown in Appendices 18 and 19.

Ongoing technical support was provided to clinicians by the research team during the implementation phase, with a complete handover to iCCnet for self-sufficiency in June 2023.

4.3.1.4 Evaluate.

The outcomes of this implementation process were measured using the RE-AIM framework for implementation studies. These findings are presented in the published manuscripts presented later in this chapter.

4.4 Conclusion

The web-based program is a novel intervention in South Australia and, as such, has required specific strategies to facilitate its successful implementation into clinical practice. This intervention included early preparatory work and engagement with ethics, clinicians and website developers. Furthermore were the consumer engagement processes, beta testing, clinician induction and public launch. During this active implementation phase, researchers were present, with an adoption phase completed where researchers are no longer present.

4.5 Summary

Having outlined how this co-designed web-based program for CR was implemented into practice, the specific outcomes from the development, implementation and evaluation of the web-based CR program are now presented in the form of a published manuscript and a submitted manuscript under peer review.

4.6 Co-design of the Web-Based CR Program

This manuscript reports the study's findings in the form of a manuscript published in the European Journal of Cardiovascular Nursing.

4.6.1 Citation.

Nesbitt, K., Beleigoli, A., Champion, S., Gebremichael, L. G., Bulamu, N., Tirimacco, R. & Clark, R. A. (2023). (Published). Development and evaluation of a co-designed website for delivering interactive self-directed CR. *European Journal of Cardiovascular Nursing*.
(Impact factor 3.6)

4.6.2 Authorship and guarantor.

Development and evaluation of a co-designed website for delivering interactive self-directed cardiac rehabilitation.

Author	Contribution
Katie Nesbitt RN, BN, MN	Concept and design Analysis and interpretation of quantitative and qualitative data Drafting/writing the article and critical revision for important concepts Final approval of submitted manuscript
Aline Beleigoli	Concept and design Guidance on analysis approach and checking analysis. Editing
Stephanie Champion	Concept and design Qualitative analysis and interpretation of data Editing
Lemlem Gebremichael	Qualitative analysis and interpretation of data Editing
Norma Bulamu	Qualitative analysis and interpretation of data Editing
Huiyun Du	Editing
Rosy Tirimacco	Editing
Robyn Clark	Concept and design Editing

Candidature Katie Nesbitt

Signed



15 May 2023

Guarantor: I certify the fidelity of the authorship and act as guarantor for all data.

4.6.3 Abstract.

Aim

To report on the development and evaluation of the co-designed website for delivering interactive self-directed CR.

Methods and Results

A multi-method user experience (UX) design framework was used to co-design the web application and complete usability testing. Participants were recruited based on their eligibility for CR. TA collected participants' design specifications and lived experiences. The SUS was administered at the completion of the website development and the usability testing workshops. This scale collected participants' perceptions of the website's effectiveness, efficiency and their satisfaction. Website development and usability testing workshops included 39 and 35 participants with a mean age of 66.5 ($SD = 11.7$) and 68.6 ($SD = 11.2$), respectively. Both genders were equally represented across both workshops, with 19 (48.7%) men and 16 (45.7%) women. Workshop themes guided the design process. Mean SUS scores increased from 66.7 ($SD = 16.8$) to 73.6 ($SD = 21$), $p = 0.26$. Easiness of use ($p = 0.03$), integration of the website functions ($p = < 0.001$) and consistency ($p = 0.038$) significantly improved from website development to usability testing. The proportion of participants rating it as excellent increased from 20.5% to 42.9%, $p = 0.11$.

Conclusion

The evolution of our CR website development was completed with an improvement in usability. The upcoming evaluation of this intervention will report on its effectiveness.

4.6.4 Introduction.

Cardiovascular disease is an established public health burden and the continuing leading cause of death globally (World Health Organization, 2021). It is the most common cause of hospitalisation, with 23.9% of all hospital admissions attributable to cardiovascular disease (Dagenais et al., 2020), burdening global economies through projected increases in health budget spending, with a global forecast increase from US\$863 billion in 2010 to US\$1.04 trillion in 2030 (Benjamin et al., 2019). This upward trajectory of spending is influenced by a reduction in mortality and increases in cardiovascular disease survival. However, cardiovascular disease is largely preventable by addressing modifiable risk factors such as cigarette smoking, unhealthy diet, cholesterol, obesity, high blood pressure and diabetes mellitus (Visseren et al., 2022).

Cardiac rehabilitation is a comprehensive intervention aimed at addressing cardiovascular disease risk factors, available to patients following a diagnosis of heart disease, often preceded by an acute cardiovascular event with hospitalisation (Dalal et al., 2015). CR programs include health education, cardiovascular disease risk reduction advice and physical activity and psychosocial management (Dalal et al., 2015). Despite its effectiveness on mortality, cardiovascular disease risk factor reduction and improving psychosocial wellbeing, poor access to CR is unremitting globally, with only 5–50% of those eligible participating in a rehabilitation program (Dalal et al., 2015).

The internet is an extremely powerful tool for disseminating and accessing health information and maintaining clinical communication. IT is rapidly driving the evolution of healthcare services with online interventions showing encouraging results in improving patients' self-care, quality of life and modifiable risk factors (Wonggom et al., 2020; Wongvibulsin et al., 2021). Remotely delivered CR is an acceptable alternative mode for completing programs (Nabutovsky, Nachshon, Klempfner, Shapiro & Tesler, 2020). Furthermore, consumer engagement with smartphones, messaging and internet use, irrespective of age, is high (Nabutovsky et al., 2020). Despite research into remotely delivered digital applications for interactive, clinician-led CR programs, translation into mainstream healthcare remains inadequate (Wongvibulsin et al., 2021).

Patient engagement is foundational to providing a high standard of healthcare. This engagement has evolved from designing *for* to designing *with*, recognising the inclusion of consumers early in the design process as key to improving patient outcomes (Bombard et al., 2018; Noorbergen, Adam, Teubner & Collins, 2021). Effective change management in the planning and implementation of healthcare requires active engagement and collaboration with service users. Co-design is best described as 'an approach to designing with, not for, people' (McKercher, 2020, page 14) and is successfully undertaken when four key principles are applied to the process: sharing of power, prioritising relationships, using participatory means and building capacity (McKercher, 2020). Several studies (Brewer et al., 2017; Devi et al., 2014; O'Shea et al., 2020; Rawstorn et al., 2016; Walsh et al., 2019) have conducted acceptability and feasibility testing, explored patient's perception of products and applied a form of co-design to the development of digital programs before, during and after their testing CR platforms.

However, early engagement in the design of interventions and along the design continuum is not commonly attended to and/or explicitly reported on (Green et al., 2020; Slattery et al., 2020).

The CHAP Project is a National Health and Medical Research Council-funded project that is developing, implementing and evaluating a model of care and clinical pathway for the translation of CR and secondary prevention guidelines into practice for rural and remote patients in Australia. With the main aim of increasing attendance to and completion of CR and as a strategy, a co-designed, interactive, clinician-led web-based CR program was developed to increase flexibility and provide choices to patients. The website program content was based on Phase 2 CR education modules as recommended by current guidelines (Aktaa et al., 2021; National Heart Foundation of Australia, 2004, 2019a). This study co-designed the website through two rounds of six workshops. Round one focused on website development and co-designing with participants, and round two was usability testing of the completed website. It was then launched for clinical use in collaboration with the Integrated Cardiovascular Clinical Network through their CATCH program, which manages all regional and rural CR referrals (Tideman et al., 2015).

Our study aimed to develop a web application CR program to improve CR access for rural and remote South Australian populations through a web-based CR delivery model. The objectives were to co-design a web-based CR program for patients with cardiovascular disease and to evaluate the usability of the web-based CR program.

4.6.5 Methods.

Overview

This was a multi-method study, adopting a qualitative and quantitative approach concurrently, as guided by user design (UX) methodology. UX design is an established co-design methodology for developing and integrating a consumer-ready intervention (Will, 2020). It typically uses a multi-method approach through observational techniques, task analysis and other feedback instruments, such as feedback forms and surveys (Philips, n.d.). The design stages are on an interchangeable continuum, including empathy, describing or defining the task or problem, ideating, prototyping and testing, seeking to understand the problem and those most affected by it, and providing definition to action. This process then guides the development of ideas and prototypes, allowing a product to be tested (Murallie, 2021).

The conceptual framework for UX design highlights the evaluative process, which comprises an observational assessment (the user's perspective on the design), psychometric scales (user self-evaluation) and psychophysiological measures (the body's response when interacting with the design; Rico-Olarte et al., 2018). This study employed two of the three processes: observational assessment and a psychometric scale.

The qualitative approach was framed by social constructionism using a phenomenological approach, defining workshop outlines and content, including questions proposed to participants and data analysis. This process involved two rounds of six co-design workshops for website development and usability testing. Co-designers collaborated with researchers iterating high-fidelity computer-generated prototypes during website development and interacted with the completed website during usability testing.

Procedures

The website development and usability testing workshops were conducted in six rural LHNs. The same CR services were attended, except for one LHN that was unavailable for usability testing and replaced with an alternate service. All workshops included the same participants, from website development to usability testing. Patients and family members living in rural and remote areas of Australia were invited to participate based on their eligibility for CR as outlined by the National Heart Foundation of Australia (2004). Patients were included if they had experienced unstable angina, non-ST-segment elevation and ST-segment elevation MI, stable angina, coronary artery bypass surgery, percutaneous coronary interventions or heart failure (National Heart Foundation of Australia, 2004). This study also included participants with valve devices, permanent pacemakers and implantable defibrillators, heart transplants and arrhythmias (National Heart Foundation of Australia, 2004). Participants were adults aged 18 years and above. The study was granted ethical and governance approval (EGR/20/RSS/15-19) by the SACHRECe. Participants were identified and approached by CR clinicians in the LHN and completed a consent form before commencing the workshop.

The empathy and definition in the design process had been previously established, enabling the ideation and testing phases to be conducted in this study (Beleigoli et al., 2022). During the website development workshops, participants worked with researchers iterating high-fidelity computer-generated prototypes using iterative, parallel and competitive processes (Nielsen, 2011). Workshops were two hours and conducted as a group activity, enabling participants to share their design ideas on the format within the website, their preferences for

receiving education and the language used to deliver the CR modules. While looking at the prototypes, set cues were used to guide the discussions. Cues included the following questions:

1. Could you use it without help?
2. Is the navigation of the website clear?
3. Is the language clear and easy to understand?
4. Does it look good?

Usability workshop activities facilitated data collection and included small groups of 2–4 participants with tablets and time to engage with the site and content freely. These groups discussed formatting within the website, the educational delivery modes, particularly the video, animation and hyperlinks, font size and general aesthetics. They were guided by a checklist of tasks to complete while using the website, fostering an independent experience. Usability testing also sought to elicit participants' perceptions of the website's relevance and applicability as a CR program.

Outcomes

Observational assessments of participants' lived experiences and design specifications were achieved through audio recordings that were transcribed verbatim.

The psychometric outcome measure employed was a validated product satisfaction survey, the SUS, administered after the website development workshops and the usability testing workshops. The SUS is a simple 10-item Likert scale giving an overall subjective assessment of usability (Brooke, 1996). The selected statements in the SUS cover various aspects of system usability, including effectiveness, efficiency and satisfaction (Brooke, 1996; Fordham, 2021). Participants ranked each statement from 1 (*strongly disagree*) to 5 (*strongly*

agree) based on how much they agreed with the statement (Brooke, 1996). The SUS is scored from 0–100, with a score of 68 indicating satisfactory usability, 68–80.3 good usability and > 80.3 excellent usability (Brooke, 1996). Reliability analysis shows the 10 items on the SUS having acceptable reliability, $\omega = 0.91$ (Lewis & Sauro, 2009; Mol et al., 2020). Convergent validity has been established through correlation with the three items on the Client Satisfaction Questionnaire (CSQ-3), $r=0.49$, 0.46 and 0.38 (Mol et al., 2020).

Qualitative Analysis

A professional transcribing service transcribed workshop audio recordings. The de-identified workshop transcripts were entered into NVivo with an electronic record saved of both the transcripts and code books (QRS International Pty Ltd, 2020). Braun and Clark's (Braun, 2022) inductive TA guided the coding of workshop audio recordings. KN, SC, LG and NB met twice to establish the analysis approach and assign tasks. Familiarisation with the topic was established through organic and subjective coding by KN, SC, LG and NB individually. Nodes were established independently and then examined collaboratively by the researchers involved with the coding to identify themes. KN, SC, LG and NB, along with others in the research team, met once after identifying recurrent themes to confirm final themes. Verbatim quotes were extracted to illustrate themes and sub-themes.

Reporting bias was mitigated with coders being from different research disciplines: nursing, pharmacy, health science and health economics. Furthermore, not all researchers involved with the coding had attended all or some of the workshops. Finally, TA was completed in NVivo, with an electronic record saved of both the transcripts and code books.

Quantitative analysis

The survey and SUS data were analysed using IBM SPSS Statistics 28.0.0.0. Descriptive statistics were generated for continuous measures. The SUS was used to measure objective feedback. Mean SUS scores were compared between the website development and usability testing rounds of the workshops using the independent *t*-test. SUS score categories were compared between the workshops through the chi-square test.

Sample size

No formal power calculations were used as this study applied a workshop and descriptive approach, for which it is not indicated. However, the UX design methodology reports that sample sizes for formal usability studies require 10–12 participants, while less formal usability studies require 4–5 participants (Sova & Nielsen, 2003). Therefore, this study aimed to recruit 10 participants per workshop, overrecruiting by 2 participants, allowing for attrition.

4.6.6 Results.

A total of 74 participants were recruited for the two rounds of six workshops for website development ($n = 39$) and usability testing ($n = 35$; see Table 4.2). Females were equally represented across both workshops, 19 (48.7%) and 16 (45.7%; see Table 4.2). Participants were predominantly Australian-born, 28 (71.8%) and 26 (62.8%), with mean ages of 66.5 ($SD = 11.7$) and 68.6 ($SD = 11.2$), respectively (see Table 4.2).

Table 4.2

Participant Characteristics

Characteristics		Website development workshop <i>n</i> = 39 (%)	Usability workshop <i>n</i> = 35 (%)
Age, mean (SD)		66.5 (11.7)	68.6 (11.2)
Sex	Male	20 (51.3)	18 (51.4)
	Female	19 (48.7)	16 (45.7)
Workshop	Mount Gambier	7 (17.9)	5 (14.2)
	Whyalla	6 (15.4)	6 (17.1)
	Murray Bridge	6 (15.4)	6 (17.1)
	Barossa	8 (15.4)	4 (11.4)
	Wallaroo/Port Lincoln	6 (15.4)	8 (22.8)
	Berri	6 (15.4)	6 (17.1)
CR program completion	Yes	39 (100)	25 (71.4)
Employment status	Employed full-time	7 (17.9)	4 (11.4)
	Employed part-time	6 (15.4)	3 (8.6)
	Unemployed	2 (5.1)	2 (5.7)
	Retired	24 (61.5)	25 (71.4)
Education level	Primary education	3 (7.7)	2 (5.7)
	Secondary education	19 (48.7)	15 (42.8)
	Certificate	9 (23.1)	11 (31.4)
	Advanced diploma	3 (7.7)	2 (5.7)
	Bachelor's degree	5 (12.8)	3 (8.6)
Country of birth	Australia	28 (71.8)	26 (74.2)
	England	8 (20.5)	3 (8.6)
	Other	3 (7.7)	5 (14.2)

Note. SD = standard deviation, CR = cardiac rehabilitation.

More than half of the participants had an MI, 24 (61.5%) (see Table 4.3).

Table 4.3

Participant Cardiovascular Conditions

Cardiovascular condition	Website development workshop <i>n</i> = 39 (%)	Usability testing workshop <i>n</i> = 35 (%)
Acute myocardial infarction	24 (61.5)	16 (45.7)
Coronary artery bypass graft	3 (7.7)	5 (14.2)
Heart failure	3 (7.7)	3 (8.6)
Coronary artery disease	5 (12.8)	11 (31.4)
Spontaneous coronary artery dissection	1 (2.6)	2 (5.7)
Cardiac effusion	1 (2.6)	1 (2.3)
Atrial Fibrillation	2 (5.1)	7 (20)
Percutaneous coronary intervention	4 (10.2)	6 (17.1)
Heart transplant	0	1 (2.8)

Note. Participants reported ≥ 1 condition/s.

Concerning IT engagement, most used a smartphone, 27 (69.2%) and 22 (62.8%), National Broadband Network internet connection, 27 (69.2%) and 18 (51.4%), and Facebook, 31 (79.5%) and 20 (57.1%), respectively (see Table 4.4).

Table 4.4

Participants Information Technology Characteristics

Information technology characteristics		<i>n</i> = 39 (%)	<i>n</i> = 35(%)
Technology	Smartphone	27 (69.2)	22 (62.8)
	iPad/Tablet	19 ((48.7)	15 (42.8)
	Home computer	24 (61.5)	15 (42.8)
	No technology use	1 (2.6)	1 (2.8)
Internet connection	NBN connection	27 (69.2)	18 (51.4)
	Home internet	9 (23.1)	8 (22.8)
	SIM card on phone	9 (23.1)	8 (22.8)
	No internet connection	0	3 (8.6)
	Other	1 (2.6)	1 (2.8)
Social media	Facebook	31 (79.5)	20 (57.1)
	WhatsApp	7 (17.9)	6 (17.1)
	Instagram	10 (25.6)	5 (14.2)
	LinkedIn	3 (7.7)	3 (8.6)
	Twitter	4 (10.2)	3 (8.6)
	TikTok	0	2 (5.7)
	No social media use	0	8 (22.8)

Note. NBN = National Broadband Network.

4.6.6.1 Themes identified.

Five primary themes were identified that reflected participants' preferences for the appearance and functionality of the website:

1. managing fear of the unknown
2. usability
3. connectivity
4. format of information
5. behaviour change empowerment (see Appendix 17).

These themes highlighted the reasoning behind the design preferences and usability outcomes measured by the SUS while emphasising the required commitment to recovery and behaviour change. Of these primary themes, managing fear of the unknown was reviewed and categorised as an overarching theme as it pervaded all workshops without specificity to precise design ideas. These themes were common to all groups in the website development and usability workshops, with a more substantial presence in usability testing.

4.6.6.1.1 Managing fear of the unknown.

Managing fear of the unknown permeated workshop discussion, indirectly influencing the development of the website and confirming its current and future role in CR program modalities. Sub-themes from managing fear of the unknown were the gap between cardiac events and commencing a CR program, lack of or overwhelming information, the benefit of hybrid CR and how these themes can positively impact mitigating fear.

The workshops explored managing fear of the unknown and how the gap or time lag from hospital discharge and Phase 1 CR to commencing Phase 2 CR contributed to this. Participants found this to be a 'no man's land' situation where they were overwhelmed while also lacking knowledge about what had happened, what should be happening and what would happen.

Furthermore, participants identified that contributing to their fear during this period was a lack of information or, alternatively, too much complex information, often relating to new medications or starting medications for the first time. Many expressed concerns that they could not remember vital information about their new routines or what the medications themselves were for and their side effects: 'The problem I found with that is it went in one ear

and out the other. I really wasn't in the state where I could consider what they were saying. It took me all my time to decide what I had to remember and what I ... worry about trying to remember'.

The website was discussed throughout the workshops, with participants favouring it as a formal alternative or hybrid program modality and a discharge program, or CR Phase 1b. This approach would address the knowledge gap, with patients accessing information and education in a format and timeframe that circumvented brain fog and fear in the early days after hospital discharge.

Participants in the co-design and usability testing workshops had all completed a traditional centre-based program with positive patient-reported outcomes. However, they felt the option to complete a hybrid program would maximise the benefits of CR. This hybrid option was explored, identifying its potential to positively impact patients who may return to work early, allow for last-minute non-attendance, complete a week at home due to unforeseen circumstances inhibiting in-person attendance and facilitate deeper knowledge acquisition through the website's content. Participants shared their positive experiences with their own CR program, which was centre-based and conducive to community and comradery building, thus allaying fear and the sense of being alone when newly diagnosed. Their reflections elicited some thoughts on how the website could replicate if only in part, this crucial factor in managing fear.

Participants had also enjoyed the contact and support of their CR clinician throughout their program and sought to know how this would be addressed if completing CR via the

website. This consideration was established before conducting development workshops, with a clinician-led and managed program planned.

4.6.6.1.2 Usability.

During website development workshops, participants discussed the nuances around UX and technology, highlighting program set-up/accessibility/access, ease of login, and limitations and benefits of activity tracking. Participants felt that either personal guidance by the CR clinician or a readily available checklist would be required to eliminate obstacles in setting up their program; ongoing ease of use would help if the process were overwhelming or confusing. Ideas around how this could be approached included a telephone and email support system, a checklist or tips and tricks list received at enrolment, and the option to set up with the clinician at the pre-assessment appointment.

Ease of login was topical early on and in all website development workshop discussions. Problem-solving around this issue included having a clear and uncomplicated login page, with the capacity to remember a password if using a private device, and instructions on how to save the icon to the home screen of a smart device or bookmark the website URL on a computer: 'The only thing that I sort of do and have found, you can go into login do the whole thing and then I go in a second time, can't find it or you get lost; that is where I have got caught a number of times'.

When shown the high-fidelity prototype login page, participants responded with concerns about the size of the login invitation, suggesting it be larger, since it is the first thing seen: 'What you want people to do is to log in, so that should be prominent. That should be the first thing they see'.

During usability testing workshops, the login function was not assessed as we used a generic logged-in test program. Participants did, however, respond to the completed website login page positively regarding the earlier request for simplicity in set up and use: 'The basic setup is, yeah user friendly, easy to read'.

Further thoughts about usability expressed were reporting activity, with participants showing examples of how this could look on the website and asking about how activity could be measured and reported if not using a wearable device. They accepted the current medium within the website for entering activity data based on minutes and type but highlighted the need for significant personal motivation to benefit from this setup.

4.6.6.1.3 Format of information.

During the website development workshops, while viewing the high-fidelity prototype images, participants discussed what design aspects would make the information on the website interesting and meaningful, particularly regarding its positive impact on behaviour change. Feedback and design ideas focused on colour, naming and design of module icons, goal setting, program progress display, video/pictures/font size/ over text and language used within the website. Initially, when workshopping design ideas, participants expressed a general concern about keeping it uncomplicated and simple to avoid confusion in the use of and understanding of content.

The colours presented on the prototypes were met with underwhelmed impressions, as our early prototypes had a brown-maroon colour. Participants agreed that brown was not an appealing colour: 'Looks like a dodgy bank. It actually, it's almost puts a block in front of you, it makes you apprehensive, it needs to be a more inviting colour, it's the wrong colour'. However,

they agreed on brighter colours, such as purple or blue, with the website using this final design input.

Further design input was given on the prototypes of the home page containing the list of modules to be completed by the client. The discussion focused on the colour of the icons and the picture represented on the icon. Participants liked the descending list of modules; however, they suggested the icons be blue and represent the module's content. This design element evolved over the development workshops, utilising a parallel and competitive iterative process, until we had a version with representative white pictures and a blue background that participants loved.

Goal setting is essential to behaviour change, with intrinsic motivation as the most powerful factor in positive change (Deci, 1985). The early website prototypes for the goal-setting fields presented to participants were a basic box format with a free-text field for goal-setting. Participants discussed the pros and cons of this free-text option, suggesting a pre-populated drop-down option menu or a combination of both.

They identified that goal setting early in their own CR journey can be an overwhelming and negative experience, often only being able to establish one quite simple goal in the early days. They addressed the need to keep it simple. Therefore, the aesthetic of the goal-setting field did not change, with the ability to write down four goals maintained and only one goal as mandatory, indicated by a red asterisk, with the option to add more or change as clients progress through their program.

The early iterations of the website CR modules displayed the client's progress by page number (e.g., 9 of 30). Participants felt this could lead to frustration and feeling overwhelmed:

‘It’s just that when you see 22 of 109 it feels like you’re climbing a mountain. And ... you want to climb a little hill; you don’t want to be climbing a mountain’. Participants discussed that a simple yet effective approach to address this while still tracking module progress was to have a progress bar, often used in exercise videos, displaying a percentage of completion.

A critical area of design input that was highly impactful on the final website was how educational content was displayed and communicated. Participants overwhelmingly preferred audiovisual formatting, videos, infographics, pictures and links. However, many said they would also like corresponding text for more in-depth reading if so desired. The prototypes evolved with these design specifications iterated. They also suggested that the combined modules, smoking cessation and alcohol, be separate, reflecting the variety of CR risk factor modifications required by clients rather than a one-size-fits-all approach. The completed website included all three design specifications and participant specifications relating to the language on the website and specifically to module titles.

4.6.6.1.4 Connectivity.

Internet availability and device ownership play a key role in client engagement with digital health interventions. Accordingly, while discussing design specifications, participants shared their thoughts on issues around age and technology use, poor internet access and data usage costs in rural areas. They also highlighted the need for the website to be device-agnostic: ‘Consider platforms the website is available on, not just desktop/laptop’. We tested and showed this on tablets, smartphones and laptops during the usability testing workshops.

4.6.6.1.5 Behaviour change empowerment.

While reflecting on their own journey post-cardiac event and the upheaval it can bring, participants identified the need for the education and general information on the website to be framed positively. Change is a pervading reality, be it goal setting around diet, smoking, weight or activity and is inevitably overwhelming. Participants emphasised that communicating risk modification education in an approachable, connected manner can increase intrinsic motivation to start changing behaviours and develop long-term habits: 'Because quite often people, they need hope and if you can get it right, and people see that, then they'll think okay, I can see where this is going', and 'Or how can, you know even change the terminology, how can we talk about quitting smoking or, initial assessment and goals, again I think that's a bit clinical'.

These insights influenced the design of the infographics, with educational information presented with interesting and enjoyable alternatives. Furthermore, videos focused on clients' understanding of the cardiovascular system and condition, empowering knowledge and behaviour change thinking. This content was received as reassuring, positive and empowering: 'What I'm saying is, this computer, the way they wrote this program, even though I had no education, it connected with me. And that's what you need to be able to do with this'.

4.6.7 Usability evaluation.

There was an improvement in the mean SUS scores, from 66.7 ($SD = 16.8$) during website development to 73.6 ($SD = 21$) in the usability testing phase, $p = 0.26$ (see Figure 4.10).

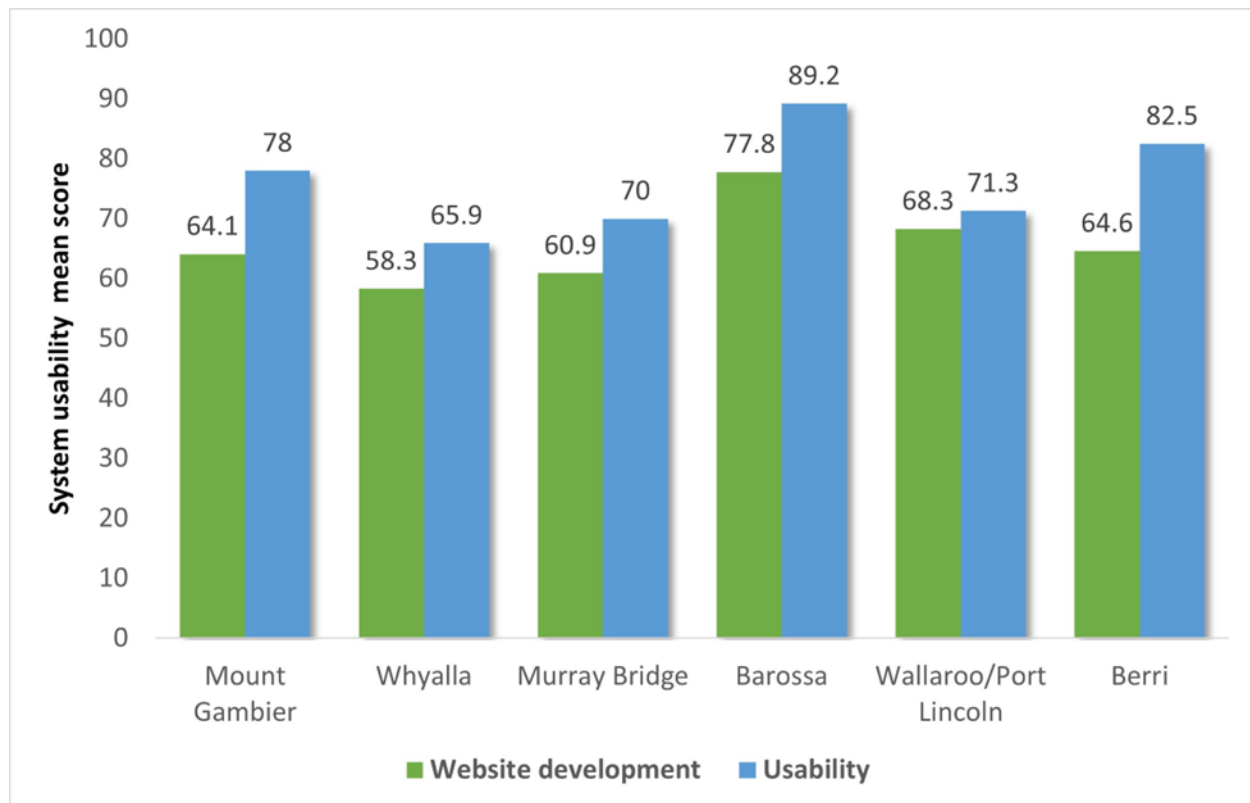


Figure 4.10. Improvement in mean System Usability Scale score.

The proportion of participants rating it as excellent increased from 20.5% to 42.9%, $p = 0.11$. The individual mean SUS scores were non-significant between website development and usability testing; however, Questions 3 (*I thought this website was easy to use*, $p = 0.03$), 5 (*I found the various functions in this website were well integrated*, $p = < 0.001$) and 6 (*I thought there was too much inconsistency in this website*, $p = 0.038$) were significant (see Table 4.5).

Table 4.5

Mean Individual System Usability Scale Scores

Question Number	Question	Website development workshop (<i>n</i> = 39), mean (SD)	Usability workshop (<i>n</i> = 35), mean (SD)	P-value*
1	I think that I would like to use this website frequently	3.7 (1.1)	4.2 (1.0)	0.08
2	I found this website unnecessarily complex	2.1 (1.0)	2.1 (1.2)	0.95
3	I thought this website was easy to use	3.4 (1.0)	4.0 (2.0)	0.03*
4	I think I would need assistance to be able to use this website	2.2 (1.1)	2.5 (1.4)	0.25
5	I found the various functions in this website well integrated	3.8 (0.9)	4.2 (1.0)	<0.001*
6	I thought there was too much inconsistency in this website	2.4 (1.0)	2.1 (1.4)	0.038*
7	I would imagine that most people would learn to use this website very quickly	3.5 (1.0)	4.0 (1.0)	0.05
8	I found this website very cumbersome/awkward to use	2.3 (1.1)	1.9 (1.3)	0.23
9	I felt very confident using this website	3.6 (1.1)	4.0 (1.3)	0.21
10	I need to learn a lot of things before I could get going with this website	2.3 (1.2)	2.3 (1.5)	0.91

Note. * p-value < 0.05 significant.

4.6.8 Discussion.

For this study, we organised co-design workshops on website development and usability testing, attended by individuals who had completed or were undertaking a centre-based CR program following a precipitative cardiac event or diagnosis and their family members. The mean age of participants and their technology and social media use was consistent with current

literature (Jin et al., 2019; Nabutovsky et al., 2020). During the workshops, participants explored their needs, preferences and perceptions regarding remotely delivered CR via a web-based program. Themes were identified across the website development and usability testing workshops, informing on design features enabling parallel and competitive iterative processes, resulting in the final website. Participants input defined specific needs within the website for usability and interactive and engaging content. The usability of the completed website improved from the website development to the completion phase.

Digital CR programs are successful alternative modalities to centre-based CR, with recent studies indicating either similar to or greater improvement in outcomes to centre-based programs and providing worthy alternatives to a centre-based, supervised program (Wongvibulsin et al., 2021). Furthermore, it has been shown that people with cardiovascular disease who are situationally limited in attending centre-based CR preferred a home-based program (Grace, McDonald, Fishman & Caruso, 2005). Despite the plethora of studies and research in remote digital CR, these alternative options are not widely available, nor are they progressing to clinical integration.

Web-based CR can potentially engage patients who cannot attend or are wary of engaging in a centre-based program. In one study, more than half of the participants stated that had they not done their program remotely via a web program, they would not have attended at all (Brough et al., 2014). Non-adherence to remotely delivered digital CR presents similar issues to centre-based delivery as outlined in previous studies (Wongvibulsin et al., 2021). The development of this website, through the co-design process, has addressed non-adherence by incorporating features such as program streaming based on cardiovascular

disease diagnosis, personal goal setting and the ability to communicate through private messaging with their CR clinician. Furthermore, the notification function to clinicians from a patient's program allows these clients to be integrated into current CR services.

4.6.9 Limitations.

The main limitation of this study was that participants had all completed a face-to-face CR program, which means that the co-design lacked the input of those who had declined or dropped out of their program. We mitigated this selection bias by clinicians being the ones recruiting participants. The trust relationship between the clinician and the participants might have helped with the engagement of participants who would have been otherwise less likely to participate.

Member checking on the interpretation of quotations was not permitted as names were not used during the workshops, with further de-identification of these group discussions in the transcription process. Finally, the generalisability of these findings to groups with low literacy and non-English speaking populations is limited due to the high proportion of people with a high education level and English as a first language in the workshops.

4.6.10 Conclusion.

Co-design is a rapidly emerging approach in person-centred research; however, studies are often not explicit in presenting details of the developmental framework, methods and reporting of co-design outcomes (Eyles et al., 2016; Noorbergen et al., 2021). Our website has been co-designed using a framework that guided workshops, website development planning, execution, data collection and reporting. This website has been incorporated into regional and metropolitan CR services in South Australia, being made available to patients referred for CR. It

has the potential to address known barriers to attending centre-based CR and enhancing behaviour change empowerment.

The evolution of our CR website development was completed with improved usability. During the usability evaluation, its role as a hybrid or bridging program was identified, contributing positively to the uncertainty experienced by cardiovascular patients after an event, diagnosis and hospital discharge. Further evaluation, based on the quality indicators for CR accreditation and clinical outcomes, will provide evidence of its effectiveness, patient-reported outcomes and experiences.

4.6.11 Conflict of interest.

The authors declare that there is no conflict of interest.

4.6.12 Acknowledgements.

This research was made possible with the country cardiac consumers and CR clinicians who gave their time to organise and participate in the workshops; without their collaboration, this program would not exist.

4.6.13 Funding.

This work is part of the CHAP Project, funded through a National Health and Research Medical Council (NHRMC) partnership grant (GNT 1169893).

4.6.14 Data availability.

All data are incorporated into the article and its online supplementary material. The data sets generated during and analysed from this study are not publicly available due to participants being identifiable if sharing the data from participation in the workshops.

4.7 Evaluation of the Implementation of the Web-Based CR Program

This manuscript reports the study's findings in the form of a manuscript that has been submitted and is under peer review.

4.7.1 Citation.

Nesbitt, K, S. Champion, L. Gebremichael, Foote, R.A. Clark, and A. Beleigoli, on behalf of the NHMRC CHAP Partnership Project Team. (Under peer review). Evaluation of the implementation of a co-designed interactive web-based cardiac rehabilitation program in rural South Australia. *Journal of Telemedicine and Telecare*. (Impact factor 5.6)

4.7.2 Authorship and guarantor.

Author	Contribution
Katie Nesbitt RN, BN, MN	Concept and design Analysis and interpretation of quantitative data Drafting/writing the article and critical revision for important concepts Final approval of submitted manuscript.
Stephanie Champion	Concept and design Checking of analysis and interpretation of data Editing manuscript
Jonathon Foote	Data cleaning. Editing manuscript
Lemlem Gebremichael	Editing manuscript
Norma Bulamu	Editing manuscript
Robyn Clark	Concept and design Editing manuscript
Alline Beleigoli	Concept and design Guidance on analysis approach and checking analysis and interpretation of data Editing manuscript

Candidature Katie Nesbitt
Authorship and guarantor:



16 October 2023

Guarantor: I certify the fidelity of the authorship and act as guarantor for all data.

4.7.3 Abstract.

Introduction. Involvement in cardiac rehabilitation programs reduces death and reoccurring cardiac events, but CR attendance is poor globally. The aim of the project was to evaluate the effectiveness of a co-designed, interactive web-based CR program as an alternative mode of delivery to improve access and attendance.

Method. This study reports on the outcomes from the implementation process evaluation utilising a descriptive observational prospective study design guided by the RE-AIM framework.

Results. A total of 828 rural patients were enrolled in CR, with 50 choosing the web-based CR program. Web patients were younger, 60 years ($SD \pm 11.9$) versus 68.5 years ($SD \pm 11.9$). The proportion of males did not differ between web 17 (34%) and usual care 195 (23.5%, $p = 0.167$). Program completion was higher for usual care than for the web-based patients (17, 34% v. 553, 71.4%, $p < 0.001$). Web-based patients reported a positive overall experience (77.8%). Clinicians reported the web-based program as high quality (71.4%). Patient fidelity to entry of self-reported data was high for the web-based patients, with all patients completing a pre-assessment. Web-based program enrolment was associated with a lower chance of CR completion (OR 0.19; 95% CI: 0.10, 0.37; $p < 0.001$) after adjustment for age and gender.

Conclusion. The web-based program provides an alternative flexible mode to complete CR. It has been integrated and successfully used by patients and clinicians, capturing a cohort not attending a CR program. Strategies for improving the completion of web-based programs need further investigation.

4.7.4 Introduction.

The role of secondary prevention for cardiovascular disease is well established, with contemporary CR emerging over the last 50 years as outpatient structured programs (Turk-Adawi et al., 2019). It is generally offered as an outpatient program delivering education and secondary prevention interventions, including education around risk factor management and reduction, structured exercise and psychosocial interventions (Grace et al., 2013; Piepoli et al., 2014) to people who have experienced acute coronary syndrome, stable angina, coronary artery bypass surgery, percutaneous coronary interventions and heart failure (Piepoli et al., 2014). Current programs remain poorly attended, with referral and non-attendance rates reported up to 70% (Dalal et al., 2021).

A web application or web app is a software program that runs on a web server (Christensson, 2017, 17 February) with web-based CR program design varying, including programs delivered through a smartphone app (Varnfield, Karunanithi, Lee et al., 2014a), websites (Brough et al., 2014; Devi et al., 2014; Duan et al., 2018; Houchen-Wolloff et al., 2018), phone text messaging (Dale et al., 2015), remote exercise monitoring (Maddison et al., 2019) and VW (Brewer et al., 2017). Regardless of the individual differences among the programs reported, they all positively impact CR attendance (Chong et al., 2021).

To increase attendance to and completion of CR, a co-designed, web-based CR program was developed to increase flexibility and provide choices to patients. The web-based CR program content was based on CR education modules as recommended by the Heart Foundation of Australia and the European Society of Cardiology current guidelines (Aktaa et al., 2022; Grace et al., 2013; National Heart Foundation of Australia, 2019a, 2019b). This approach

was then implemented in collaboration with the iCCnet, which receives and administers CR referrals for patients to services in rural and remote South Australia. This study aimed to describe the effectiveness of the web-based CR programs implementation in clinical use in rural Australia.

4.7.5 Methods.

Study design participants and setting

This study reports on the outcomes from the evaluation of the implementation process of the web-based CR program following its co-design development phase (Nesbitt et al., 2023; Nesbitt, Beleigoli, Du, Tirimacco & Clark, 2022) utilising a descriptive observational prospective study design guided by the RE-AIM framework (Glasgow et al., 1999). The RE-AIM evaluation model incorporates five steps: reach, effectiveness, adoption, implementation and maintenance (Glasgow et al., 1999). Implementation project assessment is multidimensional, reporting on how well an intervention was delivered, what happened during the implantation process, who was involved, and how they behaved (Hwang et al., 2020). Patients who were eligible for CR living in a rural and remote area were included in this project. In this study, the choice of treatment was made by the patients with the CR clinician at the point of referral to a CR service (see Figure 4.11).

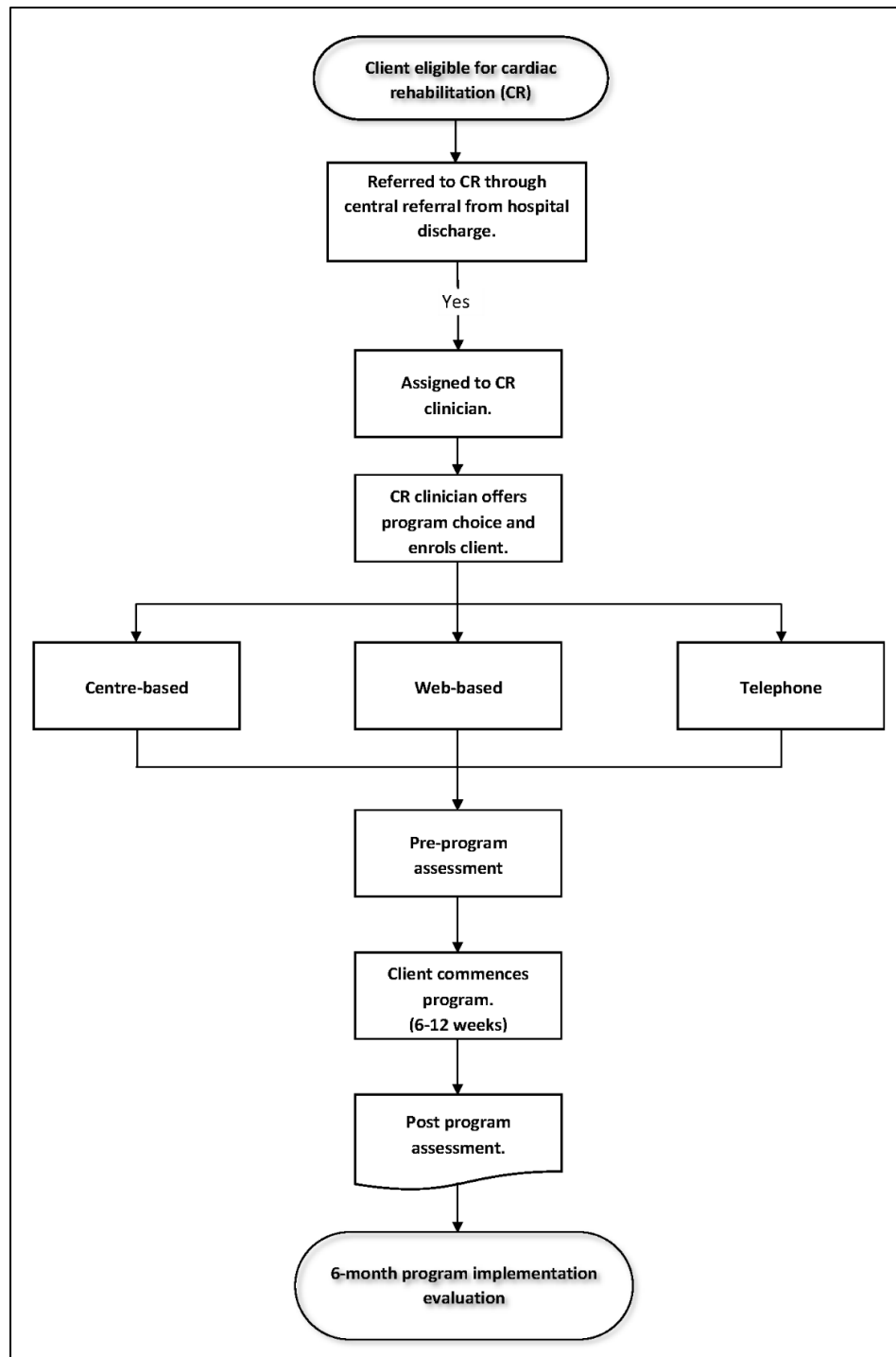


Figure 4.11. Enrolment process and program choice.

The implementation period was from 1 July 2021 to 30 June 2022. The objectives were to describe patient demographic, referral and clinical outcomes, monthly enrolment and

participating CR services, attendance and completion of the web-based CR program, patient and clinician-reported experiences and fidelity to data entry.

Data was collected from the CATCH database (Tideman et al., 2015). The CATCH database systematically receives referrals for patients who live in remote and rural South Australia upon hospital discharge. This information includes electronic data capture of patients moving through telephone and face-to-face CR services.

The study variables demographic characteristics, referral reason, attendance and completion data were obtained from iCCnet, as were clinical outcomes: SBP, DBP, BMI, weight, LDL and HbA1c (see Table 4.6).

Table 4.6

RE-AIM Variables, Measures and Outcomes

	Variables/measures/outcomes
Reach	
Per cent individuals who participate	Enrolments-among the eligible or among the referred CR Sites participating
Demographic characteristics of Web-based CR patients compared to usual care-based	Demographic and clinical characteristics
Effectiveness	
Measure of primary outcome attendance and completion of Web-based CR (Measure of short-term attrition (%) and differential rates by patient characteristics (gender, age <65 or ≥65 y, source of referral) or treatment condition and comparisons across the modes of delivery	Descriptive
Measure of clinical outcomes	BP BMI Weight LDL Glucose
Measure of subgroups gender, age	Descriptive
Patient and clinician-reported experiences. Waiting time to commencement across the groups	Qualtrics survey Descriptive
Adoption	

	Variables/measures/outcomes
Percent of staff invited that participate	CR participating sites (reported in REACH)
Patients and clinician participation	Demographics In REACH/EFFECTIVENESS, enrolments per site
Implementation	
Completeness of data entry by patient and by clinician	Fidelity (data completion, modules completed)
Maintenance – Individual Level	
Measure of primary outcome (with or w/o comparison) at ≥ 6 mo follow-up after final intervention contact	Logistic regression
Maintenance- Setting Level	
If program is still ongoing at ≥ 6 -month post study funding	Narrative
If and how the program was adapted long-term (which elements retained after program completed) This is a tough one to measure.	Narrative
Some measure/discussion of alignment to organisation mission or sustainability of business model	Not reported

Attendance was achieved by completing ≥ 1 module and completing $> 75\%$ of modules. Patient and clinician-reported experiences with the web-based program were sought via an online Qualtrics survey developed through an iterative process with clinicians and consumer representatives. Fidelity, the extent to which an intervention was delivered as intended, and the accuracy and completeness of completed modules of patients to the web-based program were obtained from their online progress of modules completed (Carroll et al., 2007).

All data were provided by iCCnet in a coded, de-identified format via a secure transfer system. Consent includes a data-sharing permission statement and future long-term follow-up.

Data analysis

First, a descriptive statistical analysis of each variable was performed (univariate analysis), calculating absolute and relative (%) frequencies and means and *SDs* for demographic variables. A bivariate analysis was performed to assess the association between the study variables with the chi-square test for nominal variables or the unpaired *t*-test for continuous variables. The binomial logistic regression adjusted for socio/clinical characteristics (age, gender, employment, program location, referral reason, BMI) and service-related factors (i.e., program choice) associated with program completion. A calculation of 95% confidence intervals using the Wilson method for small sample sizes was conducted for outcomes and interpretation of the study results while also reporting a *p*-value significant at ≥ 0.05 (Brown et al., 2001). Data were analysed using IBM SPSS Statistics 28.

4.7.6 Results.

Reach

There were six regional, rural and remote LHNs within South Australia included in the implementation of this study.

Enrolment

The number of regional or rural patients enrolled in a CR program between 1 July 2021 and 30 June 30 2022 was 828 (web-based CR 50, usual care 778; as shown in Figure 4.12) out of 4,915 referred participants. Of these, 736 attended/completed the program (6.8% web-based CR program and 93.2% usual care).

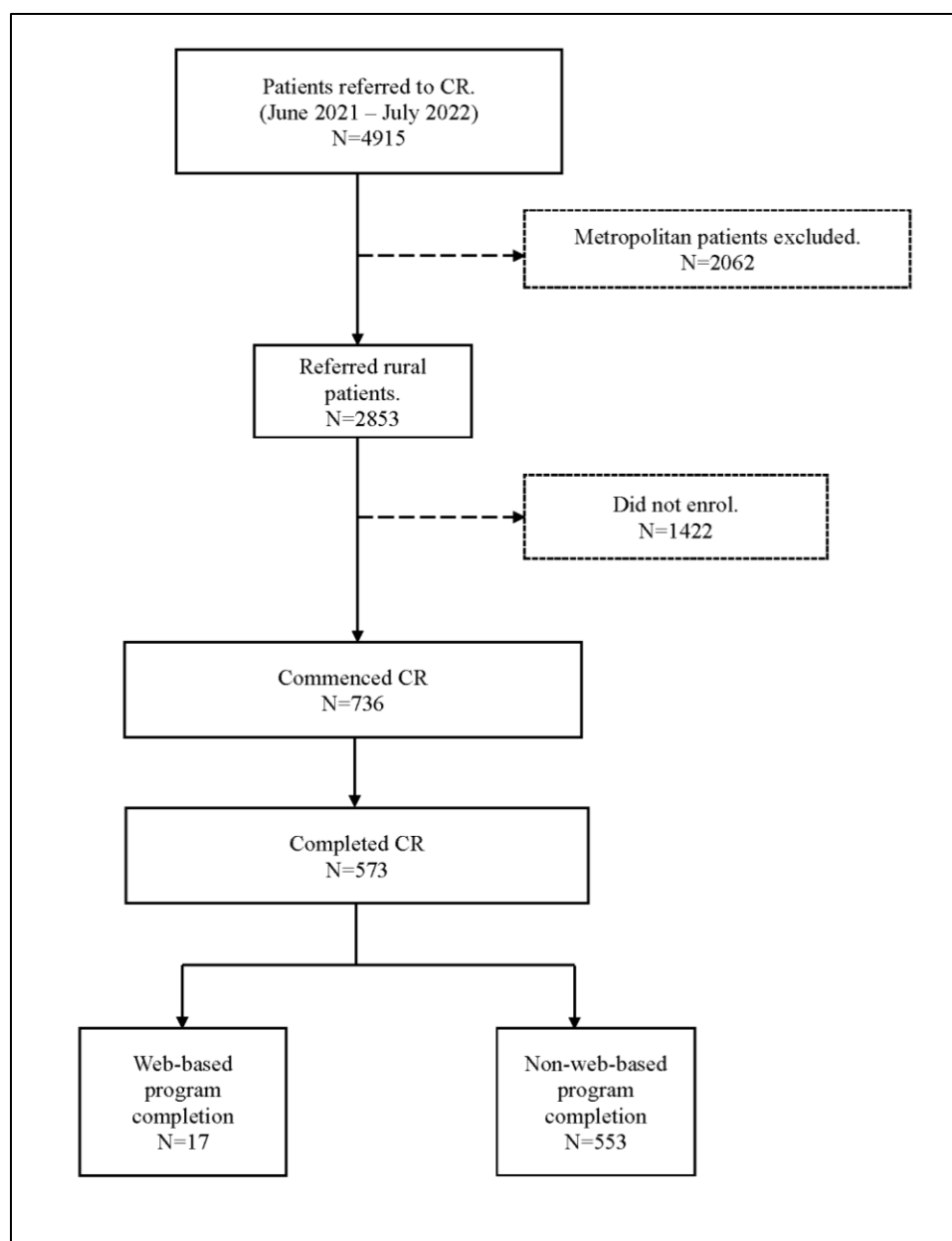


Figure 4.12. Enrolment number flowchart. *Note.*CR = cardiac rehabilitation.

Monthly web enrolments were highest in November and January 2022, with a concurrent reduction in usual care enrolments in November 2021, 17 (5%, 95% CI 0.0, 0.1) and December 2021, 21 (6.2%, 95% CI 0.0, 0.1) from 59 (17.5%, 95% CI 0.1, 0.2) in October 2021. There was a median monthly web enrolment of 3 (IQR = 1–15), as shown in Figure 4.13.

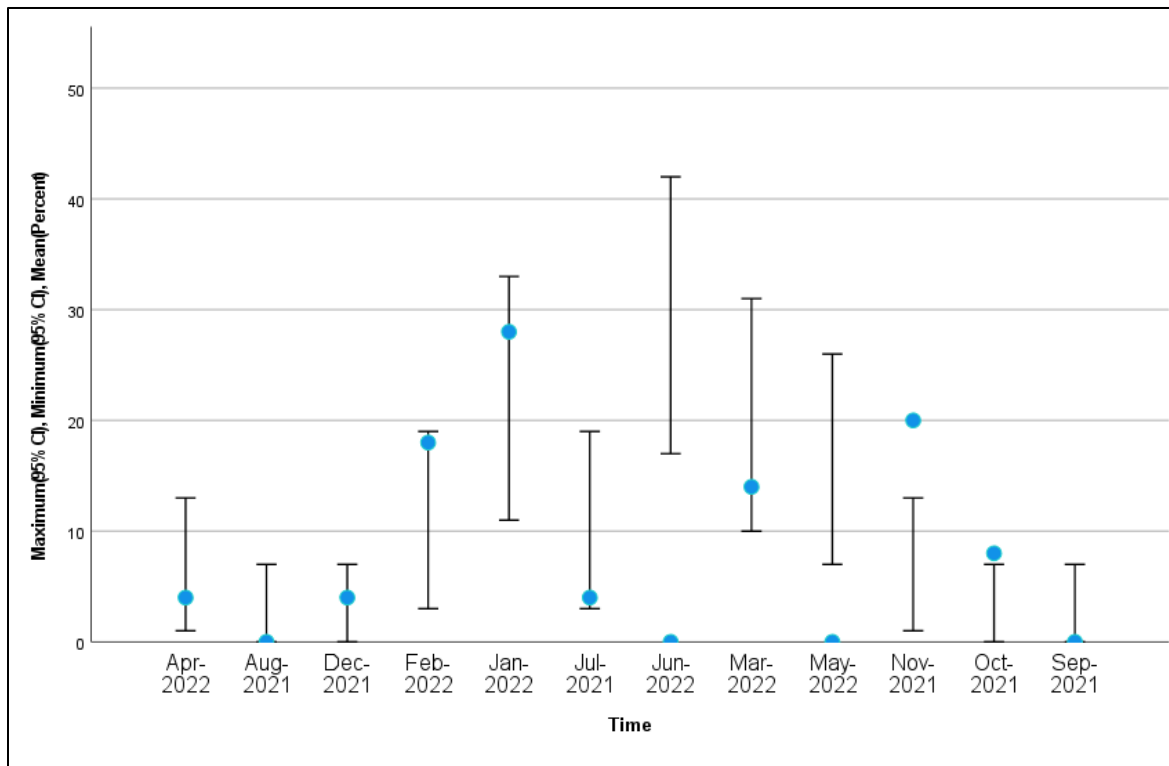


Figure 4.13. Web-based cardiac rehabilitation monthly enrolment. *Note.* CI = confidence interval, 95% CI calculated by Wilson method.

Patients' demographic and referral characteristics

Table 4.7 presents demographic and referral characteristics. Compared to usual care, web patients were younger (60, $SD = 11.9$ v. 68.5 years, $SD = 11.9$; $p = <0.001$). However, there was no significant difference between web and usual care patients regarding other demographic characteristics and referral reasons. Sex distribution did not differ between web, 17 (34%) males, and usual care, 195 (23.5%), $p = 0.167$. Most were born in Australia, web-based CR program (9; 90%) and usual care (344, 97.4%), $p = .535$ and lived with others, web-based CR program (29, 85.3%) and usual care (536, 77.7%), 0.162. At least half were retired in both groups, web-based CR program (16, 46% v. 402, 59%), $p = 0.254$. MI was the predominant reason for referral in both groups (64.3% v. 35.6%), $p = 0.051$.

Table 4.7

Participant Demographic and Referral Reason

Baseline characteristic	*Web-based <i>n</i> = 50 (%)	*Usual care <i>n</i> = 828 (%)	p-value	95% CI
Mean age years (SD)	60 (±11.6)	68.5 (±11.9)		
Gender (male)	17 (34)	195 (25.2)	0.167	-0.119, 0.025
Born in Australia			0.535	-0.060, 0.085
Yes	9 (90)	344 (82.5)		
No	1 (10)	73 (17.5)		
Living arrangements			0.162	0.020, 0.215
Lives alone	4 (11.8)	149 (21.5)		
Lives with others	29 (85.3)	536 (77.7)		
Unknown	1 (34)	5 (0.7)		
Employment			0.254	0.056, 0.252
Not currently employed	4 (11.8)	67 (9.9)		
Part-time employment	3 (8.5)	59 (8.7)		
Full-time employment	6 (17.1)	106 (15.6)		
Other paid employment	0 (0)	2 (0.3)		
Retired and/or pension	16 (45.7)	402 (59.4)		
Unknown	2 (5.7)	13 (1.9)		
Referral reason			0.051**	0.112, 0.221
Myocardial infarction	18 (68.3)	201 (35.6)		
Atrial fibrillation	1 (3.6)	44 (7.8)		
Heart failure	0 (0)	95 (16.8)		
Re-vascularisation procedure	1 (3.6)	19 (3.4)		
Unstable/stable angina (no intervention)	8 (28.6)	182 (32.2)		
Coronary heart disease	0 (0)	3 (0.5)		

Note. SD = standard deviation. *Frequencies and percentages based on available data (missing data for multiple variables), **P-value significant ≤ 0.05 . CI 95% confidence interval

Effectiveness

Completion

A higher percentage of usual care-based CR program participants completed their program, 553 (71%), compared to the web-based, 17 (34%, $p < 0.001$).

Web-based CR use

Reasons for non-completion include *choosing GP clinic visits only, did not get anything from it, distance to travel, unwell, not interested and not specified*. The greatest number reported they were not interested, web-based, 4 (12.5%) and usual care, 28 (4.4%) or did not specify, web-based, 6 (18.7%) and usual care, 77 (12.1%), $\chi^2 (7, n = 669) = .134, p = 0.10$. A detailed list of reasons for not attending can be found in Appendix 18.

Clinical outcomes

There was no significant difference in scores between all clinical risk factor control changes pre-program commencement and post-program completion, as shown in Table 4.8.

Table 4.8

Pre and Post-Program Mean Clinical Risk Factor Change

	Pre-program			Post-program		
	Web, <i>n</i> = 50	Usual care, <i>n</i> = 828	<i>p</i>	Web, <i>n</i> = 50	Usual care, <i>n</i> = 828	<i>p</i>
BMI	33.6 (7.9)	29.8 (5.9)	0.002*	31.9(6.4)	29.7 (5.4)	0.210
Weight	99.2 (19.8)	87.6 (19.5)	0.004*	110 (11.3)	88.2(18.6)	0.217
HbA1c	6.4 (0.9)	6.6 (3.5)	0.905	6.2 (1.3)	6.1 (1.1)	0.829
LDL	1.9 (1)	2.4 (1)	0.070	1.6 (0.8)	1.9 (0.4)	0.542
Diastolic BP	70 (8.6)	72.8 (10.1)	0.183	80 ^a (0)	73.4 (10.3)	0.528
Systolic BP	129 (20.8)	128.3 (17.6)	0.723	132.8 (14.6)	127.1 (14.7)	0.255

Note. Only one recording in this group. ^a Mean. *SD* = standard deviation. * P-value significant ≤ 0.05 .

Comparison of completion on age, gender and program choice

Direct logistic regression was performed to assess the impact of a number of factors on the likelihood that patients would complete their CR program. The model contained three independent variables (age, gender and program choice). The full model containing all predictors was $\chi^2 (3, n = 711) = 30.57, p < .001$. As shown in Table 4.9, there was no significant difference in patients' preference by age or gender for web-based or other modes of CR. Web-based program enrolment was associated with a lower chance of CR completion (OR 0.19; 95% CI.100, 0.372; $p < 0.001$) after adjustment for age and gender.

Table 4.9

Logistic Regression for Program Completion

Variable	OR	95% CI		p-value
		Lower	Upper	
Program choice	0.193	0.100	0.372	<0.001*
Age	1.006	0.993	1.020	0.384
Gender	0.916	0.645	1.300	0.623

Note. CI = confidence interval for odds ratio. (OR) Full logistic regression model: $\chi^2 (3, n = 711) = 30.57$.

* $p < 0.001$.

Further direct logistic regression was performed to assess the impact of employment, program location, referral reason and BMI on preference for program type and program completion. The full model containing all predictors was $\chi^2 (3, n = 512) = 33.2, p < .001$. Program location made a unique statistically significant contribution to the model on program completion (OR 0.908; 95% CI.875, 943; $p < 0.001$) and program choice (OR 1.136; 95% CI 1.070, 1.205; $p < 0.001$). The full model for program choice as the predictor was $\chi^2 (1, n = 809) = 19.6, p < 0.001$.

Patient-reported experiences

Of those using the web-based program, 17 had completed the assessment period and received an online survey link. Of these, nine (56.3%) responded. The main reasons for choosing this mode of delivery were restrictions relating to the COVID-19 pandemic, 5 (55.5%, 95% CI 30, 80), and/or geographical isolation and work commitments, 4 (44.4%, 95% CI 20, 70). Most stated that they participated in their goal setting, 8 (88.9%, 95% CI 60, 100) and 7 (77.8%, 95% CI 50, 90) achieved these goals. The information delivered in the education sessions was clear and easy to understand, contributing to positive lifestyle changes as reported by 7 (77.8%, 95% CI % 50, 90) patients. All patients reported increased confidence across the CR health domains and claimed they were treated with respect and dignity (see Figure 4.19).

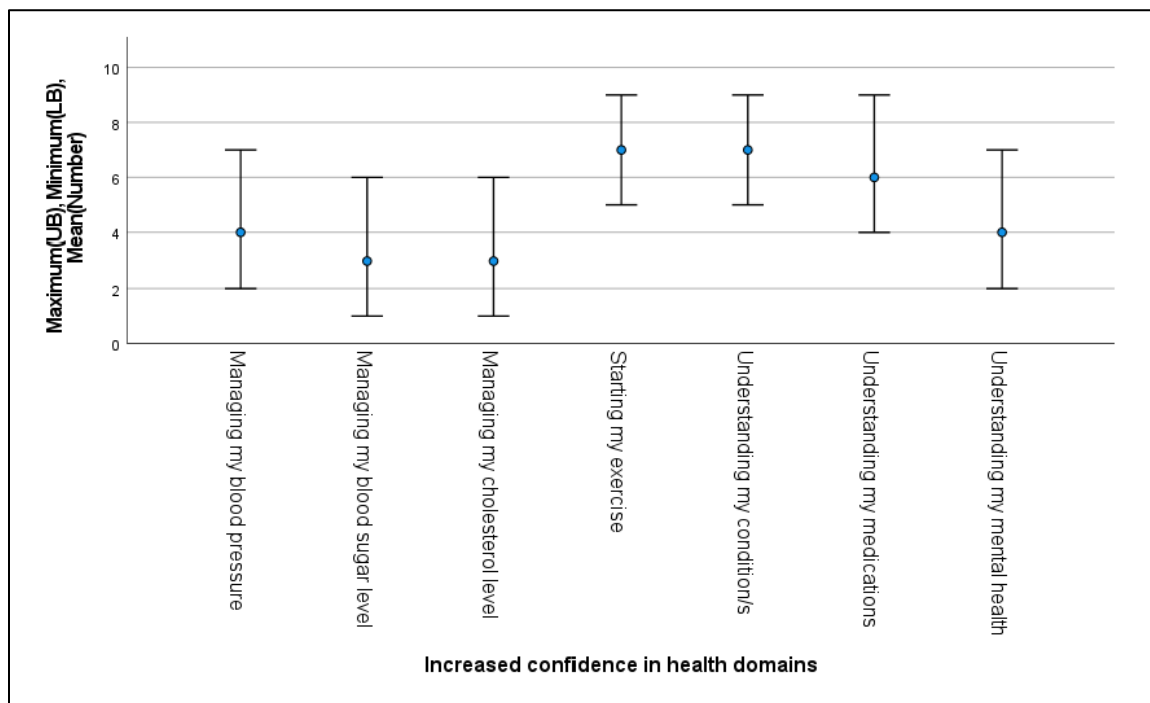


Figure 4.14. Participants report increased confidence across health domains. *Note.* UB = upper bound. LB = lower bound, 95% CI = Confidence interval. The mean number of participants reported increased confidence.

Patients reported overall satisfaction with the web-based CR program was 77.8%, which was lower when compared to usual care (face-to-face 95.9% and telephone 93.9%).

Clinician-reported experiences

Of the 41 surveyed clinicians, seven responded. Those who reported high satisfaction with the quality of the web-based program were 1 (14%, 95% CI 3, 51) extremely high quality, and 4 (57%, 95% CI 25, 84) high quality. Ease or difficulty of the web-based program use was evenly distributed with 2 (29%, 95% CI 0.08, 0.64) stating moderately easy, 1 (14%, 95% CI 3, 51) slightly easy, 1 (14%, 95% CI 3, 51) neither easy nor difficult, 2 (29%, 95% CI 0.08, 0.64) slightly difficult, and 1 (14%, 95% CI 3, 51) moderately difficult.

Clinicians report the web-based program aligning with their current service very well, 2 (29%, 95% CI 8, 64), slightly well 3 (43%, 95% CI 16, 75), and not well at all, 2 (29%, 95% CI 8, 64). Almost half of the clinicians, 4 (57%, 95% CI 25, 84), strongly agreed that the web-based program was a valuable option. Clinicians reported high satisfaction with researcher/web-developer responsiveness to questions or concerns, 5 (71%, 95% CI 36, 92), and of the quality of the web-based program as high quality, 4 (57%, 95% CI 25, 84).

Adoption

CR clinicians facilitated the adoption of the web-based program at participating sites. We inducted 23 clinicians in regional and rural services, with 12 (52%) sites engaging with the program and enrolling patients. The lowest enrolment by site was one, and the highest was 15, with a median site enrolment of three (IQR = 1–15).

Implementation

For those patients that had completed their program, fidelity to pre-assessment was high, with 100% of pre-assessment data being completed by all 17 patients, followed by 8 (47.1%, 95% CI 30, 70) completing 100% post-assessment data entry and 1 (5.8%, 95% CI 0, 30) completing 50% post assessment data. While 7 (41, 2%, 95% CI 20, 60) did not complete any post-assessment data.

Maintenance

The program completed operation in its current form on 16 June 2023. Most of the main elements were transferred to a new platform on the same URL for continued use, and a new section was added to enable a new project focused specifically on CR for women. The new platform, which allows self-enrolment, commences operation on 3 July 2023. Current active patients were re-enrolled, and data were entered into the new platform.

4.7.7 Discussion.

According to the results of our study, this program was successfully implemented, and despite attendance at and completion of the web-based program being less than usual care, it provided an alternative option during COVID-19 pandemic restrictions. This novel, evidence-based, standardised web-based program delivers CR, profiling its relevance and increasingly important place in combating poor attendance and completion in the face of persistent cardiovascular disease morbidity. As shown in this study, patient engagement with a web-based program and subsequent adherence and completion can be a potential concern (Zan et al., 2015). It should be considered when developing similar programs. Multiple competing explanations exist for this phenomenon, from individual to system factors. These include

clinician bias, be it their perception of their client's digital literacy to workflow barriers, patients' digital literacy, ethnicity, age and income to the quality of internet speed and device availability and system-level barriers, such as data accessibility and connectivity (Contreras et al., 2020; Hutchings, 2022).

Cardiac rehabilitation program completion across all program modalities is suboptimal, influenced by a multifactorial continuum. In terms of fidelity, attrition reported in the literature aligns with the outcomes of our study (Devi et al., 2014; Houchen-Wolloff et al., 2018; Kenny et al., 2023; Zan et al., 2015). A systematic review and meta-analysis of behaviour change techniques and intervention characteristics in digital CR report attrition rates ranging from < 11% to > 26% in the included studies (Kenny et al., 2023). Furthermore, generally speaking, patients are not using digital tools to their full potential, with available medical or fitness apps having a 90-day user retention rate of only 27% to 30% (Birnbaum, Lewis, Rosen & Ranney, 2015). Understanding digital literacy, system barriers and device interaction is critical to the inclusivity and retention of patients to web-based CR and can be achieved through co-design of these programs, enabling barriers to be resolved early in the program's development (Birnbaum et al., 2015; Golbus et al., 2023).

Only half the services that had the web-based CR program available to them utilised it. For web-based CR programs to be successful, they must complement the current practice of clinicians delivering CR. Clinician engagement is essential and can be achieved by incorporating the web-based model into their existing service, being cautious not to increase workloads (Devi et al., 2014; Golbus et al., 2023). This was achieved in one study with clinician login to the administrative section of the program, allowing patient enrolment, monitoring progress and

checking in with patients who were not active or completing their program (Devi et al., 2014). They also provided a private message function between the patient and the clinical team (Devi et al., 2014). Some of these aforementioned strategies, such as a private message function within the program and automatic notification to the clinician when a patient had messaged them or when the patient had not logged in for > 7 days, were built into web-based CR program in this study (Nesbitt et al., 2023).

Understanding a web-based CR program's successful implementation and clinical effectiveness relies on standardised reporting. Reporting of the same is currently not standardised, inconsistent and inexplicit (Zan et al., 2015). A recent systematic review found that fidelity was poorly reported (Kenny et al., 2023). The effectiveness of an intervention, particularly measuring adherence and completion, must be cautiously interpreted if fidelity is inexplicitly reported or unknown. Fidelity reporting is also important for service providers and clinicians, as it highlights the feasibility of the web-based program and the significance of non-adherence to be expected (Abell, Glasziou & Hoffmann, 2015). Our study prioritised measuring adherence, completion and program fidelity given the web-based program implementation into a clinical program, providing valuable evidence on impact and patient and clinician attrition. Details of the interventions and prioritising adherence and completion attrition can illuminate the cause and how best to measure and report it.

We know that centre-based, virtual and remote delivery of CR has similar effectiveness (Anderson et al., 2017; Chong et al., 2021; Turan Kavradim et al., 2020) and virtual or remote delivery modes have been shown to capture patients who do not attend, increasing CR participation (Dalal et al., 2021; Houchen-Wolloff et al., 2018). However, patient engagement

can be inconsistent and disappointing; therefore, tailoring to patients, health services and clinicians is paramount in developing or redeveloping existing CR services regarding web-based CR. Given that virtual and remote CR contributes to efficacious outcomes, the distinguishing impediment to translating web programs, apps, VW technology and other digital platforms lies largely with policymakers, generating funding for program development and implementation, and organisational level systems, such as quality high-speed internet access and clinician buy-in from program inception (Beatty et al., 2021). Furthermore, successful implementation requires programs that are user-friendly, where adequate training and support are in place (Beatty, Magnusson, Fortney, Sayre & Whooley, 2018). Including our own project, integration is being increasingly successfully undertaken with funding, health service involvement and leadership support (Brough et al., 2014; Devi et al., 2014; Houchen-Wolloff et al., 2018; Nesbitt et al., 2023; Rivers, Smith, Smith & Cameron, 2022; Varnfield, Karunanithi, Lee et al., 2014) providing exemplars for emulating a similar process in a new or already existing program.

Despite low enrolment and completion, our web-based CR program has successfully been implemented through adoption and utilisation at health service, clinician and patient levels, delivering positive outcomes with those patients and clinicians using the program reporting high satisfaction rates. Furthermore, it may have allowed the population who do not attend a CR program due to multifactorial barriers to engage. This possibility was evident during the COVID-19 pandemic restrictions, as some centre-based programs closed, highlighting the utility of a web-based program in the absence of centre-based CR.

Further work needs to be done to address barriers to engaging patients and clinicians and the routine integration of web-based CR programs into mainstream clinical use, particularly

already established programs. The translation of the CHAP Model (see Figure 4.15) into practice recommendations can contribute to this.

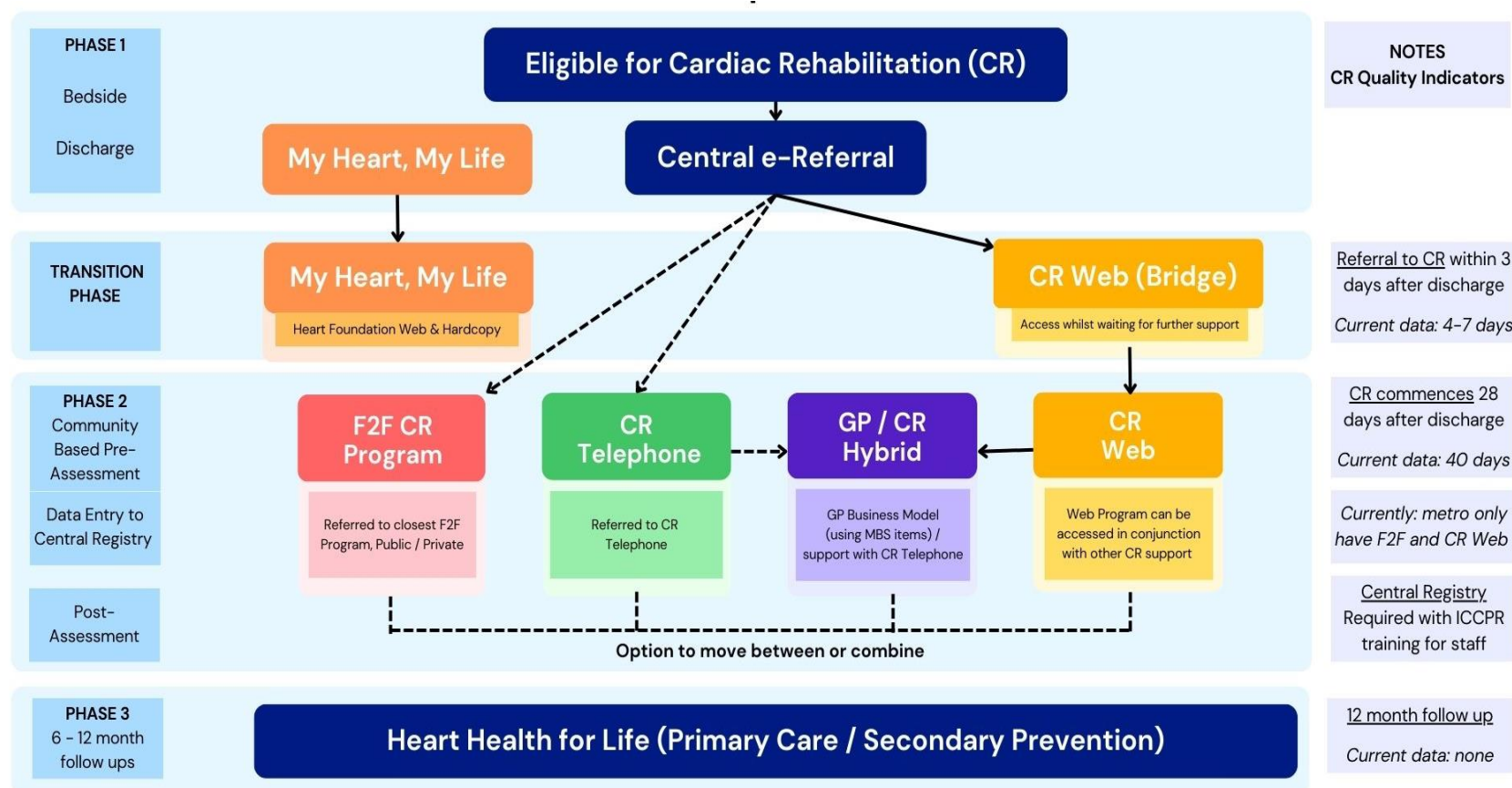


Figure 4.15. Recommendation of statewide implementation of CHAP model of care. Note. F2= F face-to-face, GP = general practitioner, MBS = Medicare benefits schedule.

These include:

1. the development of a CR web bridge to increase access to support while waiting for further, formalised usual care CR
2. a CR web program that can be accessed in conjunction with other support, such as options to move between or combine CR delivery modes to improve engagement
3. self-enrolment options to facilitate early CR engagement and reducing clinician bias and workload.

Further work to improve the landscape of CR and utilise web-based models can be achieved by working with Primary Health Care Networks to design a data system that can easily integrate long-term follow-up, measuring clinical and lifestyle change outcomes, establish a project to achieve international accreditation for all CR programs, and as part of this accreditation ensure all clinical providers achieve ICCPR accreditation.

4.7.8 Limitations.

This study had several limitations. First, the sample size for this sub-study was insufficient for a powered effectiveness study and is descriptive, so caution has been applied when interpreting and reporting the impact of web-based CR on program completion and other service outcomes. Clinical bias may have influenced the patient's choice of CR program, specifically assumptions about their information digital literacy, thereby not offering it as a choice, negatively affecting enrolments. There were a number of variables with missing data, impacting analysis and outcomes. Finally, a more complete evaluation of effectiveness, including a comprehensive cost analysis, would have enhanced our results.

4.7.9 Conclusion.

For the first time in Australia, this co-designed, clinician-managed web-based CR program was implemented for people living in rural and remote areas in Australia and evaluated the effectiveness of this in the real context of the application. Our findings demonstrated that the web-based program provides an alternative flexible mode to complete CR while capturing a cohort who would otherwise not attend a CR program. However, the ongoing success and uptake of this program mode of CR relies on it being seen as interconnected, in conjunction with traditional CR, while concurrently addressing perceived or actual barriers to adoption and integration.

4.7.10 Acknowledgements.

This research was made possible by both the consumers and clinicians who gave their time to organise and participate in the workshops; without their collaboration, this program would not exist.

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4.7.11 Declarations.

The project was approved by the South Australian Department for Health and Wellbeing Human Research Ethics Committee (HREC/15/SAH/63) and the Northern Territory Department of Health Human Research Ethics Committee (HREC 2015-2484).

All members of the research team have been trained and certified in research Good Clinical Practice.

4.7.12 Funding.

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4.7.13 Conflict of interest.

The authors have no conflicts of interest.

4.7.14 Author contribution.

The study was conceived and designed by KN, AB and RC. The first draft of the paper was written by KN with input from the remaining authors; all authors read and approved the final manuscript.

4.8 Chapter Summary

This chapter has presented the web-based CR program implementation process and two manuscripts describing its co-design and evaluation of the implementation itself. Chapter 5 provides a summary of the key findings and insights gained in the study, the limitations of the research, the implications for practice, policy and research and the study's conclusion.

Chapter 5: Conclusions and Implications

5.1 Chapter Overview

This thesis has demonstrated the justifications for and theoretical approach to the co-design design and development of an interactive web-based CR program to improve program attendance and completion for patients with cardiovascular disease. A user experience and implementation study was performed to develop the program and evaluate the effectiveness of its implementation into clinical use. The previous chapters presented the findings and discussions of the effect of the web-based CR program on attendance and completion and the effectiveness of the implementation thereof. This chapter will summarise the key findings and insight gained in the study, the limitations of the research, the implications for practice, policy and research and the study's conclusion.

5.2 Key Findings and New Knowledge

The key findings of this thesis are as follows:

1. There was a lack of RCTs measuring the effectiveness of completion in web-based CR programs.
2. Web-based CR, as a formal, standardised program, is innovative and underdeveloped.
3. Co-design of health interventions, specifically web-based, engender engagement.
4. This is the first program of its kind in South Australia and the first program integrated with a clinical service by design in Australia that is of no cost to patients.

5. Co-design delivered a web-based program that is usable, integrated and effectively utilised by clinicians and patients.
6. The implementation process highlighted problems with the enrolment of patients.
7. A web-based CR program provides an important alternative, or only choice, in combating non-attendance.

5.2.1 There was a lack of RCTs measuring the effectiveness of completion in web-based CR programs.

Our systematic review reported that only eight RCTs reported web-based CR program completion, with only two reporting this as a primary outcome. Furthermore, the completion of a web-based CR program is measured heterogeneously. The de-prioritisation of measuring program effectiveness on program completion and non-standardisation of the outcome measurements reveals a gap in research and clinical practice. Therefore, future work should focus on completion as a primary outcome with a homogenous approach to outcome measurements.

5.2.2 Web-based CR, as a formal, standardised program, is innovative and underdeveloped.

Using web-based CR programs with standardised clinical content can provide flexible learning environments in which patients can complete their CR program in a dynamic and personalised setting. Additionally, the program was able to curate the program based on their enrolment stream (i.e., acute coronary syndrome, heart failure, arrhythmia and cardiothoracic surgery), specifically targeting their needs. This means that a web-based CR program can translate evidence into practice in the context of the individual patient. Therefore,

implementing the web-based CR program into clinical use is innovative for patient CR in rural and remote areas. In addition, this novel program applies to all settings, including metropolitan patients and other chronic disease settings.

5.2.3 Co-design of health intervention, specifically web-based, engender engagement.

In this study, the web-based CR program provided a patient-specific designed web program that was presented and operated in such a way that it met patients' needs and experiences optimally. Collaboration and engagement through co-designing with patients intended for the intervention in development must ensure a user-friendly product to maximise engagement with and completion of their CR program.

5.2.4 This is the first program of its kind in South Australia and the first integrated program in Australia that is of no cost to patients.

Our study is novel in that it is the first to have co-designed, tested and implemented an interactive web-based CR program for patients with cardiovascular disease referred for a CR program. No previous studies have investigated the effectiveness of implementing a web-based CR program in South Australia. Current evidence on the effectiveness of program implementation and completion of web-based CR programs is limited. From the available research on web-based CR programs, it can be concluded that these interventions have a positive effect on clinical risk modification and attendance and completion, not dissimilar to traditional programs.

5.2.5 Co-design delivered a web-based program that is usable, integrated and effectively utilised by clinicians and patients.

The results from the implementation study demonstrated a high level of overall satisfaction from patients using the web-based CR program, resulting from a high level of engagement during its use. The web-based CR program was designed to encourage user interaction, specifically by completing pre and post-assessment information through numerous validated surveys, watching educational videos and messaging their clinician as required. Patients who completed their web-based CR program were 100% compliant with these tasks. Therefore, our study suggests that the employment of co-design in developing and implementing a web-based CR program for use in the clinical setting is a viable and effective method to develop, integrate and deliver web-based CR to people living in rural and remote areas.

5.2.6 The implementation process highlighted problems with the enrolment of patients.

Enrolment into the web-based program compared to usual care was sub-optimal and likely due to clinician bias, specifically around perceived and actual increased workload, and bias in patient selection for this mode of CR. Further issues impacting low enrolment and completion are patients' access to technology in the form of devices, quality of internet services and lack of experience with technology.

5.2.7 A web-based CR program provides an important alternative or only choice in combating non-attendance.

During the implementation of the web-based CR program, despite overall low enrolment compared to usual care, there was an uptake in patient enrolment directly correlating with face-to-face program closures due to pandemic restrictions. Furthermore, some patients reported choosing the web-based CR program due to geographical isolation and work commitments, supporting the worthiness of this mode of delivery for the cohort of patients who may otherwise not attend a program at all.

5.3 Limitations

While this thesis was carefully researched, planned and executed, it is important to acknowledge its limitations. For the co-design of the web-based CR program, the main limitation of this study was that participants had all completed a face-to-face CR program, which means that the co-design lacked the input of those who had declined or dropped out of their program. We mitigated this selection bias by clinicians being the ones recruiting participants. The trust relationship between the clinician and the participants might have helped with the engagement of participants who would have been otherwise less likely to participate. Furthermore, member checking on the interpretation of quotations was not permitted as names were not used during the workshops, with further de-identification of these group discussions in the transcription process. The generalisability of these findings to groups with low literacy and non-English speaking populations is limited due to the proportion of people with a high education level and English as a first language in the workshops.

In evaluating the effectiveness of implementing the web-based CR program, the sample size for this sub-study was insufficient for a powered effectiveness study. Therefore, this study was descriptive, measuring implementation outcomes only, and caution has been applied when interpreting and reporting the impact of web-based CR on program completion and other service outcomes. However, it was measuring implementation effectiveness and was sufficient to meet the objectives of this study. Clinical bias may have influenced the patient's choice of CR program, specifically assumptions about their IT literacy, thereby not offering it as a choice, negatively affecting enrolments. There were several variables with missing data, impacting analysis and outcomes. Finally, a more complete evaluation of effectiveness, including a comprehensive cost analysis, would have enhanced our results.

5.4 Implications

5.4.1 Implications for practice.

It is essential to involve clinicians in designing their workflows, integrating their ideas and feedback into the design of the web-based CR program and quickly and accurately resolving the issues that beset them. Furthermore, the technology to deliver web-based CR must be easy to use, reliable and supportive of the clinicians' workflow, enhancing their current and emerging practice with sufficient onboarding and training to inspire confidence and engagement with the program. Finally, prompt and targeted support needs to be available to clinicians when they encounter technological problems.

Patient engagement can be maximised through careful assessment of program modality presences, internet access and device use. Furthermore, self-enrolment options would appeal to the patient group likely to engage with web-based CR programs.

5.4.2 Implications for policy.

Further work to improve the landscape of CR and utilise web-based models can be achieved by working with healthcare networks to design a data system that can easily integrate long-term follow-up, measuring clinical and lifestyle change outcomes. Establish a national project to achieve national and international accreditation for all CR programs, including definitions of and standardisation of outcome measurement specific to web-based CR. Achievement of translating these recommendations into practice will ensure the delivery of high-quality, evidence-based CR and secondary prevention.

5.4.3 Implications for research.

This thesis presented the co-design development and implementation of a novel web-based CR program for clinical use in rural and remote South Australia. Future research studies can be undertaken to improve our understanding of this important area. Specific areas to focus on are prioritising attendance and completion as primary outcomes in randomised controlled trials. In doing so, there needs to be a consensus and resultant standardisation of definitions for web-based CR program completion and the tools used to measure this to mitigate the current lack of outcomes and measurement heterogeneity. Furthermore, behaviour change analysis measured through clinician and patient-reported experience measures, as part of implementation projects for new and ongoing web-based CR programs, will enable adaptations to facilitate optimal engagement. Finally, there is a need to expedite the development and integration of web-based CR program options for all populations through integration into current services and stand-alone programs with self-enrolment to address increasing morbidity from cardiovascular disease.

5.5 Conclusion

Cardiac rehabilitation guidelines recommend that eligible patients complete a program, highlighting the need to reduce risk factors and support them in their journey, thus reducing preventable secondary events and worsening quality of life (Knuuti et al., 2020). Such programs should meet the patient's needs from an informatic and modal viewpoint. Presently, there is a proliferation of technological interventions for patients in health self-awareness, supporting the acceptability of their use in CR.

This study has demonstrated that applying a co-design approach to creating and implementing a web-based CR program in clinical use provided an acceptable and usable product in the clinical setting. We have created a program with evidenced-based standardised content presented through infographics, audiovisual and interactivity to maximise engagement, learning and enduring change. This web-based program development is replicable and scalable for future CR programs or in other chronic disease settings.

Although the results from the evaluation of the implementation process revealed suboptimal enrolment into the web-based CR program, it successfully highlighted its role for those patients impacted by work commitments, geographical isolation and responsiveness to COVID-19 pandemic restrictions for face-to-face services. Furthermore, it outlines the process from website development to implementation as a recipe for replication by future researchers and healthcare services. This project has led to further work in redeveloping the web-based CR program both aesthetically and meaningfully by tailoring for women only, a much-underrepresented group in CR (Mamataz, Ghisi, Pakosh & Grace, 2021; Supervia et al., 2017). This second generation of the web-based CR program is now available through referral from a

clinician or self-enrolment on discharge from a tertiary hospital. This evolution of the web-based CR program presented in this thesis will soon be published in a peer-reviewed high-impact journal by Flinders University.

This thesis has reported detailed information on the co-design development, implementation and subsequent evaluation of a novel web-based CR program for people living in rural and remote areas with cardiovascular disease. Its results are useful to guide the future of web-based CR programs, specifically their co-design and implementation, seeking greater engagement and impact on program attendance and completion.

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Appendices

Appendix 1 Prospero registration

Citation

Katie Nesbitt, Lemlem Gebremichael, Alejandra Pinero de Plaza, Aline Belegoli. Effectiveness of interactive cardiac rehabilitation web-applications on program adherence rates in patients with cardiovascular disease: a systematic review protocol. PROSPERO 2021 CRD42021288690 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42021288690

Review question

What is the effectiveness of interactive CR web applications versus center based, telephone and General Practitioner hybrid CR programs on CR program adherence in patients with cardiovascular disease?

Searches

The search strategy will aim to locate both published and unpublished studies. An initial limited search of MEDLINE was undertaken to identify articles on the topic. The text words contained in the titles and abstracts of relevant articles, and the index terms used to describe the articles were used to develop a full search strategy for MEDLINE (via Ovid). The search strategy, including all identified keywords and index terms, will be adapted for each included information source. The reference lists of all studies selected for critical appraisal will be screened for additional studies.

Studies published in all languages will be included. Non-English studies with English abstracts that meet the criteria will be included into a table and included as an appendix. Studies published from internet inception, 1983, to January 2022 will be included to capture all relevant evidence for better data presentation and conclusion.

The databases to be searched include MEDLINE (via Ovid), Emcare (via Ovid), Cochrane Library, Scopus, and CINAHL. Sources of unpublished studies and grey literature to be searched include ClinicalTrials.gov and ProQuest Dissertations and Theses Global, TROVE, Networked Digital Library of Theses and Dissertations (NDLTD), World Health Organization International Clinical Trial Registry Platform, National Institute for Health and Care Excellence, and OpenGrey.

Types of study to be included

This review will consider both experimental and quasi-experimental study designs including randomized controlled trials, non-randomized controlled trials, before and after studies, and interrupted time-series studies. In addition, analytical observational studies including prospective and retrospective cohort studies, case-control studies, and analytical cross-sectional studies will be considered for inclusion. This review will also consider descriptive observational study designs including case series, individual case reports, and descriptive cross-sectional studies for inclusion.

Condition or domain being studied

Cardiac rehabilitation is poorly attended, and completion rates are suboptimal globally with a paucity in studies measuring attendance and completion as a primary outcome in digital cardiac rehabilitation programs. Accordingly, this systematic review will inform future research to address poor attendance and completion rates of cardiac rehabilitation, enabling the future development of digital programs for clinical use.

Participants/population

This review will consider studies that include CR programs that are inclusive of patients who have experienced unstable angina, non-ST segment elevation and ST-segment elevation myocardial infarction, stable angina, coronary artery bypass surgery, percutaneous coronary interventions, and heart failure. This review will also include patients who have or had valve devices, permanent pacemaker and implantable defibrillators, heart transplant, and arrhythmias. Patients will be adults aged from 18 years.

Intervention(s), exposure(s)

This review will consider studies that evaluate CR web applications that are interactive, populated with standardized CR program content and are clinically managed and/or monitored. Cardiac rehabilitation web applications will be defined as, clinically managed, adhering to clinical guidelines for standardized cardiac rehabilitation programs that are accessed through computers (desktop/laptop), smart phones and tablets. For the purposes of this review an interactive program is that which requires a patient to log into a password protected portal, is tailored to the patient, and requires them to complete tasks to progress through the program. Other features that can reflect interactivity are patients' ability to communicate with their clinician, with clinicians having administration access to respond and monitor overall progress. A web application is a software which is accessible using any web browser or server, uniformly responsive to being viewed on a computer, smart phone, or tablet.

Comparator(s)/control

This review will consider studies that compare the intervention to telephone, center-based, and General Practitioner-led CR programs.

Main outcome(s)

Primary outcome: adherence with CR program. Adherence is defined as attendance and completion of 75% or more sessions required of the program.⁶ Programs vary in duration, number of sessions offered, and the frequency of sessions, therefore, this review will measure adherence with at least 75% of the program sessions of each included study.

Measures of effect

Studies will, where possible, be pooled with statistical meta-analysis using JBI SUMARI. For statistical analysis, IBM SPSS version 27 will be used. Effect sizes will be expressed as either odds ratios (for dichotomous data) or weighted (or standardized) final post-intervention mean differences (for continuous data) and their 95% confidence intervals will be calculated for analysis. Heterogeneity will be assessed statistically using the standard χ^2 and I^2 tests. Statistical analyses will be performed using random-effects model. Subgroup analyses will be conducted where there are sufficient data to investigate thematic areas of interest such as outcomes by dose and frequency of cardiac rehabilitation programs and modes of service deliveries. Sensitivity analyses will be conducted to test decisions made regarding the effectiveness of the intervention on the study outcome. Where statistical pooling is not possible the findings will be presented in narrative form including tables and figures to aid in data presentation, where appropriate.

A funnel plot will be generated using RevMan 5.0 (Copenhagen: The Nordic Cochrane Centre, Cochrane) to assess publication bias if there are 10 or more studies included in a meta-analysis. Statistical tests for funnel plot asymmetry (Egger test, Begg test, Harbord test) will be performed where appropriate.

Additional outcome(s)

Secondary outcomes: CVD-related death; hospital readmissions and physical activity; a reduction in low density lipids; reduction in and or control of blood glucose; reduction in and or control of blood pressure; weight reduction and co-design in web application development. Studies reporting CVD-related death and hospital readmissions recorded by hospital admission data and death registries will be included. Physical activity is measured in a variety of ways, accordingly studies reporting this outcome based on self-reported physical activity, pedometers (step count), accelerometers, 6-minute walk test and 1-min sit-to stand test will be included.

Measures of effect

Studies that report the effectiveness of interactive CR web applications on clinical outcomes with standardized mean, weighted mean difference or mean difference with a 95% confidence interval will be considered.

Data extraction (selection and coding)

Data will be extracted from studies included in the review by two independent reviewers using the standardized JBI data extraction tool. The data extraction will include specific details about the interventions, populations, study methods and outcomes of significance to the review question and specific objectives. Any disagreements that arise between the reviewers will be resolved through discussion or with a third reviewer. Authors of papers will be contacted to request missing or additional data, where required.

Risk of bias (quality) assessment

Eligible studies will be critically appraised by two independent reviewers at the study level for methodological quality in the review using standardized critical appraisal instruments from JBI for experimental and quasi-experimental studies. Authors of papers will be contacted to request missing or additional data for clarification, where required. Any disagreements that arise between the reviewers will be resolved through discussion or with a third reviewer. The results of the critical appraisal will be reported in a table with an accompanying narrative. All studies, regardless of the results of their methodological quality, will undergo data extraction and synthesis (where possible).

Strategy for data synthesis

Studies will, where possible, be pooled with statistical meta-analysis using JBI SUMARI. Effect sizes will be expressed as odds ratios as all our outcomes are dichotomous, and their 95% confidence intervals will be calculated for analysis. Heterogeneity will be assessed statistically using the standard χ^2 and I^2 tests. Statistical analyses will be performed using JBI SUMARI.

Analysis of subgroups or subsets

Subgroup analyses will be conducted where there are sufficient data to investigate web-based cardiac rehabilitation intervention and clinical and economic outcomes. Sensitivity analyses will be conducted to test decisions made regarding the delivery of both study interventions and usual care. Where statistical pooling is not possible the findings will be presented in the narrative form including tables and figures to aid in data presentation, where appropriate.

A funnel plot will be generated in RevMan 5.0 (Copenhagen: The Nordic Cochrane Centre, Cochrane) to assess publication bias if there are 10 or more studies included in a meta-analysis. Statistical tests for funnel plot asymmetry (Egger test, Begg test, Harbord test) will be performed where appropriate.

Contact details for further information

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Type and method of review

Systematic review

Preliminary searches	Yes	Yes
Piloting of the study selection process	Yes	Yes
Formal screening of search results against eligibility criteria	Yes	Yes
Data extraction	Yes	Yes
Risk of bias (quality) assessment	Yes	Yes
Data analysis	Yes	Yes

Provide any other relevant information about the stage of the review here.

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6. * Named contact.

The named contact is the guarantor for the accuracy of the information in the register record. This may be any member of the review team.

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Appendix 2 Systematic review full search strategies

Medline

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions <1946 to August 09, 2022>		
1	cardiovascular diseases/ or heart diseases/ or exp arrhythmias, cardiac/ or exp cardiac conduction system disease/ or exp cardiomyopathies/ or exp endocarditis/ or heart aneurysm/ or exp heart arrest/ or exp heart defects, congenital/ or exp heart failure/ or exp heart rupture/ or exp heart valve diseases/ or exp myocardial ischemia/ or exp pericarditis/ or exp ventricular dysfunction/ or exp ventricular outflow obstruction/ or exp aneurysm/ or exp arterial occlusive diseases/ or exp arteriovenous malformations/ or exp peripheral vascular diseases/ or exp Cardiovascular Surgical Procedures/ or exp assisted circulation/ or exp pacemaker, artificial/ or Hypercholesterolemia/	1869144
2	((Heart or cardiac or coronary or cardiovascular) adj2 (disease* or rupture* or attack* or aneurysm or arrest* or death or failure or surgery or surgical or surgeries or transplant* or valve disease or bypass or graft* or procedure* or arrhythmia*)).tw,kf.	891234
3	(Valve adj3 (replacement* or prostheses*)).tw,kf.	44543
4	(Myocardial adj4 (ischemia or infarct* or ST elevation or non-ST elevation or revascularization)).kw,kf.	32648
5	or/1-4	2152487
6	Cognitive Behavioral Therapy/ or rehabilitation/ or exercise therapy/ or rehabilitation, vocational/ or telerehabilitation/ or psychoanalytic therapy/ or consumer health information/ or health literacy/ or Patient Education as Topic/ or psychology/ or cognitive psychology/ or psychology, positive/ or exp psychology, medical/ or psychology, social/ or psychotherapy/ or hypnosis/	302227
7	((exercise or diet or lifestyle or occupational or educat* or rehab* or council* or psycholog* or psychosocial or psychotherapy*) adj4 (program* or intervention* or modification or therapy or therapies or process*)).tw,kf.	258003
8	(health literacy or consumer health information or telerehabilitation or patient education or CBT or cognitive behavior* or psycholog* feedback or hypnosis or psychoanaly*).tw,kf.	80707
9	or/6-8	550196
10	5 and 9	38845
11	Cardiac Rehabilitation/	3473
12	(cardiac adj2 rehab*).tw,kf.	8140
13	or/11-12	9172
14	10 or 13	43248

15	cell phones/ or smartphone/ or computer communication networks/ or computer communication networks/ or internet/ or internet access/ or 'internet of things'/ or 'internet use'/ or internet-based intervention/ or mobile applications/ or web browser/	118496
16	(internet* or web or web- or website or online* or on-line or android or cell phone* or cellphone* or mobile phone* or mobile-phone* or cyber* or internet* or ipad* or i-pad* or iphone* or i-phone* or smart phone* or smartphone* or multi-media* or multimedia* or online* or virtual* or WWW or mobile app or mobile application*).tw,kf.	607980
17	(handheld adj2 (devise* or tablet*)).tw,kf.	57
18	or/16-17	608015
19	Clinical Trials as Topic/	200260
20	randomized controlled trial.pt.	574999
21	controlled clinical trial.pt.	94981
22	(random* or placebo or trial).ti,ab.	1728462
23	or/19-22	2009060
24	14 and 18 and 23	795
25	exp animals/ not humans.sh.	5036620
26	24 not 25	794

Scopus

TITLE-ABS-KEY ((((((heart OR cardiac OR coronary OR cardiovascular) W/2 (disease* OR rupture* OR attack* OR aneurysm OR arrest* OR death OR failure OR surgery OR surgical OR surgeries OR transplant* OR "valve disease" OR bypass OR graft* OR procedure* OR arrhythmia*)) OR (valve W/3 (replacement* OR prosthes*)) OR (myocardial W/4 (ische*mia OR infarct* OR "ST elevation" OR "non-ST elevation" OR revascularization))) AND (psychotherapy OR hypnosis OR "health literacy" OR "consumer health information" OR telerehabilitation OR "patient education" OR cbt OR "cognitive behavior*" OR hypnosis OR psychoanaly* OR ((exercise OR diet OR lifestyle OR occupational OR educat* OR rehab* OR council* OR psycholog* OR psychosocial OR psychotherapy*) W/4 (program* OR intervention* OR modification OR therapy OR therapies OR process*)))) OR "Cardiac

Rehabil*") AND (internet* OR web OR web- OR website OR online* OR on-line OR android OR "cell phone*" OR cellphone* OR "mobile phone*" OR mobile-phone* OR cyber* OR internet* OR ipad* OR i-pad* OR iphone* OR i-phone* OR "smart phone*" OR smartphone* OR multimedia* OR multimedia* OR online* OR virtual* OR www OR "mobile app" OR "mobile application*" OR (handheld W/ 2 device*)) AND (random* OR placebo* OR trial* OR rct)))

Limitations applied by year and document type.

TITLE-ABS-KEY (((((heart OR cardiac OR coronary OR cardiovascular) W/2 (disease* OR rupture* OR attack* OR aneurysm OR arrest* OR death OR failure OR surgery OR surgical OR surgeries OR transplant* OR "valve disease" OR bypass OR graft* OR procedure* OR arrhythmia*)) OR (valve W/3 (replacement* OR prosthes*)) OR (myocardial W/4 (ische*mia OR infarct* OR "ST elevation" OR "non-ST elevation" OR revascularization))) AND (psychotherapy OR hypnosis OR "health literacy" OR "consumer health information" OR telerehabilitation OR "patient education" OR cbt OR "cognitive behavior*" OR hypnosis OR psychoanaly* OR ((exercise OR diet OR lifestyle OR occupational OR educat* OR rehab* OR council* OR psychologist* OR psychosocial OR psychotherapy*) W/4 (program* OR intervention* OR modification OR therapy OR therapies OR process*)))) OR "Cardiac Rehabil*") AND (internet* OR web OR web- OR website OR online* OR on-line OR android OR "cell phone*" OR cellphone* OR "mobile phone*" OR mobile-phone* OR cyber* OR internet* OR ipad* OR i-pad* OR iphone* OR i-phone* OR "smart

phone*" OR smartphone* OR multi-media* OR multimedia* OR online* OR virtual* OR www OR "mobile app" OR "mobile application*" OR (handheld W/ 2 device*)) AND (random* OR placebo* OR trial* OR rct))) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English"))

CINAHL

#	Query	Results
S22	S14 AND S18 AND S21	517
S21	S19 OR S20	620,534
S20	((TI random* OR AB random*) OR (TI placebo OR AB placebo) OR (TI trial* OR AB trial))	600,798
S19	(MH "Randomized Controlled Trials+")	131,358
S18	S15 OR S16 OR S17	483,019
S17	((TI handheld OR AB handheld OR SU handheld) N2 ((TI devise* OR AB devise* OR SU devise*) OR (TI tablet* OR AB tablet* OR SU tablet*)))	34
S16	((TI internet* OR AB internet* OR SU internet*) OR (TI web OR AB web OR SU web) OR (TI web- OR AB web- OR SU web-) OR (TI website OR AB website OR SU website) OR (TI online* OR AB online* OR SU online*) OR (TI on-line OR AB on-line OR SU on-line) OR (TI android OR AB android OR SU android) OR (TI "cell phone*" OR AB "cell phone*" OR SU "cell phone*") OR (TI cellphone* OR AB cellphone* OR SU cellphone*) OR (TI "mobile phone*" OR AB "mobile phone*" OR SU "mobile phone*") OR (TI mobile-phone* OR AB mobile-phone* OR SU mobile-phone*) OR (TI cyber* OR AB cyber* OR SU cyber*) OR (TI internet* OR AB internet* OR SU internet*) OR (TI ipad* OR AB ipad* OR SU ipad*) OR (TI i-pad* OR AB i-pad* OR SU i-pad*) OR (TI iphone* OR AB iphone* OR SU iphone*) OR (TI i-phone* OR AB i-phone* OR SU i-phone*) OR (TI "smart phone*" OR AB "smart phone*" OR SU "smart phone*") OR (TI smartphone* OR AB smartphone* OR SU smartphone*) OR (TI multi-media* OR AB multi-media* OR SU multi-media*) OR (TI multimedia* OR AB multimedia* OR SU multimedia*) OR (TI online* OR AB online* OR SU online*) OR (TI virtual* OR AB virtual* OR SU virtual*) OR (TI WWW OR AB WWW OR SU WWW) OR (TI "mobile app" OR AB "mobile app" OR SU "mobile app") OR (TI "mobile application*" OR AB "mobile application*" OR SU "mobile application*"))	476,846

S15	(MH "Cellular Phone") OR (MH "Text Messaging+") OR (MH "Smartphone") OR (MH "Computer Communication Networks") OR (MH "Internet") OR (MH "World Wide Web Applications+") OR (MH "World Wide Web+") OR (MH "Internet of Things") OR (MH "Web Browsers")	153,728
S14	S10 OR S13	22,889
S13	S11 OR S12	6,688
S12	TI (cardiac N2 rehabil*) OR AB (cardiac N2 rehabil*) OR SU (cardiac N2 rehabil*)	6,688
S11	(MH "Rehabilitation, Cardiac")	4,642
S10	S5 AND S9	18,365
S9	S6 OR S7 OR S8	396,545
S8	((TI "health literacy" OR AB "health literacy" OR SU "health literacy") OR (TI "consumer health information" OR AB "consumer health information" OR SU "consumer health information") OR (TI telerehabilitation OR AB telerehabilitation OR SU telerehabilitation) OR (TI "patient education" OR AB "patient education" OR SU "patient education") OR (TI CBT OR AB CBT OR SU CBT) OR (TI "cognitive behavior#" OR AB "cognitive behavior#" OR SU "cognitive behavior#") OR (TI "psycholog* feedback" OR AB "psycholog* feedback" OR SU "psycholog* feedback") OR (TI hypnosis OR AB hypnosis OR SU hypnosis) OR (TI psychoanaly* OR AB psychoanaly* OR SU psychoanaly*))	118,271
S7	((TI exercise OR AB exercise OR SU exercise) OR (TI diet OR AB diet OR SU diet) OR (TI lifestyle OR AB lifestyle OR SU lifestyle) OR (TI occupational OR AB occupational OR SU occupational) OR (TI educat* OR AB educat* OR SU educat*) OR (TI rehab* OR AB rehab* OR SU rehab*) OR (TI council* OR AB council* OR SU council*) OR (TI psycholog* OR AB psycholog* OR SU psycholog*) OR (TI psychosocial OR AB psychosocial OR SU psychosocial) OR (TI psychotherapy* OR AB psychotherapy* OR SU psychotherapy*)) N4 ((TI program* OR AB program* OR SU program*) OR (TI intervention* OR AB intervention* OR SU intervention*) OR (TI modification OR AB modification OR SU modification) OR (TI therapy OR AB therapy OR SU therapy) OR (TI therapies OR AB therapies OR SU therapies) OR (TI process* OR AB process* OR SU process*))	244,367
S6	(MH "Cognitive Behavioral Therapy") OR (MH rehabilitation) OR (MH "exercise therapy") OR (MH "rehabilitation, vocational") OR (MH telerehabilitation) OR (MH "psychoanalytic therapy") OR (MH "consumer health information") OR (MH "health literacy") OR (MH "Patient Education as Topic") OR (MH psychology) OR (MH "cognitive psychology") OR (MH "psychology, positive") OR (MH "psychology, medical"+) OR (MH "psychology, social") OR (MH psychotherapy) OR (MH hypnosis)	83,588
S5	S1 OR S2 OR S3 OR S4	415,829

S4	TI ((Myocardial N4 (ische#mia OR infarct* OR “ST elevation” OR “non-ST elevation” OR revascularization))) OR AB ((Myocardial N4 (ische#mia OR infarct* OR “ST elevation” OR “non-ST elevation” OR revascularization))) OR SU ((Myocardial N4 (ische#mia OR infarct* OR “ST elevation” OR “non-ST elevation” OR revascularization)))	82,040
S3	((TI Valve OR AB Valve OR SU Valve) N3 ((TI replacement* OR AB replacement* OR SU replacement*) OR (TI prosthes* OR AB prosthes* OR SU prosthes*)))	13,716
S2	(((TI Heart OR AB Heart OR SU Heart) OR (TI cardiac OR AB cardiac OR SU cardiac) OR (TI coronary OR AB coronary OR SU coronary) OR (TI cardiovascular OR AB cardiovascular OR SU cardiovascular)) N2 ((TI disease* OR AB disease* OR SU disease*) OR (TI rupture* OR AB rupture* OR SU rupture*) OR (TI attack* OR AB attack* OR SU attack*) OR (TI aneurysm OR AB aneurysm OR SU aneurysm) OR (TI arrest* OR AB arrest* OR SU arrest*) OR (TI death OR AB death OR SU death) OR (TI failure OR AB failure OR SU failure) OR (TI surgery OR AB surgery OR SU surgery) OR (TI surgical OR AB surgical OR SU surgical) OR (TI surgeries OR AB surgeries OR SU surgeries) OR (TI transplant* OR AB transplant* OR SU transplant*) OR (TI “valve disease” OR AB “valve disease” OR SU “valve disease”) OR (TI bypass OR AB bypass OR SU bypass) OR (TI graft* OR AB graft* OR SU graft*) OR (TI procedure* OR AB procedure* OR SU procedure*) OR (TI arrhythmia* OR AB arrhythmia* OR SU arrhythmia*))	339,945

Cochrane

((((((heart OR cardiac OR coronary OR cardiovascular) NEAR/2 (disease* OR rupture*
 OR attack* OR aneurysm OR arrest* OR death OR failure OR surgery OR surgical OR surgeries
 OR transplant* OR “valve disease” OR bypass OR graft* OR procedure* OR arrhythmia*)) OR (valve NEAR/3 (replacement* OR prosthes*)) OR (myocardial NEAR/4 (ische?mia OR infarct*
 OR “ST elevation” OR “non-ST elevation” OR revascularization))) AND (psychotherapy OR
 hypnosis OR “health literacy” OR “consumer health information” OR telerehabilitation OR
 “patient education” OR cbt OR “cognitive behavior?” OR hypnosis OR psychoanaly* OR ((exercise OR diet OR lifestyle OR occupational OR educat* OR rehab* OR council* OR
 psycholog* OR psychosocial OR psychotherapy*) NEAR/4 (program* OR intervention* OR
 modification OR therapy OR therapies OR process*)))) OR “Cardiac Rehab” OR “Cardiac

Rehabilitation") AND (internet* OR web* OR website OR online* OR "on-line" OR android OR
"cell phone" OR "cell phones" OR cellphone* OR "mobile phone" OR "mobile phones" OR
"mobile-phone" OR cyber* OR internet* OR ipad* OR "i-pad" OR iphone* OR "i-phone" OR
"smart phone" OR "smart phones" OR smartphone* OR "multi-media" OR multimedia* OR
online* OR virtual* OR www OR "mobile app" OR "mobile application" OR "mobile
applications" OR (handheld NEAR/2 device*)) AND (random* OR placebo* OR trial* OR rct))

Appendix 3 Systematic review critical appraisal tool



THE JOANNA BRIGGS INSTITUTE

JBI Critical Appraisal Checklist for Randomized Controlled Trials

Reviewer.....Date.....

Author.....Year.....Record Number.....

	Yes	No	Unclear	NA
1. Was true randomization used for assignment of participants to treatment groups?	☐	☐	☐	☐
2. Was allocation to treatment groups concealed?	☐	☐	☐	☐
3. Were treatment groups similar at the baseline?	☐	☐	☐	☐
4. Were participants blind to treatment assignment?	☐	☐	☐	☐
5. Were those delivering treatment blind to treatment assignment?	☐	☐	☐	☐
6. Were outcomes assessors blind to treatment assignment?	☐	☐	☐	☐
7. Were treatment groups treated identically other than the intervention of interest?	☐	☐	☐	☐
8. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	☐	☐	☐	☐
9. Were participants analyzed in the groups to which they were randomized?	☐	☐	☐	☐
10. Were outcomes measured in the same way for treatment groups?	☐	☐	☐	☐
11. Were outcomes measured in a reliable way?	☐	☐	☐	☐
12. Was appropriate statistical analysis used?	☐	☐	☐	☐
13. Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

© Joanna Briggs Institute 2017

Critical Appraisal Checklist
for Randomized Controlled Trials | 3

Used with permission (Tufanaru et al 2020)

Appendix 4 Instruments

Web-development workshop questionnaire.



Co-design workshops Regional LHN Questionnaire

Contact Information

- ☐ Email address _____
- ☐ Telephone number _____

1. Please indicate your gender

- ☐ Male
- ☐ Female
- ☐ Non-binary
- ☐ Prefer not to disclose
- ☐ Prefer to self-describe

2. Are you Aboriginal and/or Torres Strait Islander?

☐

No

☐

Yes, Aboriginal

☐

Yes, Torres Strait Islander

3. Please indicate your age

4. Country of birth

5. Language spoken at home

6. What is your highest level of education level

☐

No schooling

☐

Primary education

☐

Secondary education (Year 9 and above)

☐

Certificate

☐

Advanced diploma

☐

Bachelor's degree

☐

Postgraduate degree

7. What is your current employment status?

- ☐ Employed full time
- ☐ Employed part time
- ☐ Unemployed
- ☐ Retired

8. Please indicate your postcode

9. Please indicate the name of your heart condition (ie. heart attack, heart failure, atrial fibrillation)

10. Have you attended a cardiac rehabilitation program?

- ☐ Yes
- ☐ No
- ☐ Unsure

11. Please indicate what technology you use **regularly** (select all that apply):

- ☐ Smartphone
- ☐ iPad / tablet
- ☐ Home computer
- ☐ Other

12. Please indicate your **home** internet connection (select all that apply):

- ☐ Through SIM card on phone
- ☐ Home internet
- ☐ NBN connection
- ☐ Other _____

13. Please indicate what social media you use (select all that apply):

- ☐ Facebook
- ☐ Twitter
- ☐ LinkedIn
- ☐ WeChat
- ☐ WhatsApp
- ☐ Instagram
- ☐ Other _____

Thank you for completing these questions.

Usability testing workshops questionnaire



Co-design workshop demographics

Q1 Please indicate your gender

- ☐ Male
 - ☐ Female
 - ☐ Non-binary
 - ☐ Prefer not to disclose
 - ☐ Prefer to self-describe
-

Q2 Are you Aboriginal and/or Torres Strait Islander?

- ☐ No
 - ☐ Yes, Aboriginal
 - ☐ Yes, Torres Strait Islander
-

Q3 Please indicate your age

Q4 Country of birth

Q5 Language spoken at home

Q6 What is your highest level of education level

- ☐ No schooling
- ☐ Primary education
- ☐ Secondary education (Year 9 and above)
- ☐ Certificate
- ☐ Advanced diploma
- ☐ Bachelor's degree
- ☐ Postgraduate degree

Q7 What is your current employment status?

- ☐ Employed full time
- ☐ Employed part time
- ☐ Unemployed
- ☐ Retired

Q8 Please indicate your postcode

Q9 Who do you currently live with?

- ☐ Family/ Partner
- ☐ Friends
- ☐ Live alone
-

Q10 Please indicate the name of your heart condition (ie. heart attack, heart failure, atrial fibrillation)

Q11 Do you have a history of any of these medical conditions? Tick all that apply.

- ☐ Hypertension
- ☐ Hypercholesterolemia
- ☐ Heart failure
- ☐ Diabetes - insulin dependent
- ☐ Diabetes - non-insulin dependent
- ☐ Valvular disease
- ☐ Stroke/ TIA/ thromboembolism
- ☐ Peripheral vascular disease
- ☐ Congenital heart condition
- ☐ Cancer
- ☐ COPD
- ☐ GORD
- ☐ Bowel disease
- ☐ Kidney disease
- ☐ Liver disease
- ☐ Mental health
- ☐ Other - _____

WKS-Qu-V2-1472021

Page 4 of 6

Q12 Have you attended a cardiac rehabilitation program?

- ☐ Yes
- ☐ No
- ☐ Unsure

Q13 When did you start cardiac rehabilitation? Month and year.

Q14 Please indicate what technology you use (select all that apply):

- ☐ Smartphone
- ☐ iPad / tablet
- ☐ Home computer
- ☐ Other _____

Q15 Please indicate your internet connection (select all that apply):

- ☐ Through SIM card on phone
 - ☐ Home internet
 - ☐ NBN connection
 - ☐ Other _____
-

Q16 Please indicate what social media you use (select all that apply):

- ☐ Facebook
- ☐ Twitter
- ☐ LinkedIn
- ☐ WeChat
- ☐ WhatsApp
- ☐ Other _____

System Usability Scale

Participant ID: _____ Site: _____

Date: ____/____/____

System Usability Scale

Instructions: For each of the following statements, mark one box that best describes your reactions to the website *today*.

		Strongly Disagree				Strongly Agree
1.	I think that I would like to use this website frequently.	☐	☐	☐	☐	☐
2.	I found this website unnecessarily complex.	☐	☐	☐	☐	☐
3.	I thought this website was easy to use.	☐	☐	☐	☐	☐
4.	I think that I would need assistance to be able to use this website.	☐	☐	☐	☐	☐
5.	I found the various functions in this website were well integrated.	☐	☐	☐	☐	☐
6.	I thought there was too much inconsistency in this website.	☐	☐	☐	☐	☐
7.	I would imagine that most people would learn to use this website very quickly.	☐	☐	☐	☐	☐
8.	I found this website very cumbersome/awkward to use.	☐	☐	☐	☐	☐
9.	I felt very confident using this website.	☐	☐	☐	☐	☐
10.	I needed to learn a lot of things before I could get going with this website.	☐	☐	☐	☐	☐

Please provide any comments about this website:

Note: Reprinted with permission from J Brooke. This questionnaire is based on the System Usability Scale (SUS), which was developed by John Brooke while working at Digital Equipment Corporation. © Digital Equipment Corporation, 1986.

Appendix 5 Ethics approvals

Office for Research

Flinders Medical Centre
Ward 6C, Room 6A219
Flinders Drive, Bedford Park SA 5042
Tel: (08) 6204 6453
E: Health.SALHNOfficeforResearch@sa.gov.au



Health
Southern Adelaide
Local Health Network

Final Approval for Ethics: Low and Negligible risk research

23 October 2020

Professor Robyn Clark
College of Nursing & Health Sciences
Flinders University

Email contact: nesb0023@flinders.edu.au

Dear Professor Clark

OFR Number: 266.20

SSA Reference number:

Project title: Co-design of patient-centred, user-friendly web-based Cardiac Rehabilitation

Chief Investigator: Professor Robyn Clark

Associate Investigators: Dr Huiyun Du, Dr Alline Beleigoli, Ms Katie Nesbitt

Ethics Approval Period: 23 October 2020 – 23 October 2023

The Southern Adelaide Clinical Human Research Ethics Committee (SAC HREC) (EC00188) and the SALHN Director, Office for Research have reviewed and approved this application out of session, through the low and negligible risk pathway, and provided approval for this research to commence, as it meets the requirements of the *National Statement on Ethical Conduct in Human Research (2007, updated 2018)* and the SALHN Research Governance policy.

The annual review for this study is due: 23 October 2021

Public health sites approved under this application:

- Eyre and Far North LHN
- Flinders and Upper North LHN: Whyalla
- York and Northern LHN: Wallaroo
- Barossa, Hills and Fleurieu LHN: Tanunda
- Riverland, Mallee and Coorong LHN: Berri/Murray Bridge
- Limestone Coast LHN: Mount Gambier

Please ensure this study meets current SA Health COVID-19 regulations before recruitment commences.

The below documents have been reviewed and approved:

Document	Version	Date
Low and negligible risk application form		
Protocol	3.0	22.10.2020
Study summary	1.0	20.10.2020
Participant information sheet and consent form	3.0	22.10.2020

Design for web portal	1.0	22.10.2020
Participant questionnaire	2.0	21.10.2020
Recruitment email	1.0	23.09.2020
System Usability Scale	1.0	15.09.2020

TERMS AND CONDITIONS OF ETHICS AND GOVERNANCE APPROVAL

The Principal Investigator must ensure this research complies with the National Statement on Ethical Conduct in Human Research (2018) & the Australian Code for the Responsible Conduct of Research (2007 updated 2018) by immediately reporting to the Office for Research (OFR) anything that may change the ethics or scientific integrity of the project. Final approval is granted subject to the researcher agreeing to meet the following terms and conditions:

1. Confidentiality of research participants MUST be maintained at all times.
2. Non-SA Health researchers viewing confidential SALHN data are required to complete and sign a SALHN Confidentiality Disclosure Deed
3. All approved requests for access to medical records at any SALHN site must be accompanied by this approval letter.
4. If your study involves a tertiary institution, contact the University to ensure compliance with University requirements prior to commencement of this study. This includes any insurance and indemnification.
5. The PI must adhere to Monitoring and Reporting requirements for both ethics and governance which are available on the SALHN Research Website.
6. The PI must immediately report to SAC HREC anything that may change the ethics or scientific integrity of the project
7. An annual report must be submitted to the SAC HREC and SALHN governance on each anniversary of the date of final approval. Please visit the Office for Research website for the current template.
8. Non-SA Health researchers coming onsite at SALHN must provide evidence of a recent (<3 years) screening check. It is the responsibility of the Principal Investigator to ensure any non-SA Health personnel who conducts or monitors research meets SA Health screening requirements as per the SA Health Criminal & Relevant History Screening Policy Directive before they access any SA Health site. The cost of any such screening is the responsibility of the individual accessing the site or their employer.
9. Any reports or publications derived from the research should be submitted to the Committee at the completion of the project.
10. Once the research project has concluded, any new product/procedure/intervention cannot be conducted in the SALHN as standard practice without the approval of the SALHN New Medical Products and Standardisation Committee or the SALHN New Health Technology and Clinical Practice Innovation Committee (as applicable). Please refer to the relevant committee link on the SALHN Intranet for further information.
11. SALHN site-monitoring of authorised studies - this approval/authorisation is subject to participation in this monitoring process. You will be notified in advance if your site has been selected for an inspection.

Please visit the SALHN Research website regularly and comply with all submission requirements as they may change from time to time.

For any queries about this matter, please contact The Office for Research on (08) 8204 6453 or via email to Health.SALHNOfficeforResearch@sa.gov.au

Yours sincerely,


Professor Bill Heddle
Chair - Southern Adelaide Clinical Human Research Ethics Committee

Dear Katie

OFR Number: 266.20

SSA Reference number:

Project title: Co-design of patient-centred, user-friendly web-based Cardiac

Rehabilitation

Chief Investigator: Professor Robyn Clark

Associate Investigators: Dr Huiyun Du, Dr Alline Beleigoli, Ms Katie Nesbitt

Ethics Approval Period: 23 October 2020 – 23 October 2023

The amendment to the above study has been reviewed and approved by the SAC HREC.

Public Health sites approved under this application:

- Eyre and Far North LHN
- Flinders and Upper North LHN: Whyalla
- York and Northern LHN: Wallaroo
- Barossa, Hills and Fleurieu LHN: Tanunda
- Riverland, Mallee and Coorong LHN: Berri/Murray Bridge
- Limestone Coast LHN: Mount Gambier

The following documents have been reviewed and approved:

Document	Version	Date
Project amendment form – addition of Dr Stephanie Champion, Dr Lemlem	-	30.06.2021

Gebremichael and Ms Anushka Jacob / Update to questionnaire.		
Protocol	4.0	01.07.2021
Study summary	1.0	30.06.2021
Participant information sheet and consent form	4.0	14.07.2021
Questionnaire	2.0	14.07.2021
Recruitment email	1.0	30.06.2021

The terms and conditions of ethics and governance approval remain unchanged from the original approval. Please note a formal approval letter will not be provided. Please retain a copy of this email as evidence of approval.

Kind Regards,

Petrina Kasperski

On behalf of

Professor Bill Heddle

Chair

SAC HREC

Appendix 6 Site Specific approvals



Government of South Australia

SA Health

Authorisation Date: 5 November 2020

Professor Robyn Clark
College of Nursing and Health Sciences
Flinders University
Bedford Park SA 5042

Rural Support Service

Adelaide Office
Level 2, 22 King William Street
PO Box 287, Rundle Mall
ADELAIDE SA 5000
Tel 08 8226 6120
Fax 08 8226 7170
Email: Health.RuralSupportService@sa.gov.au

www.sahealth.sa.gov.au

Dear Professor Clark

Project Title: Co-design of patient centred, user-friendly web-based cardiac rehabilitation

RSS Reference Number: EGR/20/RSS/15

SALHN OFR Number: 266.20

Chief Investigator: Professor Robyn Clark

Associate Investigators: Dr Huiyun Du, Dr Aline Beleigoli, Ms Katie Nesbitt

Governance Approval Period: 5 November 2020 – 5 November 2021

Thank you for submitting the above proposal for review. This project has undergone ethics review by the Southern Adelaide Clinical Human Research Ethics Committee (HREC), through the low and negligible risk pathway, and has been granted approval to commence.

Governance requirements have been met and I am pleased to advise that your project is now authorised at the following site and may commence.

Site	Local Health Network
Country Health Connect – Gawler/Barossa	Barossa Hills Fleurieu Local Health Network

Project authorisation is valid for **one (1) year** from **05 November 2020 to 05 November 2021**. An annual progress report requesting an extension must be submitted if the duration of the project continues beyond this period.

GENERAL TERMS AND CONDITIONS OF PROJECT AUTHORISATION:

1. The Southern Adelaide Clinical Human Research Ethics Committee is the 'lead HREC' for the purpose of this ethics approval.
2. The study must be conducted in accordance with the standards outlined in the National Statement on Ethical Conduct in Human Research 2007 (updated 2018), the Australian Code for the Responsible Conduct of Research (2018), and SA Health policies.
3. Adequate record keeping must be maintained in accordance with Good Clinical Practice, and the NHMRC, state, and national guidelines. The duration of record retention for all low risk research data is five years from the date of publication.
4. Proposed amendments to the research protocol or conduct of the research which may affect

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the ongoing ethical acceptability of the project and/or the site acceptability of the project must to be submitted to the Rural Support Service Research Office. Researchers are required to immediately report anything which might warrant review of ethical approval of the study, including:

- a) Adverse events which warrant protocol change or notification to research participants;
 - b) Changes to the protocol;
 - c) Changes to the safety or efficacy of the investigational product, device or method;
 - d) Matters that may affect the conduct of the project;
 - e) Premature termination of the study.
5. Confidentiality of the research participants must be maintained at all times as required by law.
 6. A report of the progress of the project at least annually, and related to the degree of risk to participants. The report is due on the anniversary of project authorisation. Continuation of approval is contingent on submission of this report, due within 30 days of the approval anniversary. Failure to comply may result in suspension of the project
 7. A final report of the outcome of the project must be submitted on completion of the project. A copy of any published material must also be provided with the report, or following when available.
 8. A copy of this letter should also be maintained on file by the Coordinating Principal Investigator as evidence of project authorisation.
 9. If University personnel are involved in this project, the Principal Investigator should notify the University before commencing their research to ensure compliance with University requirements including any insurance and indemnification requirements. **A copy of compliance confirmation must be forwarded to RSS Research Office upon receipt.**

Should you have any queries regarding your project authorisation, or any other matters pertaining to research governance, please Ph: (08) 8553 4208 or email Health.RegionalResearchGovernance@sa.gov.au.

I wish you every success in your research.

Yours sincerely,



Andrea Church
Research Governance Officer
Rural Support Service

5 November 2020

cc: Dr Alline Belegioli
Ms Katie Nesbitt



Authorisation Date: 25 October 2021

Professor Robyn Clark
College of Nursing and Health Sciences
Flinders University
Bedford Park SA 5042

Rural Support Service

Adelaide Office
Level 14, 25 Grenfell Street
PO Box 3017, Rundle Mall
ADELAIDE SA 5000
Tel 08 7117 9289

Email: Health.RuralSupportService@sa.gov.au

www.sahealth.sa.gov.au

Dear Professor Clark

Project Title: Co-design of patient centred, user-friendly web-based cardiac rehabilitation

RSS Reference Number: LNR/21/RSS/07

SALHN OFR Number: 266.20

Chief Investigator: Professor Robyn Clark

Associate Investigators: Dr Stephanie Champion, Dr Alline Beleigoli, Ms Katie Nesbitt

Governance Approval Period: 25 October 2021 – 25 October 2022

Thank you for submitting the above proposal for review. This project has undergone ethics review by the Southern Adelaide Clinical Human Research Ethics Committee (HREC), through the low and negligible risk pathway, and has been granted approval to commence.

Governance requirements have been met and I am pleased to advise that your project is now authorised at the following site and may commence.

Site	Local Health Network
Port Lincoln Health Service	Eyre and Far North Local Health Network

Project authorisation is valid for **one (1) year** from **25 October 2021 to 25 October 2022**. An annual progress report requesting an extension must be submitted if the duration of the project continues beyond this period.

GENERAL TERMS AND CONDITIONS OF PROJECT AUTHORISATION:

1. The Southern Adelaide Clinical Human Research Ethics Committee is the 'lead HREC' for the purpose of this ethics approval.
2. The study must be conducted in accordance with the standards outlined in the National Statement on Ethical Conduct in Human Research 2007 (updated 2018), the Australian Code for the Responsible Conduct of Research (2018), and SA Health policies.
3. Adequate record keeping must be maintained in accordance with Good Clinical Practice, and the NHMRC, state, and national guidelines. The duration of record retention for all low risk research data is five years from the date of publication.
4. Proposed amendments to the research protocol or conduct of the research which may affect

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the ongoing ethical acceptability of the project and/or the site acceptability of the project must to be submitted to the Rural Support Service Research Office. Researchers are required to immediately report anything which might warrant review of ethical approval of the study, including:

- a) Adverse events which warrant protocol change or notification to research participants;
 - b) Changes to the protocol;
 - c) Changes to the safety or efficacy of the investigational product, device or method;
 - d) Matters that may affect the conduct of the project;
 - e) Premature termination of the study.
5. Confidentiality of the research participants must be maintained at all times as required by law.
 6. A report of the progress of the project at least annually, and related to the degree of risk to participants. The report is due on the anniversary of project authorisation. Continuation of approval is contingent on submission of this report, due within 30 days of the approval anniversary. Failure to comply may result in suspension of the project
 7. A final report of the outcome of the project must be submitted on completion of the project. A copy of any published material must also be provided with the report, or following when available.
 8. A copy of this letter should also be maintained on file by the Coordinating Principal Investigator as evidence of project authorisation.
 9. If University personnel are involved in this project, the Principal Investigator should notify the University before commencing their research to ensure compliance with University requirements including any insurance and indemnification requirements. **A copy of compliance confirmation must be forwarded to RSS Research Office upon receipt.**

Should you have any queries regarding your project authorisation, or any other matters pertaining to research governance, please Ph: (08) 8553 4208 or email Health.RegionalResearchGovernance@sa.gov.au.

I wish you every success in your research.

Yours sincerely,



Andrea Church
Research Governance Officer
Rural Support Service

25 November 2021

cc: Dr Alline Belegioli
Ms Katie Nesbitt
Dr Stephanie Champion



Authorisation Date: 3 November 2020

Professor Robyn Clark
College of Nursing and Health Sciences
Flinders University
Bedford Park SA 5042

Rural Support Service

Adelaide Office
Level 2, 22 King William Street
PO Box 287, Rundle Mall
ADELAIDE SA 5000
Tel 08 8226 6120
Fax 08 8226 7170
Email: Health.RuralSupportService@sa.gov.au

www.sahealth.sa.gov.au

Dear Professor Clark

Project Title: Co-design of patient centred, user-friendly web-based cardiac rehabilitation

RSS Reference Number: EGR/20/RSS/16

SALHN OFR Number: 266.20

Chief Investigator: Professor Robyn Clark

Associate Investigators: Dr Huiyun Du, Dr Alline Beleigoli, Ms Katie Nesbitt

Governance Approval Period: 3 November 2020 – 3 November 2021

Thank you for submitting the above proposal for review. This project has undergone ethics review by the Southern Adelaide Clinical Human Research Ethics Committee (HREC), through the low and negligible risk pathway, and has been granted approval to commence.

Governance requirements have been met and I am pleased to advise that your project is now authorised at the following site and may commence.

Site	Local Health Network
Whyalla Hospital and Health Services	Flinders and Upper North Local Health Network

Project authorisation is valid for **one (1) year** from **03 November 2020 to 03 November 2021**. An annual progress report requesting an extension must be submitted if the duration of the project continues beyond this period.

GENERAL TERMS AND CONDITIONS OF PROJECT AUTHORISATION:

1. The Southern Adelaide Clinical Human Research Ethics Committee is the 'lead HREC' for the purpose of this ethics approval.
2. The study must be conducted in accordance with the standards outlined in the National Statement on Ethical Conduct in Human Research 2007 (updated 2018), the Australian Code for the Responsible Conduct of Research (2018), and SA Health policies.
3. Adequate record keeping must be maintained in accordance with Good Clinical Practice, and the NHMRC, state, and national guidelines. The duration of record retention for all low risk research data is five years from the date of publication.
4. Proposed amendments to the research protocol or conduct of the research which may affect the ongoing ethical acceptability of the project and/or the site acceptability of the project must

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to be submitted to the Rural Support Service Research Office. Researchers are required to immediately report anything which might warrant review of ethical approval of the study, including:

- a) Adverse events which warrant protocol change or notification to research participants;
 - b) Changes to the protocol;
 - c) Changes to the safety or efficacy of the investigational product, device or method;
 - d) Matters that may affect the conduct of the project;
 - e) Premature termination of the study.
5. Confidentiality of the research participants must be maintained at all times as required by law.
 6. A report of the progress of the project at least annually, and related to the degree of risk to participants. The report is due on the anniversary of project authorisation. Continuation of approval is contingent on submission of this report, due within 30 days of the approval anniversary. Failure to comply may result in suspension of the project
 7. A final report of the outcome of the project must be submitted on completion of the project. A copy of any published material must also be provided with the report, or following when available.
 8. A copy of this letter should also be maintained on file by the Coordinating Principal Investigator as evidence of project authorisation.
 9. If University personnel are involved in this project, the Principal Investigator should notify the University before commencing their research to ensure compliance with University requirements including any insurance and indemnification requirements. **A copy of compliance confirmation must be forwarded to RSS Research Office upon receipt.**

Should you have any queries regarding your project authorisation, or any other matters pertaining to research governance, please Ph: (08) 8553 4208 or email Health.RegionalResearchGovernance@sa.gov.au.

I wish you every success in your research.

Yours sincerely,



Andrea Church
Research Governance Officer
Rural Support Service

3 November 2020

cc: Dr Alline Belegioli
Ms Katie Nesbitt



Authorisation Date: 23 October 2020

Professor Robyn Clark
College of Nursing and Health Sciences
Flinders University
Bedford Park SA 5042

Rural Support Service

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Fax 08 8226 7170
Email: Health.Rural.Support.Service@sa.gov.au
www.sahealth.sa.gov.au

Dear Professor Clark

Project Title: Co-design of patient centred, user-friendly web-based cardiac rehabilitation
RSS Reference Number: EGR/20/RSS/17
SALHN OFR Number: 266.20
Chief Investigator: Professor Robyn Clark
Associate Investigators: Dr Huiyun Du, Dr Aline Beleigoli, Ms Katie Nesbitt
Governance Approval Period: 23 October 2020 – 23 October 2021

Thank you for submitting the above proposal for review. This project has undergone ethics review by the Southern Adelaide Clinical Human Research Ethics Committee (HREC), through the low and negligible risk pathway, and has been granted approval to commence.

Governance requirements have been met and I am pleased to advise that your project is now authorised at the following site and may commence.

Site	Local Health Network
Mount Gambier and Districts Health Service	Limestone Coast Local Health Network

Project authorisation is valid for **one (1) year** from **23 October 2020 to 23 October 2021**. An annual progress report requesting an extension must be submitted if the duration of the project continues beyond this period.

GENERAL TERMS AND CONDITIONS OF PROJECT AUTHORISATION:

1. The Southern Adelaide Clinical Human Research Ethics Committee is the 'lead HREC' for the purpose of this ethics approval.
2. The study must be conducted in accordance with the standards outlined in the National Statement on Ethical Conduct in Human Research 2007 (updated 2018), the Australian Code for the Responsible Conduct of Research (2018), and SA Health policies.
3. Adequate record keeping must be maintained in accordance with Good Clinical Practice, and the NHMRC, state, and national guidelines. The duration of record retention for all low risk research data is five years from the date of publication.

OFFICIAL

4. Proposed amendments to the research protocol or conduct of the research which may affect the ongoing ethical acceptability of the project and/or the site acceptability of the project must be submitted to the Rural Support Service Research Office. Researchers are required to immediately report anything which might warrant review of ethical approval of the study, including:
 - a) Adverse events which warrant protocol change or notification to research participants;
 - b) Changes to the protocol;
 - c) Changes to the safety or efficacy of the investigational product, device or method;
 - d) Matters that may affect the conduct of the project;
 - e) Premature termination of the study.
5. Confidentiality of the research participants must be maintained at all times as required by law.
6. A report of the progress of the project at least annually, and related to the degree of risk to participants. The report is due on the anniversary of project authorisation. Continuation of approval is contingent on submission of this report, due within 30 days of the approval anniversary. Failure to comply may result in suspension of the project
7. A final report of the outcome of the project must be submitted on completion of the project. A copy of any published material must also be provided with the report, or following when available.
8. A copy of this letter should also be maintained on file by the Coordinating Principal Investigator as evidence of project authorisation.
9. If University personnel are involved in this project, the Principal Investigator should notify the University before commencing their research to ensure compliance with University requirements including any insurance and indemnification requirements. **A copy of compliance confirmation must be forwarded to RSS Research Office upon receipt.**

Should you have any queries regarding your project authorisation, or any other matters pertaining to research governance, please Ph: (08) 8553 4208 or email Health.RegionalResearchGovernance@sa.gov.au.

I wish you every success in your research.

Yours sincerely,



Andrea Church
Research Governance Officer
Rural Support Service

23 October 2020

cc: Dr Alline Belegioli
Ms Katie Nesbitt



Authorisation Date: 23 October 2020

Professor Robyn Clark
College of Nursing and Health Sciences
Flinders University
Bedford Park SA 5042

Rural Support Service

Adelaide Office
Level 2, 22 King William Street
P O Box 287, Rundle Mall
ADELAIDE SA 5000
Tel 08 8226 6120
Fax 08 8226 7170
Email: Health.Rural.Support@sa.gov.au
www.sahealth.sa.gov.au

Dear Professor Clark

Project Title: Co-design of patient centred, user-friendly web-based cardiac rehabilitation
RSS Reference Number: EGR/20/RSS/18
SALHN OFR Number: 266.20
Chief Investigator: Professor Robyn Clark
Associate Investigators: Dr Huiyun Du, Dr Aline Beleigoli, Ms Katie Nesbitt
Governance Approval Period: 23 October 2020 – 23 October 2021

Thank you for submitting the above proposal for review. This project has undergone ethics review by the Southern Adelaide Clinical Human Research Ethics Committee (HREC), through the low and negligible risk pathway, and has been granted approval to commence.

Governance requirements have been met and I am pleased to advise that your project is now authorised at the following site and may commence.

Site	Local Health Network
Country Health Connect – Murray Bridge	Riverland Mallee Coorong Local Health Network
Country Health Connect - Riverland	Riverland Mallee Coorong Local Health Network

Project authorisation is valid for **one (1) year** from **23 October 2020 to 23 October 2021**. An annual progress report requesting an extension must be submitted if the duration of the project continues beyond this period.

GENERAL TERMS AND CONDITIONS OF PROJECT AUTHORISATION:

1. The Southern Adelaide Clinical Human Research Ethics Committee is the 'lead HREC' for the purpose of this ethics approval.
2. The study must be conducted in accordance with the standards outlined in the National Statement on Ethical Conduct in Human Research 2007 (updated 2018), the Australian Code for the Responsible Conduct of Research (2018), and SA Health policies.
3. Adequate record keeping must be maintained in accordance with Good Clinical Practice, and the NHMRC, state, and national guidelines. The duration of record retention for all low risk research data is five years from the date of publication.

OFFICIAL

4. Proposed amendments to the research protocol or conduct of the research which may affect the ongoing ethical acceptability of the project and/or the site acceptability of the project must be submitted to the Rural Support Service Research Office. Researchers are required to immediately report anything which might warrant review of ethical approval of the study, including:
 - a) Adverse events which warrant protocol change or notification to research participants;
 - b) Changes to the protocol;
 - c) Changes to the safety or efficacy of the investigational product, device or method;
 - d) Matters that may affect the conduct of the project;
 - e) Premature termination of the study.
5. Confidentiality of the research participants must be maintained at all times as required by law.
6. A report of the progress of the project at least annually, and related to the degree of risk to participants. The report is due on the anniversary of project authorisation. Continuation of approval is contingent on submission of this report, due within 30 days of the approval anniversary. Failure to comply may result in suspension of the project
7. A final report of the outcome of the project must be submitted on completion of the project. A copy of any published material must also be provided with the report, or following when available.
8. A copy of this letter should also be maintained on file by the Coordinating Principal Investigator as evidence of project authorisation.
9. If University personnel are involved in this project, the Principal Investigator should notify the University before commencing their research to ensure compliance with University requirements including any insurance and indemnification requirements. **A copy of compliance confirmation must be forwarded to RSS Research Office upon receipt.**

Should you have any queries regarding your project authorisation, or any other matters pertaining to research governance, please Ph: (08) 8553 4208 or email Health.RegionalResearchGovernance@sa.gov.au.

I wish you every success in your research.

Yours sincerely,



Andrea Church
Research Governance Officer
Rural Support Service

23 October 2020

cc: Dr Alline Belegioli
Ms Katie Nesbitt



Authorisation Date: 23 October 2020

Professor Robyn Clark
College of Nursing and Health Sciences
Flinders University
Bedford Park SA 5042

Rural Support Service

Adelaide Office
Level 2, 22 King William Street
P O Box 287, Rundle Mall
ADELAIDE SA 5000
Tel 08 8226 6120
Fax 08 8226 7170
Email: Health.Rural.Support.Service@sa.gov.au
www.sahealth.sa.gov.au

Dear Professor Clark

Project Title: Co-design of patient centred, user-friendly web-based cardiac rehabilitation
RSS Reference Number: EGR/20/RSS/19
SALHN OFR Number: 266.20
Chief Investigator: Professor Robyn Clark
Associate Investigators: Dr Huiyun Du, Dr Aline Beleigoli, Ms Katie Nesbitt
Governance Approval Period: 23 October 2020 – 23 October 2021

Thank you for submitting the above proposal for review. This project has undergone ethics review by the Southern Adelaide Clinical Human Research Ethics Committee (HREC), through the low and negligible risk pathway, and has been granted approval to commence.

Governance requirements have been met and I am pleased to advise that your project is now authorised at the following site and may commence.

Site	Local Health Network
Wallaroo Hospital and Health Service	Yorke and Northern Local Health Network

Project authorisation is valid for **one (1) year** from **23 October 2020 to 23 October 2021**. An annual progress report requesting an extension must be submitted if the duration of the project continues beyond this period.

GENERAL TERMS AND CONDITIONS OF PROJECT AUTHORISATION:

1. The Southern Adelaide Clinical Human Research Ethics Committee is the 'lead HREC' for the purpose of this ethics approval.
2. The study must be conducted in accordance with the standards outlined in the National Statement on Ethical Conduct in Human Research 2007 (updated 2018), the Australian Code for the Responsible Conduct of Research (2018), and SA Health policies.
3. Adequate record keeping must be maintained in accordance with Good Clinical Practice, and the NHMRC, state, and national guidelines. The duration of record retention for all low risk research data is five years from the date of publication.

OFFICIAL

4. Proposed amendments to the research protocol or conduct of the research which may affect the ongoing ethical acceptability of the project and/or the site acceptability of the project must be submitted to the Rural Support Service Research Office. Researchers are required to immediately report anything which might warrant review of ethical approval of the study, including:
 - a) Adverse events which warrant protocol change or notification to research participants;
 - b) Changes to the protocol;
 - c) Changes to the safety or efficacy of the investigational product, device or method;
 - d) Matters that may affect the conduct of the project;
 - e) Premature termination of the study.
5. Confidentiality of the research participants must be maintained at all times as required by law.
6. A report of the progress of the project at least annually, and related to the degree of risk to participants. The report is due on the anniversary of project authorisation. Continuation of approval is contingent on submission of this report, due within 30 days of the approval anniversary. Failure to comply may result in suspension of the project
7. A final report of the outcome of the project must be submitted on completion of the project. A copy of any published material must also be provided with the report, or following when available.
8. A copy of this letter should also be maintained on file by the Coordinating Principal Investigator as evidence of project authorisation.
9. If University personnel are involved in this project, the Principal Investigator should notify the University before commencing their research to ensure compliance with University requirements including any insurance and indemnification requirements. **A copy of compliance confirmation must be forwarded to RSS Research Office upon receipt.**

Should you have any queries regarding your project authorisation, or any other matters pertaining to research governance, please Ph: (08) 8553 4208 or email Health.RegionalResearchGovernance@sa.gov.au.

I wish you every success in your research.

Yours sincerely,



Andrea Church
Research Governance Officer
Rural Support Service

23 October 2020

cc: Dr Alline Belegioli
Ms Katie Nesbitt

Appendix 7 Consents

Web-development



Participant Information Sheet/Consent Form

Non-Interventional Study - Adult providing own consent

Local Health Network (SA Health) Workshops

Title	Co-design of patient-centred, user-friendly web-based Cardiac Rehabilitation
Short Title	Cardiac Rehabilitation website workshops
Protocol Number	266.20
Study Sponsor	Co-sponsored NHMRC Partnership Grant (1169893)
Coordinating Principal Investigator Principal Investigator	Professor Robyn Clark
Associate Investigator(s)	Dr Huiyun Du Dr Alline Beleigoli Ms Katie Nesbitt
Location	Regional Local Health Networks

Part 1 What does my participation involve?

1 Introduction

You are invited to take part in this research study, to assist in co-designing a web-based cardiac Rehabilitation website. This is because you have a heart condition and you have completed or are completing a cardiac rehabilitation program. The research study is aiming to develop a web-based cardiac rehabilitation program delivery model, through a co-design process with cardiac rehabilitation patients.

This Participant Information Sheet/Consent Form tells you about the research study. It explains the research involved. Knowing what is involved will help you decide if you want to take part in the research.

Please read this information carefully. Ask questions about anything that you do not understand or want to know more about. Before deciding whether to take part, you might want to talk about it with a relative, friend or local doctor.

WKS-PICF-V3-22102020

Page 1 of 7

Participation in this research is voluntary. If you don't wish to take part, you don't have to. You will receive the best possible care whether or not you take part.

If you decide you want to take part in the research study, you will be asked to sign the consent section. By signing it you are telling us that you:

- Understand what you have read
- Consent to take part in the research study

You will be given a copy of this Participant Information and Consent Form to keep.

2 What is the purpose of this research?

Cardiac rehabilitation has been poorly attended over the last 20 years with distance from cardiac rehabilitation programs, costs involved in travelling and interruptions to work commitments, among some of the barriers. This study aims to make cardiac rehabilitation more accessible, increasing patient's opportunity to attend and complete their program.

This study will test the usability of the CR website developed by Flinders University through co-design workshops.

This research has been initiated by the chief investigator, Professor Robyn Clark.

This research has been funded by a Co-sponsored NHMRC Partnership Grant (1169893)

3 What does participation in this research involve?

- You will be asked to sign a consent form. This is to tell us that you understand what you have read and consent to take part in the research study.
- Participation involves attending one workshop for 2 hours
- Participants will fill in an anonymous questionnaire about themselves
- The workshop will involve looking at the website user interface design, then giving feedback in a group setting
- Participants will also fill in a survey about the website at the end of the workshop

There are no costs associated with participating in this research study, nor will you be paid. You will be compensated for any reasonable travel with the research study visit. The workshop will provide morning tea.

4 Other relevant information about the research study

The workshops will be conducted in regional Local Health Networks (LHNs). Obtaining feedback from actual web users living with heart disease is one of the important ways we can ensure development of a website that will be a valuable resource for other people with heart disease in the future, as well as easy to use.

5 Do I have to take part in this research study?

Participation in any research study is voluntary. If you do not wish to take part, you do not have to. If you decide to take part and later change your mind, you are free to withdraw from the study at any stage.
If you do decide to take part, you will be given this Participant Information and Consent Form to sign and you will be given a copy to keep.
Your decision whether to take part or not to take part, or to take part and then withdraw, will not affect your routine treatment.

6 What are the possible benefits of taking part?

There will be no clear benefit to you from your participation in this research but you will be assisting to improve care for future cardiovascular patients. You will however be reimbursed for your travel and provided with morning or afternoon tea at the workshop.

7 What are the possible risks and disadvantages of taking part?

We do not foresee any physical or emotional risks from taking part in this research. All we need is two hours of your time. However, if you experience any emotional discomfort, you can contact Beyond Blue (include telephone for the 24h/7d service) or at <https://www.beyondblue.org.au/> for support / counselling that may be accessed free of charge by all participants. If you have any concerns regarding anticipated or actual risks or discomforts, please raise them with the researcher.

8 What if I withdraw from this research study?

If you decide to withdraw from this research study, please notify a member of the research team before you withdraw.

If you do withdraw your consent during the research study you should be aware that data collected by the researcher up to the time you withdraw will form part of the research study results. If you do not want them to do this, you must tell them before you join the research study.

9 What happens when the research study ends?

Participants can receive a summary of the overall findings for each stage along with any direct quotes we plan to use. The final website will be made available for participants, to see the finished product.

Part 2 How is the research study being conducted?

10 What will happen to information about me?

Any information obtained in connection with this research study that can identify you will remain confidential. Data will be recorded in word documents and audio recordings, stored on the main secure Flinders University R drive, which is only accessible to the researchers listed in this application. All data files are password protected and only researchers listed on the study have access to the study folders. Data will be retained for 15 years at the completion of the study.

Your information will only be used for the purpose of this research study.

The research team intends to publish and present the study's results in journals, conferences, and research seminars. In any publication and/or presentation, information will be provided in such a way that you cannot be identified, except with your permission.

In accordance with relevant Australian and/or South Australian privacy and other relevant laws, you have the right to request access to the information collected and stored by the research team about you. You also have the right to request that any information with which you disagree be corrected. Please contact the research team member named at the end of this document if you would like to access your information.

11 Complaints and compensation

If you suffer any distress as a result of this research study, you should contact the study team as soon as possible and you will be assisted with arranging appropriate treatment. Should you have a complaint you can contact the Principal Investigator listed in this form

12 Who is organising and funding the research?

This research study is being conducted by Flinders University in Australia and is co-sponsored and funded by a NHMRC Partnership Grant. The study is being funded with \$10,000 from Novartis.

Flinders University may benefit financially from this research study.

You will not benefit financially from your involvement in this research study even if, for example, knowledge acquired from analysis of your input, prove to be of commercial.

In addition, if knowledge acquired through this research leads to discoveries that are of commercial value to Flinders University, there will be no financial benefit to you or your family from these discoveries.

No member of the research team will receive a personal financial benefit from your involvement in this research study (other than their ordinary wages).

13 Who has reviewed the research study?

All research in Australia involving humans is reviewed by an independent group of people called a Human Research Ethics Committee (HREC). The ethical aspects of this research study have been approved by the HREC of Southern Adelaide Clinical HREC.

This study will be carried out according to the *National Statement on Ethical Conduct in Human Research (2007)*. This statement has been developed to protect the interests of people who agree to participate in human research studies.

14 Further information and who to contact

The person you may need to contact will depend on the nature of your query. If you want any further information concerning this study you can contact any of the following people:

Clinical contact person

Name	Robyn Clark
Position	Professor, College of Nursing and Health Sciences, Flinders University
Telephone	(08) 820813266
Email	robyn.clark@flinders.edu.au

For matters relating to research at the site at which you are participating, the details of the local site complaints person are:

Complaints contact person

Name	Southern Adelaide Clinical Human Research Ethics Committee
Position	Director, Research Operations
Telephone	(08) 8204 6453
Email	health.SALHNOfficeforResearch@sa.gov.au

If you have any complaints about any aspect of the study, the way it is being conducted or any questions about being a research participant in general, then you may contact:

Reviewing HREC approving this research and HREC Executive Officer details

Reviewing HREC name	Southern Adelaide Clinical
Position	Executive Officer
Telephone	08 8204 6453
Email	Health:SALHNOfficeforresearch@sa.gov.au

Local HREC Office contact (Single Site -Research Governance Officer)

Position	Research Governance Officer, Country Health
Telephone	08 8553 4208
Email	Health.RegionalResearchGovernance@sa.gov.au

Consent Form - Adult providing own consent

Title Co-design of patient-centred, user-friendly web-based Cardiac Rehabilitation

Short Title Cardiac Rehabilitation website workshops

Protocol Number 266.20

Study Sponsor Co-sponsored NHMRC Partnership Grant

**Coordinating Principal Investigator/
Principal Investigator** Professor Robyn Clark

Associate Investigator(s) Dr Huiyun Du
Dr Alline Beleigoli
Ms Katie Nesbitt

Location Regional Local Health Networks

Declaration by Participant

I have read the Participant Information Sheet or someone has read it to me in a language that I understand.

I understand the purposes, procedures and risks of the research described in the study .

I have had an opportunity to ask questions and I am satisfied with the answers I have received.

I freely agree to participate in this research study as described and understand that I am free to withdraw at any time during the study without affecting my future health care.

I understand that I will be given a signed copy of this document to keep.

Name of Participant (please print) _____

Signature _____ Date _____

Name of Witness* to
Participant's Signature (please print) _____

Signature _____ Date _____

* Witness is not to be the investigator, a member of the study team or their delegate. In the event that an interpreter is used, the interpreter may not act as a witness to the consent process. Witness must be 18 years or older.

Declaration by Investigator/Senior Researcher†

I have given a verbal explanation of the research study , its procedures and risks and I believe that the participant has understood that explanation.

Name of investigator/
Senior Researcher† (please print) _____

Signature _____ Date _____

† A senior member of the research team must provide the explanation of, and information concerning, the research study .

Note: All parties signing the consent section must date their own signature.

Participant Information Sheet/Consent Form 31.7.20_V1_Focus Group

Page 6 of 7

Form for Withdrawal of Participation - *Adult providing own consent*

Title Co-design of patient-centred, user-friendly web-based Cardiac Rehabilitation

Short Title Cardiac Rehabilitation website workshops

Protocol Number 266.20

Study Sponsor Co-sponsored NHMRC Partnership Grant

**Coordinating Principal Investigator/
Principal Investigator** Professor Robyn Clark

Associate Investigator(s) Dr Huiyun Du
Dr Alline Beleigoli
Ms Katie Nesbitt

Location Regional Local Health Networks

Declaration by Participant

I wish to withdraw from participation in the above research study and understand that such withdrawal will not affect my routine treatment, my relationship with those treating me or my relationship with *Flinders University*.

Name of Participant (please print) _____

Signature _____ Date _____

Declaration by Investigator/Senior Researcher[†]

I have given a verbal explanation of the implications of withdrawal from the research study and I believe that the participant has understood that explanation.

Name of investigator/
Senior Researcher[†] (please print) _____

Signature _____ Date _____

[†] A senior member of the research team must provide the explanation of and information concerning withdrawal from the research study.

Note: All parties signing the consent section must date their own signature.

Participant Information Sheet/Consent Form 31.7.20_V1_Focus Group

Page 7 of 7

Usability testing



Participant Information Sheet/Consent Form

Non-Interventional Study - Adult providing own consent

Local Health Network (SA Health) Workshops

Title	Co-design of patient-centred, user-friendly web-based Cardiac Rehabilitation
Short Title	Cardiac Rehabilitation website workshops
Protocol Number	266.20
Study Sponsor	Co-sponsored NHMRC Partnership Grant (1169893)
Coordinating Principal Investigator Principal Investigator	Professor Robyn Clark Dr Alline Beleigoli
Associate Investigator(s)	Dr Huiyun Du Ms Katie Nesbitt Dr Stephanie Champion Dr Lemlem Gebremichael Dr Carolyn Astley Ms Anushka Jacob
Location	Regional Local Health Networks

Part 1 What does my participation involve?

1 Introduction

You are invited to take part in this research study, to assist in co-designing a web-based cardiac Rehabilitation (CR) website. This is because you have a heart condition and you have completed or are completing a cardiac rehabilitation program. The research study is aiming to develop a web-based cardiac rehabilitation program delivery model, through a co-design process with cardiac rehabilitation patients.

This Participant Information Sheet/Consent Form tells you about the research study. It explains the research involved. Knowing what is involved will help you decide if you want to take part in the research.

Please read this information carefully. Ask questions about anything that you do not understand or want to know more about. Before deciding whether to take part, you might want to talk about it with a relative, friend or local doctor.

Participation in this research is voluntary. If you don't wish to take part, you don't have to. You will receive the best possible care whether or not you take part.

If you decide you want to take part in the research study, you will be asked to sign the consent form section. By signing it you are telling us that you:

- Understand what you have read
- Consent to take part in the research study

You will be given a copy of this Participant Information and Consent Form to keep.

2 What is the purpose of this research?

Cardiac rehabilitation (CR) has been poorly attended over the last 20 years with distance from cardiac rehabilitation programs, costs involved in travelling and interruptions to work commitments, among some of the barriers. This study aims to make cardiac rehabilitation more accessible, increasing patient's opportunity to attend and complete their program and get the health and quality of life benefit from it.

This study will test the usability and accessibility of the CR website developed by Flinders University through co-design workshops.

This research has been initiated by the chief investigator, Professor Robyn Clark.

This research has been funded NHMRC Partnership Grant (GNT1169893) in partnership with Novartis

3 What does participation in this research involve?

- You will be asked to sign a consent form. This is to tell us that you understand what you have read and consent to take part in the research study.
- Participation involves attending one workshop for 2 hours
- Participants will fill in an anonymous questionnaire about themselves
- The workshop will involve looking at the website user interface design, then giving feedback in a group setting
- Participants will also fill in a survey about the website at the end of the workshop

There are no costs associated with participating in this research study, nor will you be paid. You will be compensated for any reasonable travel and parking costs with the research study visit. The workshop will provide morning tea.

4 Other relevant information about the research study

The workshops will be conducted in regional Local Health Networks (LHNs). Obtaining feedback from actual web users living with heart disease is one of the important ways we can ensure

development of a website that will be a valuable and accessible resource for other people with heart disease like you in the future..

5 Do I have to take part in this research study?

Participation in any research study is voluntary. If you do not wish to take part, you do not have to. If you decide to take part and later change your mind, you are free to withdraw from the study at any stage.
If you do decide to take part, you will be given this Participant Information and Consent Form to sign and you will be given a copy to keep.
Your decision whether to take part or not to take part, or to take part and then withdraw, will not affect your routine treatment.

6 What are the possible benefits of taking part?

There will be no clear benefit to you from your participation in this research but you will be assisting to improve care for future cardiovascular patients.

7 What are the possible risks and disadvantages of taking part?

We do not foresee any physical or emotional risks from taking part in this research. All we need is two hours of your time. However, if you experience any emotional discomfort, you can contact your GP or Beyond Blue (include telephone for the 24h/7d service) or at <https://www.beyondblue.org.au/> for support / counselling that may be accessed free of charge by all participants. If you have any concerns regarding anticipated or actual risks or discomforts, please raise them with the research team.

8 What if I withdraw from this research study?

If you decide to withdraw from this research study, please notify a member of the research team before you withdraw.

If you do withdraw your consent during the research study you should be aware that data collected by the researcher up to the time you withdraw will form part of the research study results. If you do not want them to do this, you must tell them before you join the research study.

9 What happens when the research study ends?

Participants can receive a summary of the overall findings for each stage along with any direct quotes we plan to use. The final website will be made available for participants, to see the finished product.

Part 2 How is the research study being conducted?

10 What will happen to information about me?

Any information obtained in connection with this research study that can identify you will remain confidential. Data will be recorded in word documents and audio recordings, stored on the main secure Flinders University R drive, which is firewalled and only accessible to the researchers listed in this application. All data files are password protected and only researchers listed on the study have access to the study folders. Data will be retained for 15 years at the completion of the study as per the Good Clinical Practice guidelines.
Your information will only be used for the purpose of this research study.

The research team intends to publish and present the study's results in journals, conferences, and research seminars. In any publication and/or presentation, information will be provided in such a way that you cannot be identified, except with your permission.

In accordance with relevant Australian and/or South Australian privacy and other relevant laws, you have the right to request access to the information collected and stored by the research team about you. You also have the right to request that any information with which you disagree be corrected. Please contact the research team member named at the end of this document if you would like to access your information.

11 Complaints and compensation

If you suffer any distress as a result of this research study, you should contact the study team as soon as possible and you will be assisted with arranging appropriate treatment. Should you have a complaint you can contact the Principal Investigator listed in this form

12 Who is organising and funding the research?

This research study is being conducted by Flinders University in Australia and is co-sponsored and funded by a NHMRC Partnership Grant. The study is being funded with \$20,000 from Novartis.

Flinders University will not benefit financially from this research study.

You will not benefit financially from your involvement in this research study even if, for example, knowledge acquired from analysis of your input, prove to be of commercial.

In addition, if knowledge acquired through this research leads to discoveries that are of commercial value to Flinders University, there will be no financial benefit to you or your family from these discoveries.

No member of the research team will receive a personal financial benefit from your involvement in this research study (other than their ordinary wages).

13 Who has reviewed the research study?

All research in Australia involving humans is reviewed by an independent group of people called a Human Research Ethics Committee (HREC). The ethical aspects of this research study have been approved by the Southern Adelaide Clinical HREC

This study will be carried out according to the *National Statement on Ethical Conduct in Human Research (2007)*. This statement has been developed to protect the interests of people who agree to participate in human research studies.

14 Further information and who to contact

The person you may need to contact will depend on the nature of your query. If you want any further information concerning this study you can contact any of the following people:

Clinical contact person

Name	Robyn Clark
Position	Professor, College of Nursing and Health Sciences, Flinders University
Telephone	(08) 820813266
Email	robyn.clark@flinders.edu.au

For matters relating to research at the site at which you are participating, the details of the local site complaints person are:

Complaints contact person

Name	Southern Adelaide Clinical Human Research Ethics Committee
Position	Manager, Research Governance and Ethics
Telephone	(08) 8204 6453
Email	Health.SALHNOfficeforResearch@sa.gov.au

If you have any complaints about any aspect of the study, the way it is being conducted or any questions about being a research participant in general, then you may contact:

Reviewing HREC approving this research and HREC Executive Officer details

Reviewing HREC name	Southern Adelaide Clinical
Position	Executive Officer
Telephone	08 8204 6453
Email	Health:SALHNOfficeforresearch@sa.gov.au

Local HREC Office contact (Single Site -Research Governance Officer)

Position	Research Governance Officer, Country Health
Telephone	08 8553 4208
Email	Health.RegionalResearchGovernance@sa.gov.au

Consent Form - *Adult providing own consent*

Title	Co-design of patient-centred, user-friendly web-based Cardiac Rehabilitation
Short Title	Cardiac Rehabilitation website workshops
Protocol Number	266.20
Study Sponsor	Co-sponsored NHMRC Partnership Grant
Coordinating Principal Investigator/ Principal Investigator	Professor Robyn Clark Dr Alline Beleigoli
Associate Investigator(s)	Dr Huiyun Du Ms Katie Nesbitt Dr Stephanie Champion Dr Lemlem Gebremichael Dr Carolyn Astley Ms Anushka Jacob
Location	Regional Local Health Networks

Declaration by Participant

I have read the Participant Information Sheet or someone has read it to me in a language that I understand.

I understand the purposes, procedures and risks of the research described in the study .

I have had an opportunity to ask questions and I am satisfied with the answers I have received.

I freely agree to participate in this research study as described and understand that I am free to withdraw at any time during the study without affecting my future health care.

I understand that I will be given a signed copy of this document to keep.

I understand that, if I want to, I can talk about this study with my family, relatives, friends or local doctor

Name of Participant (please print) _____

Signature _____ Date _____

Name of Witness* to
Participant's Signature (please print) _____

Signature _____ Date _____

* Witness is not to be the investigator, a member of the study team or their delegate. In the event that an interpreter is used, the interpreter may not act as a witness to the consent process. Witness must be 18 years or older.

Declaration by Investigator/Senior Researcher[†]

I have given a verbal explanation of the research study, its procedures and risks and I believe that the participant has understood that explanation.

Name of investigator/
Senior Researcher[†] (please print) _____
Signature _____ Date _____

[†] A senior member of the research team must provide the explanation of, and information concerning, the research study .

Note: All parties signing the consent section must date their own signature.

† A senior member of the research team must provide the explanation of and information concerning withdrawal from the research study .

Note: All parties signing the consent section must date their own signature.

Form for Withdrawal of Participation - Adult providing own consent

Title	Co-design of patient-centred, user-friendly web-based Cardiac Rehabilitation
Short Title	Cardiac Rehabilitation website workshops
Protocol Number	266.20
Study Sponsor	Co-sponsored NHMRC Partnership Grant
Coordinating Principal Investigator/ Principal Investigator	Professor Robyn Clark Dr Aline Beleigoli
Associate Investigator(s)	Dr Huiyun Du Ms Katie Nesbitt Dr Stephanie Champion Dr Lemlem Gebremichael Dr Carolyn Astley Ms Anushka Jacob
Location	Regional Local Health Networks

Declaration by Participant

I wish to withdraw from participation in the above research study and understand that such withdrawal will not affect my routine treatment, my relationship with those treating me or my relationship with *Flinders University*.

Name of Participant (please print) _____
Signature _____ Date _____

--

Declaration by Investigator/Senior Researcher†

I have given a verbal explanation of the implications of withdrawal from the research study and I believe that the participant has understood that explanation.

Name of investigator/ Senior Researcher† (please print) _____
Signature _____ Date _____

Appendix 8 Country Access to Cardiac Health Services

CATCH – What is the Telephone Program?



The telephone based coaching service is provided by qualified members of the CATCH clinical nursing team and allied health team (dietitian, pharmacist and exercise physiologist). The telephone program consists of phone coaching sessions provided over about 6 weeks. The first phone call will take approximately 45 minutes and will introduce the program, identify your individual needs and schedule future sessions.

Subsequent phone calls will take approximately 30 minutes each.

Call 1 - Introduction, schedule calls for coming weeks

Call 2 - Heart Disease and the Warning signs

Call 3 - Medication

Call 4 - Healthy Eating, Cholesterol, Weight, Diabetes

Call 5 - Physical Activity, Returning to active daily living

Call 6 - Smoking, Hypertension, Alcohol

Call 7 - Mood, Depression, Social Supports

Heart failure – if relevant to you.

All cardiac rehab calls are provided by experienced CATCH cardiac rehab nurses, clinical nurses and allied health team members (dietitian, pharmacist exercise physiologist and social worker).

CATCH – What is the GP Hybrid / Telephone Program?

Combining both the GP Management Plan/Team Care Arrangement through the local GP, and the telephone support program above, patients can potentially access 8 allied health consultations at low or no cost to them. As part of the GPMP/TCA, the additional five allied health options further tailor the program to the patient's specific needs, enabling long-term management of the patient's cardiovascular disease and other health conditions. Coordinating a high level of expertise between the local GP, practice nurse, telephone cardiac rehabilitation nurse and allied health professionals; dietitian, exercise physiologist, pharmacist and social worker - ensure the patient receives the best possible cardiac rehabilitation for them.

How do I start?

Shortly after discharge from hospital you will be phoned and offered the opportunity to participate in the telephone support program or closest group class. If you haven't heard from us within 2 weeks from your discharge you are more than welcome to phone **(08) 7117 0600** and enquire about **your** referral to these free services.

Country Access To Cardiac Health



Patient Information

ICCNET SA
Mitcham Shopping Centre
PO Box 952
Mitcham SA 5062

Phone: (08) 7117 0600 Fax: (08) 7117 0635
health.chsacardiarehab@sa.gov.au
www.catchsa.com.au



ICCnet SA gratefully acknowledges that this service is supported by funding from Country SA Primary Health Network through the Australian Government's PHN Program.

Country Access to Cardiac Health

CATCH Program

This program has been developed to improve access to cardiac rehabilitation and secondary prevention programs (Heart Health) for people living in country South Australia by providing a range of different access options.

What is Cardiac Rehabilitation?

Cardiac rehabilitation is a multidisciplinary program to assist people with a cardiac condition to return to an active fulfilling life. Its goal is to assist people to reduce the likelihood of a further cardiac event, increase chance of their survival and improve their quality of life.

Who needs cardiac rehabilitation?

Anyone who has had a recent cardiac event.

What is available?

Cardiac Rehabilitation programs are provided via:

- Telephone based coaching and support services
- Individual or group classes (face-to-face programs)
- On-line web based access to education and self monitoring
- General Practice based services

Or a combination of the above programs.

How can I access the CATCH cardiac rehabilitation program?

All Country SA patients, upon discharge from hospital, are referred to the CATCH program. This referral can be sent by their GP, cardiologist, metropolitan or country hospital or a health worker. Make sure you ask if your referral has been sent to the CATCH program. Patients are also welcome to refer themselves into the program by phoning **(08) 7117 0600** and discussing their suitability with our Cardiac Rehab Nurses.



We are here to help you take your health into your own hands

Did you know that most health issues which contribute to the progression of cardiovascular disease are preventable or able to be modified? These RISK FACTORS are important to address to reduce or stop the progression of cardiovascular disease.

Risk factors are managed by your Cardiologist and GP, with support and education from experienced Cardiac Rehab nurses. You can take control by changing common lifestyle and behaviours such as:

- ✓ engaging in regular exercise and physical activity
- ✓ modifying diet
- ✓ managing stress; dealing with anxiety
- ✓ reducing or stopping smoking
- ✓ alcohol intake
- ✓ improving sleep
- ✓ developing social supports



Every heart condition is different and everyone has different risk factors that need to be understood and addressed. As a result you are allocated an experienced cardiac rehab nurse to walk alongside you during this journey.

Face-to-Face Programs – conducted in a local Health Service

These programs are conducted individually (1:1) or in group settings. The sessions are provided by experienced cardiac rehabilitation nurses and allied health professionals. Participants have a physical assessment i.e. check weight, blood pressure, wounds and blood results. Education is provided covering your diagnosis, cardiovascular disease risk factors such as medications, heart disease information, exercise, healthy eating, resuming daily living activities and providing skills for behaviour change and maintenance.



Appendix 9 Country Access to Cardiac Health referral form



Country Access To Cardiac Health

REFERRAL - CARDIAC REHABILITATION

All enquiries to (08) 7117 0600
Monday to Friday 9am – 5pm
SEND COMPLETED REFERRAL TO:

- E-mail health.chsacardiacrehab@sa.gov.au
- Fax- (08) 7117 0635

UR Number:			
Title:		Surname:	
Given Names:			
Alias:			
D.O.B:		Gender:	☐ Male ☐ Female
Medicare No.			
DVA	☐ Yes ☐ No	DVA No.	
Private Health Insurance		☐ Yes ☐ No	

Complete details or affix client identification label

Complete all relevant sections (Please print clearly)			
Client/patient contact details	Address 1:		City/Suburb:
	Address 2:		Postcode: State:
	Phone:		Mobile:
	Email:		
	Aboriginal or Torres Strait Islander: ☐ YES ☐ NO ☐ UNKNOWN		
Cardiac Rehabilitation	☐ PUBLIC / ☐ PRIVATE		
	☐ Face to Face / ☐ CATCH Telephone / ☐ CATCH Web		
	Nominated Cardiac Rehab Site:		
Hospital Admission Details	Admission Date:	Discharge Date:	Transferred to:
Inpatient cardiac rehabilitation review	Was this person reviewed by a cardiac rehabilitation nurse whilst an inpatient in hospital?		Phase 1 Completed ☐ YES ☐ NO
Referrer details	Name:	Role / Organisation:	Date of Referral:
Cardiologist details (if applicable)	Name:		Organisation:
	Address:		
	Phone:	Fax:	E-mail:
Client/patient's GP or other primary health care provider details (if known)	Name:		Practice:
	Address:		
	Phone:	Fax:	E-mail:
Has the patient been given the following written resources?	MY HEART MY LIFE / LIVING WELL WITH HEART FAILURE		☐ YES ☐ NO ☐ UNKNOWN
	MY HEART MY FAMILY OUR CULTURE		☐ YES ☐ NO ☐ N/A
Principal diagnosis or reason for referral			
Current medications (Attach list if necessary)			
Relevant medical history summary (Attach list if necessary)			
Risk Profile:	Height (cm)	Weight (kg)	Smoker / Ex-Smoker ☐ YES ☐ NO
			Blood Pressure

Appendix 10 Patient reported experience survey.

Default Question Block

SA Cardiac Rehabilitation Services PREMS questionnaire.

Congratulations on completing your recent CR Program at Whyalla BCIC.

We hope you now have all the skills and knowledge for heart health for life. Because we wish to deliver health care that is consumer focused, your thoughts and feedback are very valuable to us.

As a participant in our cardiac rehab program, we would value your assistance with the continued improvement of our service by providing us with your feedback using the following evaluation form.

Your feedback will remain anonymous unless you wish us to contact you for detailed feedback about any matter of concern.

Your anonymous feedback may also be used for research purposes and consent to do this will be implied by completing this evaluation form.

The evaluation form is very short and easy to complete and will take only 10 minutes of your time. Remember your thoughts and feedback are very valuable to us and we take all feedback seriously.



In the first section we will ask a few short questions about yourself, the service(s) you attended and setting goals for your heart health for life



How old were you at the time of your cardiac rehab program?

- ☐ Younger than 30
- ☐ 30-40
- ☐ 40-50
- ☐ 50-60
- ☐ 60-70
- ☐ 70-80
- ☐ Older than 80

What is your gender?

- ☐ Male
- ☐ Female
- ☐ Non-binary
- ☐ Prefer not to say

What type of service did you participate in? (select all that apply)

- ☐ Face to face
- ☐ Telephone
- ☐ Web
- ☐ With your GP
- ☐ Hybrid (face to face and telephone or face to face and web based)

Can you please tell us why you chose this mode of delivery? (Telephone/ Face to Face/ Web/ GP)

Do you remember the date you were discharged from hospital and the approximate date that you began your cardiac rehabilitation program?

☐ Yes (please specify below)

☐ No

☐ Other

What were you most concerned about with regard to your heart condition?

What motivated you to attend a cardiac rehabilitation

program?

Were you involved with setting goals for your heart health and wellbeing?

☐ Yes

☐ No

☐ Other

Do you think you achieved your goals during the program? If no, what was/ were the reason/s?

☐ Yes

☐ No (Please specify below)

☐ Other

Was your partner or carer invited to join you in the cardiac rehab sessions?

☐ Yes

☐ No

☐ Other

What were the 3 main goals you have set for yourself to maintain after a cardiac rehab?

Did you complete the program?

☐ Yes

☐ No

☐ Other

Of the program(s) you participated in how many weeks did you complete?

☐ 1

☐ 2

☐ 3

☐ 4

- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10
- ☐ Greater than 10

Thank you for completing this section.



EDUCATION COMPONENT OF THE PROGRAM

In this section we will ask for your thoughts about the education content of your cardiac rehab?



The information delivered in the education sessions helped me make positive changes to my lifestyle

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

The information provided during the education sessions was clear and easy to understand

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

The presenter/s were responsive/ supportive and addressed my concerns or questions

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Do you have any additional comments about the presenter/s?

- ☐ Yes (Please specify below)
- ☐ No
- ☐ Other

The information provided made me more confident in (select all that apply)

- ☐ Understanding my condition/s
- ☐ Understanding my medications
- ☐ Understanding my mental health
- ☐ Starting my exercise

- ☐ Managing my blood pressure
- ☐ Managing my cholesterol level
- ☐ Managing my blood sugar level
- ☐ None
- ☐ Other (Please specify below)

GROUP SESSIONS AND REFERRAL

Well done, this is the last section.

In this next section we will ask about group sessions and referral to allied health specialist and your overall thoughts about the service you received.

If you attended telephone or web-based sessions, you can skip this section. If answered "No" or "I do not know" to the first question in this section, skip ahead to the allied health referral section.



Did your cardiac rehab program offer group sessions?

- ☐ Yes
- ☐ No
- ☐ I do not know
- ☐ Other

Did you attend the group sessions?

- ☐ Yes
- ☐ No
- ☐ Not applicable
- ☐ Other

How was your experience in the group sessions? If you would like, please tell us more about your experience (e.g. what did you like about the program?, what else would you have liked to see?).

Allied health referral



Which allied health care referral and care did you receive during and/or after your cardiac rehab? (select all answers that apply)

- ☐ Exercise Physiologist
- ☐ Physiotherapist
- ☐ Dietician
- ☐ Pharmacist
- ☐ Psychologist

- ☐ Social worker
- ☐ None
- ☐ Other/ Awaiting Appointment (Please specify below)

How long did you wait to get allied health support?

Was the referral time length convenient to you?

- ☐ Yes
- ☐ No
- ☐ Other

The consultation/education provided by the allied health team was beneficial

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Do you have any comments about the consultation/
education provided by the allied health team?

- ☐ Yes (Please specify below)
- ☐ No
- ☐ Other

Did you feel safe and well supported during exercise
sessions?

- ☐ Yes
- ☐ No
- ☐ Not applicable
- ☐ Comments (Please specify below)

The exercise component of the program helped me
understand safety issues during exercise including
recognizing warning signs/ symptoms and the
importance of self-monitoring

- ☐ Yes
- ☐ No

- ☐ Not applicable
- ☐ Other

During my rehab I was treated with respect and dignity

- ☐ Yes
- ☐ No
- ☐ Other

During my rehab I was treated in a culturally sensitive manner

- ☐ Yes
- ☐ No
- ☐ Other

Are you now working with your GP and practice nurses to continue your cardiac rehabilitation and lifestyle changes?

- ☐ Yes
- ☐ No (please comment below)

☐ Other

Are there any other messages or comments you would like to share with the team to improve our cardiac rehab program?

Thank you for taking the time to complete this evaluation of our service. Please provide your name and mobile number if you wish to discuss any concerns with your local Cardiac Rehab Coordinator.

Thank you again - keep up the good work of taking care of your heart.

Appendix 11 Clinician-reported experience survey.

Product Satisfaction

We'd like to know more about your experiences with the following product:

CATCH Web

How long have you used CATCH Web?

- ☐ Less than a week
- ☐ A week to a month
- ☐ A month to half a year
- ☐ Half a year to a year
- ☐ Over a year
- ☐ Never

When was the last time you used CATCH Web?

- ☐ In the past week
- ☐ Not in the past week, but in the past month
- ☐ Not in the past month, but in the past 6 months
- ☐ More than 6 months ago
- ☐ Never

How often do you use CATCH Web?

- ☐ Daily
- ☐ Weekly
- ☐ Monthly

- ☐ Rarely
- ☐ Never

How easy or difficult is it to use CATCH Web?

- ☐ Extremely easy
- ☐ Moderately easy
- ☐ Slightly easy
- ☐ Neither easy nor difficult
- ☐ Slightly difficult
- ☐ Moderately difficult
- ☐ Extremely difficult

How well does CATCH Web align with your current service?

- ☐ Extremely well
- ☐ Very well
- ☐ Moderately well
- ☐ Slightly well
- ☐ Not well at all

How much do you agree with this statement: CATCH Web is a valuable option for clients?

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

How would you rate the quality of CATCH Web?

- ☐ Extremely high quality

- ☐ High quality
- ☐ Neither high nor low quality
- ☐ Low quality
- ☐ Very low quality

How responsive have we been to your questions or concerns?

- ☐ Extremely responsive
- ☐ Somewhat responsive
- ☐ Neither responsive nor unresponsive
- ☐ Somewhat unresponsive
- ☐ Extremely unresponsive

Overall, how satisfied or dissatisfied are you with CATCH Web?

- ☐ Extremely satisfied
- ☐ Somewhat satisfied
- ☐ Neither satisfied nor dissatisfied
- ☐ Somewhat dissatisfied
- ☐ Extremely dissatisfied
- ☐ Not Applicable

What would you change or improve about CATCH Web?

How satisfied are you with your ongoing experience with CATCH Web?

- ☐ Extremely satisfied

- ☐ Somewhat satisfied
- ☐ Neither satisfied nor dissatisfied
- ☐ Somewhat dissatisfied
- ☐ Extremely dissatisfied
- ☐ Not applicable

Powered by Qualtrics

Appendix 12 Implementation emails

Dear

As you are aware there is a large translational research project currently underway through Flinders University (Professor Robyn Clark) and iCCNet (Rosy Tirimacco) called the Country Heart Attack Prevention (CHAP) project. The primary aim of this work is to increase attendance and completion of cardiac rehabilitation (CR) in regional, rural and remote South Australia. To achieve this we will be designing and translating alternate modes of CR to increase access to this critical secondary prevention program. One of which will be a web-based delivery model of CR, which could be a stand-alone model or be used as a supplement for face to face or telephone CR.

Thank you for your assistance earlier this year when we obtained governance and ethical approval for the main CHAP study (HREC/20/SAC/78). We are now seeking governance and ethical approval for a **low risk sub-study to run co-design workshops with a small group of past/current cardiac rehabilitation patients in your LHN**. This study will contribute to Ms Katie Nesbitt's PhD – Katie is currently a Registered Nurse at the Naracoorte Hospital and undertaking her PhD through Flinders University on the CHAP Project.

We plan to visit six regional sites including Wallaroo. We have already been in contact with Brooke and she is supportive of this work and is able to assist us with participant recruitment and logistics on the day of the workshops (identifying a suitable room/location etc.).

Research Methods – in brief (full details in Summary and Protocol attachments)

- Once off workshops with the aim to co-design a web-based CR model
- 2 hours duration, morning tea will be supplied
- With ~8 participants who are past/current CR patients (local CR coordinators will identify and initially approach participants on behalf of researchers)
- Data collection will be in the form of qualitative data and quantitative survey data
- No patient records will be accessed
- Informed consent from each participant will be required prior to commencing (Patient Information and Consent Form attached)

Requirement of CR coordinators in your LHN

We have tried to ensure that only minimal input from the CR Coordinators is required as we know they are busy:

- CR Coordinator will provide identification and initial approach of suitable participants (email script attached)
- Guide research team in a suitable location for the workshops

What is required of you

We are happy to answer any questions you may have. Please contact Katie Nesbitt (nesb0023@flinders.edu.au) or Dr Alline Beleigoli (alline.beleigoli@flinders.edu.au) for more information if needed.

You may have been recently contacted by Dr Alline Beleigoli for a separate but semi-related governance approval for a COVID Cardiac Rehabilitation project our group is also running, and Dr Beleigoli will be taking over my role as Senior Research Fellow in the coming weeks.

If you are happy to approve the governance of this project, please sign the attached form (First attachment – “WKS-SSA...”). As we are on a tight timeline we would appreciate receiving signatures by COB Wednesday 7th October. The following signature are required:

[Redacted signature]

Once Governance has been signed off, this low-risk project then goes for ethical review to the Southern Adelaide Clinical HREC.

The research team that will be onsite have current signed confidentiality deeds, Flinders University Indemnity, and criminal history screening. Please let us know if you would like to sight these documents – we will be submitting them to SAC HREC with our submission as required.

Inservice

While our team is out in these regions conducting this research we are very happy to provide an Inservice to the local hospital or community health centre on any cardiac topics of your choice – our clinician researchers have a wide range of skills and knowledge that they would be happy to present to staff if interested.

Thank you for your time and assistance with this research and don't hesitate to contact Katie or Alline with any further questions.

Warm regards,

Dear,

I hope you are well. I am excited to inform you of one of the next stages of the CHAP project – where we hope to come and visit you!!

As you know, we are developing a new modality of CR delivery – which will be web-based. This modality will be able to be used as an adjunct for the other modes of delivery (F2F, telephone, GP Hybrid) and can be used as a stand-alone mode to increase access and completion of CR. We plan to develop the website with consumers (and their family members if interested) and hold some co-design workshops at key sites within each regional LHN.

We are keen to try and visit your region– if you feel it would be appropriate and we could get some consumers engaged. For the co-design workshops we were hoping local CR Coordinators like yourself would be able to identify and approach around 6 – 8 previous CR attendees (+/- a family member) in your area, to see if they were interested in participating in the workshops. So our specific questions to you would be:

- Would you be able to approach 6 – 8 previous CR participants to attend our one off workshop, held locally, for a max of 2 hours duration (participant reimbursement will be provided, likely in the form of a voucher – TBC)
- Would you know of an appropriate space/venue where we could hold each of the workshops and where we could spread out enough in order to be COVID compliant?

In addition to the workshops – we also plan to hold a local in-service for staff– this could potentially be held at the local hospital.

In terms of timelines, at this stage we are aiming to come out to sites late October, early November – we are currently deep in the governance and ethics paperwork (much fun as you can imagine!) – of which if you were happy to assist us in participant recruitment, we would add you on to this paperwork as a site investigator.

Let me know if you can help us with the answer to those two questions and what your thoughts are. Happy to chat on the phone if that is easier.

Warm regards,

Dear,

I hope you are well. I am excited to inform you of the next steps in coming to you for our consumer co-design workshops.

We would like to visit your region the week beginning 16 November. Can you specify a suitable date during this week that would suit for the workshop? We plan to conduct the workshop from 9:30 till 11:30 with morning tea.

Are you able to recommend and assist with;

1. Venue (any cost covered by Flinders University)
2. Catering providers (cost covered by Flinders University)
3. Audio-visual availability (so I know what extra equipment to bring)

I am happy to assist with the booking of venues and speaking to caterers, please forward any of this information.

The workshops will go for 2 hours and will entail

- 6-12 participants
- CR coordinators can choose to attend/observe/make introductions (not compulsory)
- Introductions/icebreakers
- Interaction with the prototype website
- Break for morning tea (15 mins)
- Discussion using focused questions and sticky notes/ white board
- Complete a survey
- Close workshop with thanks and a goodie bag

In addition to the workshops – we also plan to hold a local in-service for staff, this could potentially be held at the local hospital.

- Are you able to book this on the day of/following the workshop?
- Are there any hot topics would you like our team to discuss?

Let me know if you can assist and be involved with these steps for the project. Happy to chat on the phone if that is easier.

Warm regards,

Appendix 13 Web-based cardiac rehabilitation program prototypes and completed pages.



LOGIN



Welcome to the CHAP Patient Portal
Please log in

Username

Password

LOGIN





Sign in
Sign in to access CHAP Patient Management

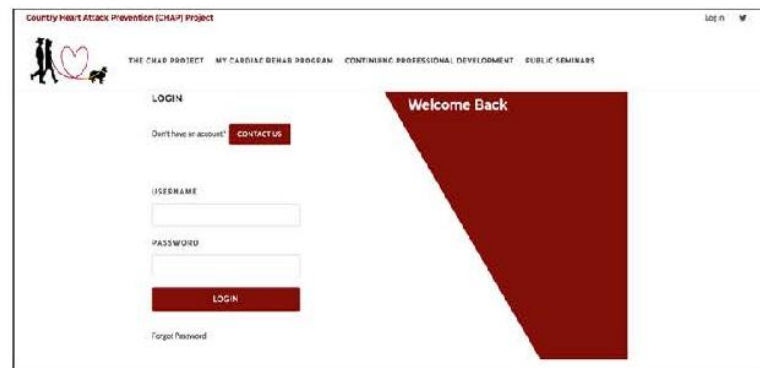
User ID

Password

Sign in

[Forgot password?](#)





County Heart Attack Prevention (CHAP) Project



[THE CHAP PROJECT](#) [MY CARDIAC REHAB PROGRAM](#) [CONTINUING PROFESSIONAL DEVELOPMENT](#) [PUBLIC SEMINARS](#)

LOGIN

[Don't have an account? CONTACT US](#)

USERNAME

PASSWORD

LOGIN

[Forgot Password](#)

Welcome Back





Sign in
Sign in to access the CHAP Patient Portal

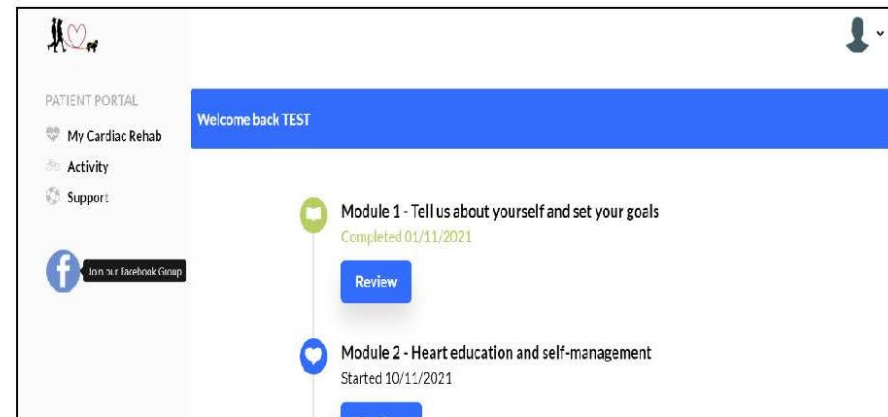
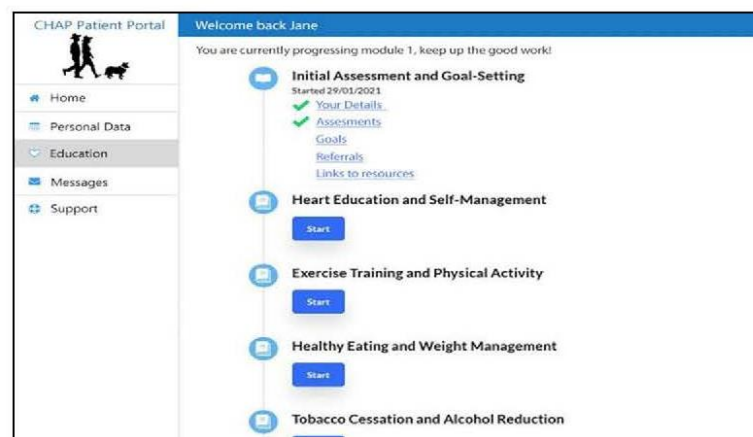
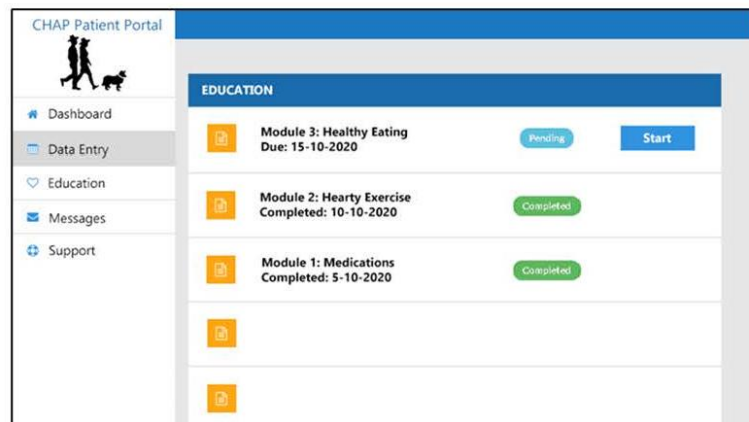
User ID

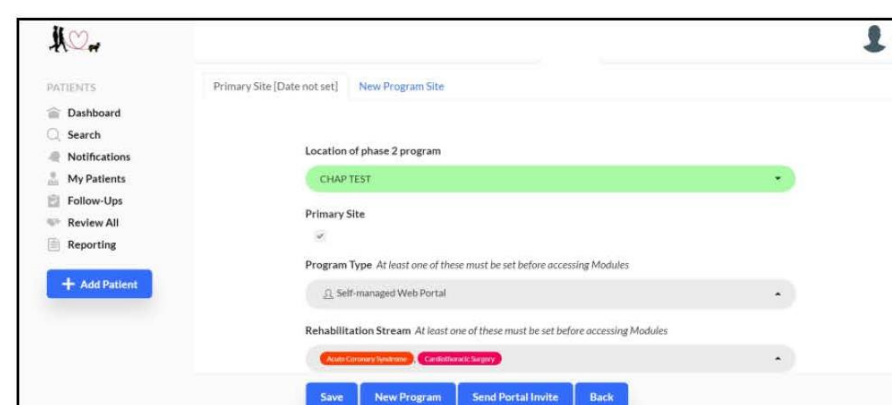
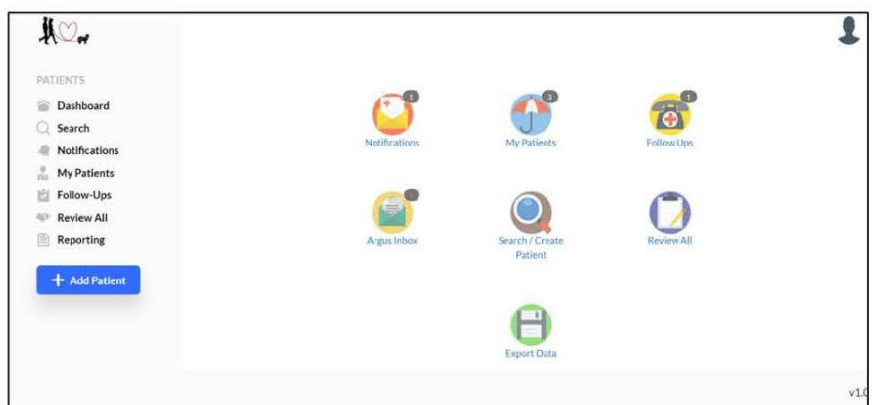
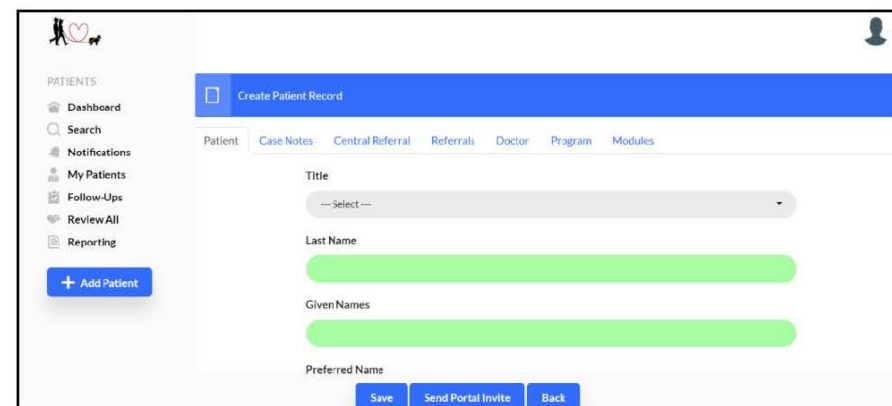
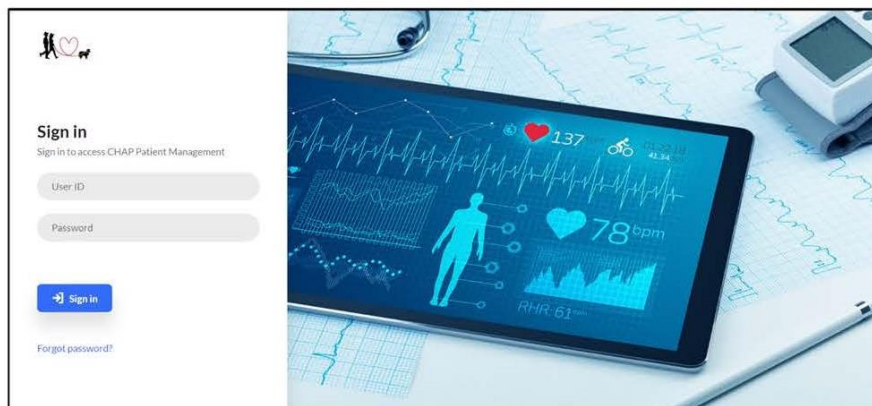
Password

Sign in

[Forgot password?](#)







CITIZEN, Jane DOB: 01/06/1965

Patient Case Notes Central Referral Referrals Doctor Program Modules

Initial Assessment and Goal-Setting
Started 29/01/2021
Continue

Heart Education and Self-Management
Start

Exercise Training and Physical Activity
Start

Healthy Eating and Weight Management
Start

Tobacco Cessation and Alcohol Reduction
Start

PATIENTS

Dashboard
Search
Notifications
My Patients
Follow-Ups
Review All
Reporting
Add Patient

PT12, PT12 DOB: 12/12/1995

Patient Case Notes Central Referral Referrals Doctor Program Modules

Select Current View:
 Face to Face

Module 1 - Tell us about yourself and set your goals
Completed by Patient: 20/06/2021
Continue

Module 2 - Heart education and self-management
Completed by Patient: 24/06/2021

Save New Program Back

Appendix 14 Usability testing prompt sheet



Co-design workshops (*Regional Local Health Networks*)

CATCH WEB ACCEPATABILITY/USABILITY TESTING

- ☐ Log in (Password- CHAP123)
- ☐ Go to Module 2
- ☐ Navigate through the pages
- ☐ Read the information
- ☐ Play the videos
- ☐ Click on any links
- ☐ Continue till you come to the end of Module 2
- ☐ Time allowing look at other Modules

Things to think about while looking at the website:

- ✓ Font size
- ✓ Quantity of text
- ✓ Content of information
- ✓ Format of information
- ✓ Positive or negative impact
on behaviour change
- ✓ Language used

Appendix 15 Patient beta testing reports



Patient Beta testing report {round 2}

Patient response

- Testing period 2/6/21-11/6/21
- 12 invites sent (1 Lemlem, pharmacist)
- 3 incorrect emails, unable to get an answer from these participants for their correct email
- 9 emails delivered successfully
- 2 responses to Qualtrics survey

Issues arising

- Some user issues with password set up, resolved with Chris help, and communicating with these participants
- Participants invite had expired, resolved

General feedback

- All pictures/videos were wonderful
- Generally, website is rich in words (lots of text to read and understand)
- Liked SMART video
- All videos are great
- Ethnicity, can the program cater for this
- Medicare status, can impact on medication adherence, should this effect patients program
- Audio/visual options- for hearing and site impaired
- Less text, infographics with audio option for both interactivity and site impaired

Patient Beta testing report {round 2}

Qualtrics report

I have attached the Qualtrics report



Patient beta testing
Qualtrics report 17_6_

Patient Beta testing report {round 2}

Specific feedback/Actions

This action list is a guide for working through the problems and suggestions that have arisen during beta testing and who is responsible for addressing it.

Patient beta testing report. 17 June 2021.

Action	Katie	Syslinx	Team discussion	Outcome
Spelling errors - Module 2, pg 13, line 2, add <i>these</i> before important - Module 2, pg 13, line 1, delete <i>an</i> - Module 2, pg 18, change to this line <i>Lets now learn about the warning signs of a heart attack. They can be varied and may not always be sudden or severe</i> - Module 2, pg 70, change extreme <i>fat</i> pulse to <i>fast</i> - Mod 5a, pg 5, line 1, delete <i>to</i> after damage - Mod 8, pg 7, para 1, line 1 delete <i>form</i> and add <i>from</i> - Mod 8, pg 10, para 1, line 1 add <i>s</i> to <i>treatment(s)</i> - Mod 9, pg 20, para 1, line 2 change <i>frost</i> to <i>first</i> - Mod 9, pg 25, Qu 2B, change <i>food</i> to <i>good</i>	✓	✓		KN has checked over these plus all modules. KN can confirm the need to correct these
 Welcome of the Medications Module PT2.		✓		
This is reoccurring. Should say <i>to</i> not <i>of</i>		✓		
Missing PHQ9 following PHQ2		✓		
Quiz, can't skip and move on		✓		KN these should be optional
Self-assessment, can skip when should have to complete to move o	✓	✓		KN This is important data to collect, so should be mandatory before progressing
Remove family history of heart disease at start of Module 10, 6m and 12m.		✓		KN this information will not change during these time frames, one less question
When completing modules and selecting to download certificate, link dead		✓		

Thank you
Katie Nesbitt

Patient beta testing report. 17 June 2021.

Appendix 16 Clinician beta testing reports



Clinician Beta testing report

Clinician response

- 16 invites sent 19 May, testing closing date 27 May
- Reminders sent on Monday 31 May
- 8 clinicians have logged in
- 4 Qualtrics survey completed
- Post close of beta testing ICCNET feedback (added below)

Issues arising

- Frozen screens- Syslinx/Katie needed to select CHAP Test
- One invalid login -reassigned and all others checked
- Clinicians not clicking on save, unable to progress- emails with these clinicians resolved this issue and it is included in the feedback to follow
- Clinicians unable to locate the send invite tab- when I logged in as them it was there, after email discussions it appeared to be their web browser, it worked in Chrome

Specific feedback

- Save function when choosing program type and streams (either a prompt to save or an auto save function)
- Mandatory fields – need program type and stream set as mandatory fields (prompt)
- Drop down boxes need a more prominent background, it's almost indistinguishable when trying to choose
- Inclusion of quality indicators (need to decide where)
- There a few grammatical mistakes in opening piece to each module, i.e. what does "How is? "mean, will these fields be populated in an individualized way? How will the <...> be customized? Also, it says, "welcome of" and should be "welcome to"
- In module 2 the Action plan in the colored tab Blue is only for AF but there is no heading here. There should also be a clear heart failure heading too for green tab. For the green, blue, red a orange in tabs could it come up with a heading when hovering over it?
- Text questions appear to come from the patient's point of view when it's the clinician that will be completing it.
- NHF action plan and warning signs link takes you to too broader party of website- clinicians and participants will take ages to find the action plan or warning signs- can this be more targeted?
- Quiz, comes up with red font when I don't check all the boxes, which implies I've got it wrong, is there any way this could be done differently?
- Alcohol action plan link won't take me back to the website- I got shut out.
- Module 5a Quit smoking has reducing alcohol info in it which is then repeated aging in 5b healthy drinking is this intentional, I think you should keep them separate?

Clinician beta testing report. 3 June 2021.

- Module 6 medication education and review- starts off with Quit smoking info from 5a i.e. "Welcome to the tobacco cessation and alcohol reduction module"??
- Website for Medicines Line link works but it is not complete- it just says "org.au"
- 6-month flu/current symptoms/pain- when I check "none" the pain scale pops up.

Clinician Beta testing report

Qualtrics report

I have attached the Qualtrics report, which was circulated earlier, however I have highlighted some specific information and output.

- 3 responses, the other 2 are previews when writing the questionnaire
- 100% agreed it was easy to navigate around the website
- Text- needs to be a darker colour and larger for patient portal
- Font- needs to be easier to read (no suggestions made)
- 66.7%- too much text
- Page freeze when navigating tabs 2-5/60
- 100% pre/post assessments took too long
- Unable to load videos
- Need Chrome/updated windows browser to open videos
- 66.7% recommend the website

Actions

This action list is a guide for working through the problems and suggestions that have arisen during beta testing and who is responsible for addressing it.

Clinician beta testing report. 3 June 2021.

Action	Katie	Syslinx	Team discussion	Outcome
Save function when choosing program type and streams (either a prompt to save or an auto save function)		✓		Self-explanatory CE: Now mandatory, so should resolve this?
Text- needs to be a darker colour and larger for patient portal Font- needs to be easier to read (no suggestions made)		✓		Self-explanatory CE : I've increased the font size again and made the text black for all the module content. Not sure what else we can really do.. perhaps look at a different Font but this font is highly regarded.
Mandatory fields – need program type and stream set as mandatory fields (prompt)		✓		Self-explanatory CE: Done
Drop down boxes need a more prominent background, it's almost indistinguishable when trying to choose		✓		Self-explanatory CE: Done, made the background of the dropdown menu grey
Inclusion of quality indicators (need to decide where)			✓	CE: Awaiting details
There is a few grammatical mistakes in opening piece to each module, i.e. what does "How is? "mean, will these fields be populated in an individualized way? How will the <....> be customized? Also, it says, "welcome of" and should be "welcome to"	✓	✓		Module 3, first page Should <i>how is</i> say <i>how are you?</i> (all modules) CE: The intention is to populate these parts with their "fun fact". Do we just remove these bits if fun fact is unlikely to be populated? Yes-KN
In module 2 the Action plan in the colored tab Blue is only for AF but there is no heading here. There should also be a clear heart failure heading too for green tab	✓	✓		For the green, blue, red a orange in tabs could it come up with a heading when hovering over it? CE: As a trial I have added a colored badge in the associated popup when clicking the button. This makes it clear that the information being viewed is specific to that condition. Let me know if this is an acceptable solution
Text questions appear to come from the patient's	✓	✓		Is this meant to be this way Chris?

Clinician beta testing report. 3 June 2021.

point of view when it's the clinician that will be completing it.				CE: Yes, there is no "alternate wording" for data collection or questionnaires based on if the user is a clinician or a patient. You can only have targeted wording outside these components. ie introductions etc. This is fine then- KN
NHF action plan and warning signs link takes you to too broader party of website- clinicians and participants will take ages to find the action plan or warning signs- can this be more targeted?	✓			https://www.heartfoundation.org.au/Blog/5-warning-signs-of-a-heart-attack-that-you-may-not Can this be linked to warning signs on pg 1 of Module 2, in orange Tab CE: Done
Quiz, comes up with red font when I don't check all the boxes, which implies I've got it wrong, is there any way this could be done differently?			✓	Self-explanatory CE: This probably needs a discussion so I can narrow down how the quiz is being performed (clinician or patient) and if this is a setting or it needs programming work to refine
Alcohol action plan link won't take me back to the website- I got shut out.			✓	I tested this (KN) and had no trouble. Could it open in a new page though Chris? CE: Done
Module 5a Quit smoking has reducing alcohol info in it which is then repeated aging in 5b healthy drinking is this intentional, I think you should keep them separate?	✓		✓	Agree with this Chris, I think this has happened based on the manual lay out Can we remove it? CE: Done
Many questions are repeated in modules 1, 10, 6 and 12 month review that would not change between this time, therefore these modules are taking way longer than necessary. For example- family hx of IHD, whether a close relative has died of an MI, highest education level, STOP BANG score, congenital heart disease, height? These things could be done in module 1 but there is no	✓		✓	KN- will go through and make recommendations to Chris as to what should go

Clinician beta testing report. 3 June 2021.

reason to repeat as they are not going to change. I would say that presence of diabetes also is not going to change.				
It asks if heart failure is current or past- I don't really think Heart Failure would be something that someone had in the past and has now resolved- unless perhaps thinking of takotsubo?	✓	✓		Change wording. KN to advise Chris
Chest pain- the question isn't really clear- is the patient having chest pain now? Has the patient been having chest pain?	✓			KN Check wording +/- change
And asking for a score for the chest pain is a bit of an issue as this could change from one time to the next.	✓			KN Check wording +/- change
The question about resumption of sexual activity- should probably have an n/a option.	✓	✓		+/- Change
Module 6 medication education and review- starts off with Quit smoking info from 5a i.e. "Welcome to the tobacco cessation and alcohol reduction module"??	✓	✓		Can you remove this smoking information please Chris? CE: Done
Website for Medicines Line link works but it is not complete- it just says "org.au"	✓	✓		Please add <i>nps</i> (nps.org.au) pg 4 Module 6 CE: Done
6-month flu/current symptoms/pain- when I check "none" the pain scale pops up.	✓	✓		Can this be removed if none is chosen? CE: Not currently, will require programming

Thank you
Katie Nesbitt

Clinician beta testing report. 3 June 2021.

Appendix 17 Co-design workshop themes table

Theme	Sub theme	Representative quote	Action
Fear of the unknown	Human connection	"Yes, and I had a really bad dose of ... one night and it was, I was crying. It was absolutely terrifying for me and I didn't know and I thought if I get home and have that what am I going to do because you know, it was really scary. And I was just worried. I still, I'm still worried to an extent that it'll happen again, you know that it, that the arteries will clog up again or something and I'll have to, have problems. So it's always in the back of your mind, it doesn't really go away" "What we all need is access to professionals that can look after our, can help us look after our health. But the one thing that we all feel we need is that there's help there if we need it"	Clinician managed Private message function Clinician email notifications of client activity
	Shared experience	"That was, it's just dealing with that, that once got into the rehab group knowing that there are others there, that, that felt better, in yourself you felt, okay I'm not alone" "For me, I guess it was just being around people that sort of understand what you're going through" "Well, I thought it was just fantastic with being able to come here and see other people that have had a similar situation, but everybody's story was different. Like, isn't it, you know, everybody you speak to, it's different. And I thought it was almost like therapy, you would - and quite emotional at times, and you'd talk about it"	Private group forum Facebook private group created
	Gap between event and CR	"The problem I found with that is it went in one ear and out the other. I really wasn't in the state where I could consider what they were saying. It took me all my time to decide what I had to remember and what I ... worry about trying to remember"	Use the web-based program as a bridge between Phase 1 to Phase 2
	Lack of support		

Theme	Sub theme	Representative quote	Action
		"It felt a blur to me, I couldn't even tell you, I can picture it, but I couldn't tell you what the nurse said, because it was so fast. And everything and I just remember being given the plastic bag with all the medications, you take this then, this is then, I wouldn't know what she said" "It was a little overwhelming, and it was very fast. It felt a blur to me, I couldn't even tell you, I can picture it, but I couldn't tell you what the nurse said, because it was so fast. And everything and I just remember being given the plastic bag with all the medications, you take this then, this is then, I wouldn't know what she said. But very quick, very, very clinical, I suppose the doctors do it all the time, and they have to get through it. But for the person receiving the information it's very overwhelming because you went from having one tablet a day to having. A bit overwhelmed with all the pills yeah" "There was a gap. What should've happened, for me, personally, I should've come out of Flinders, went straight to seeing my doctor, my doctor should've gone you've got cardiac rehab today or tomorrow, okay thank you" This is something that you're given after you've had a heart event? And I think at that point after you've had a heart attack when you are laid up, you can just be laying there looking at this, reading it... So they've got that time in those first couple of weeks.	
	F2F and web better together	"I really think it would be good in conjunction with the face-to-face. I wouldn't do web only but I think it would ... do really well with face-to-face. I enjoy the face-to-face" "It's handy to have the web to look up if you're not sure or something to check things out. But when someone sits and explains to you, can't beat it, one on one"	Offer hybrid program/F2F and web-based

Theme	Sub theme	Representative quote	Action
Usability	Ease of use and age	“Yeah, that would be the biggest frustration; that’s what I find the most frustrating is when you’re doing something on your phone, and you go hit and it goes yeah, now it comes back and you’ve got to go through it again to get to where you are” “The only thing that I sort of do and have found, you can go into login do the whole thing and then I go in a second time, can’t find it or you get lost; that is where I have got caught a number of times. And so it’s like yeah, that’s good because it’s simple, I can see where you’re going because that’s one, but if I open it up and I go yeah, I’ve forgotten my password, okay so they’re going to give me a new password, so they’re going to send it to my email ... so yeah, gets there, do all the bits, get back again, now we’re going; but if we get lost, like get really lost”	Instruction on how to add to home screen or save URL on computer
	Program access	“If someone’s a bit older would someone be able to initially lead them through on how to... Because some people aren’t very tech savvy, so some people would probably go to be lead through pretty well” “step by step guide for registration, with a help contact number”	Cheat sheet
	Login	“But you’ve got log in – I can’t even read it from here, and it’s up in the right-hand corner” “What you want people to do is to log in, so that should be prominent. That should be the first thing they see”	Improve size of login font Dynamic colours/images Login prominent
	Pros/cons technology for activity tracking	“how else can activity be measured if no watch or app is used”	Self-reported minutes and type of activity
	Reflections on overall usability	11“What I’m saying is, this computer, the way they wrote this program, even though I had no education, it connected with me. And that’s what you need to be able to do with this” “The basic setup is, yeah user friendly, easy to read”	

Theme	Sub theme	Representative quote	Action
Format of information	Simplicity	“Simple yeah. I think that’s really all you need. Yeah not too overwhelming it’s good”	Change colour to blue
		“With this program, you’ll be able to if they say do this over one week, but you can do a couple of hours. You can go back, and you can review it if you didn’t quite understand what that was ...to this week. And you fly through that. Then the next week, you have to watch the video a couple of times”	
	Vibrant colours important	“...So you’ve got, you got an overlap generation and now the people that are having heart attacks are the older ones....I always thought as an older person I’m a bit more you know, I’m not too stayed whatever, but I’m getting to the point where I’m sick of technology. It’s so much interrupting my life, I want to keep it as simple as possible”	
		It’s not encouraging. ... the colour- It’s too dark. Looks like a dodgy bank. It actually, it’s almost puts a block in front of you, it makes you apprehensive, it needs to be a more inviting colour, it’s the wrong colour. Something a little bit brighter. Maybe a nice purple. Just something, brown is dull.	
	Naming and designs of icons	“I think icons relating to the topic would be helpful too” “I reckon you should have some specific Emojis for each one of those because there’s, I work with a lot of people who English is a second language and they would probably be better off if they had like the heart; have a little red heart. Exercise maybe a little picture of a man riding a bicycle. Health eating and weight management, then a couple, yeah, the internet’s full of all that stuff. And every other stuff I’ve got, I get, because I work with schools and they do it with	Descriptive icon on blue backing

Theme	Sub theme	Representative quote	Action
		kids so the kids have difficulty reading so they have little pictures to go, explain, it gives them a hint as to where they can go. So that's what I would do. I'd have pictures on there and you'd go straight there"	
	Goal setting	"Because I could sit there and look at that and go goals and you know what Homer Simpson and go der but if you've got a drop-down box you go oh yeah, I can do that and then that might prompt you to do something else under other"	Drop-down only Drop-down with free text option Free text with only 1 mandatory field
	Displaying progress	"I don't think it should be a goal that's one-size-fits-all either, because every, all of us would have had different goals at that time" It's scaring, it says 109 pages. "Yes so we've just been chatting over there about maybe the idea in the menu of having subsections. So there are people who might possibly need to be streamed in all of those, but where instead of having 109 pages as a whole. You can go into module 2 but then go into an aspect of module 2 and then go out of it and back into it" "It's just that when you see 22 of 109 it feels like you're climbing a mountain. And ... you want to climb a little hill; you don't want to be climbing a mountain"	Have a progress bar with % of completion Subsections
	Videos/pictures over text	"You've got to try and put people at ease so they can understand what you're describing. So, you've got to make it fairly simple like more drawings" "I think it's pictures. I think you've got to put a lot more pictures on so people can look and see the heart and the valves and the veins. If you just put big pictures up and then they can sort of look and they can look at the pictures or if they have a video, which will tell them the information instead of written this long"	Primary material- videos/infographics/links Secondary-back up text
	Font size	"That would scare people. No, that scares people off straight away. You've got small writing. You've got little pictures. You've got information at the top that most people won't even see"	Increase font size

Theme	Sub theme	Representative quote	Action
Connectivity	Language within the website	“Or how can, you know even change the terminology, how can we talk about quitting smoking or, initial assessment and goals, again I think that’s a bit clinical” “Why would it be needed? My first thought is that the buttons could be at the side, or a space for it at the side then you don’t have the list going right down there where you can’t see the button and I would separate tobacco cessation and alcohol reduction into 2 different things” “ I tend to agree because if you’re not a smoker you won’t, probably won’t click on that one” “Initial, so – you’re cardiac history, or your cardiac event. Let’s find a way that it can be not – do you think it’s a bit clinical. Like initial assessment you feel like you’re under, you know you’ve got to”	Have dynamic self-explanatory pictures Clearer language Separate smoking and alcohol modules
	Financial cost	“Because I keep on thinking of people like myself, well I’m hopeless with computers, and some people don’t even have a computer, and so, and if they live fairly remote, this system is not going to be any good to them, is it?” “Have you cost it if someone did it what their cost is in their data use and stuff like?” “what about people who don’t have computer?” “consider platforms the website is available on, not just desktop/laptop”	Agnostic devices
	Data use		
	Device and website connection		
Behaviour change empowerment	Accessibility -people without tech		
	Self-motivation	“People have to feel they’re going to get something out of it”	Education framed positively
	Strategies to cater for all learning types	“Because quite often people, they need hope and if you can get it right, and people see that, then they’ll think okay, I can see where this is going”	Information focused on understanding to create motivation for change

Theme	Sub theme	Representative quote	Action
	Competition with self/others	“The only, well maybe some benefit could be that if you ..., if you, say you were doing this as a weekly thing as a rehab, each week the graph would do how much you progressed. I mean even here when we do, we all lifted more weights, we did it longer, you know. So from week one to week eight there’s a massive difference between here and here” “...one of the things of doing the rehab was the encouragement that Anne and her crew gave us when we were here that sort of made us go ahead I think. You know, I feel like it gave us something to aim for because we were getting a pat on the back for doing something that was good” “Maybe ideas on sort of foods you can eat, not what you don’t/can’t. You know the can do’s instead of the can’t do’s; please don’t eat heaps of chocolate, but you can do this – you know what I mean? ... Yeah, so these are appropriate cheeses for you to use. And so therefore you’re not going against – your head goes yes/no/yes, I’m going to go yeah, I’ll go no because I do like bananas, so I want the parmesan on pasta but no I won’t ... but you know what I mean, it’s like if we got the can do’s then you’ve got a positive feed to it and people sort of look at it in a different way” “So I would like personally on each slide or something there would be something encouraging you know, like you can do, ... you know, all this motivation stuff that you get”	
	Activity tracking		
	Positive content		

Appendix 18 Reasons for non-attendance

Reason
Accessing Services, Education, Support External To CATCH Web
Attended 2 Sessions Before Covid Stopped Groups.
Attended 3 Sessions Then COVID Hit Not Wanting Further Follow Up
Attended Previously
Attending Face-to-face
Awaiting Hip Replacement - Hip Pain And COVID Stop
Cancer Diagnosis
CHRONIC PAIN
Client Attended 4 Education Session Because Of COVID Unable To Complete
Client Declined
Client Did Phone Consult Unable To Do Any Further Follow Up After Initial Consult Client Not Respond
Client Died
Client Has Chosen The F2F CRP Option
Client Will Attend When Program Recommences
Clinic Visits And Home Program
Connectivity Issues Unable To Use iPad / Phone
COVID - Group Program Ceased - Prefer To Self-Manage
COVID Precautions
COVID Restrictions And Client Not Confident For Face-To-Face Service Or Telehealth
COVID Restrictions, Groups Discontinued, Independent Exercise
COVID Shut Down Unable To Complete
Deceased
Declined
Did CR Visits In Clinic
Did Not Attend And Did Not Respond To Attempts To Contact
Did Not Continue Have Been Unable To Get Any Follow Up When Trying To Contact File Close
Did not attend consult and unable to contact
Doing HH Only- Closed Due To COVID 19 Restrictions
Engaged In BUPA Phone Support Instead
Exercise Was Exacerbating A Back Condition
Face-to-face Ppogram suspended due to covid
Feels He Has Enough Information And Wants To Self-Manage
Found The Program Not What He Wanted Not IT Savvy

Reason
Found The Program Not What She Wanted Not Suitable
Going To Complete With Wallaroo Face-to-face
Happy To Self-Manage
Has Chosen To Go Back To F2F Program With Phone Contact Rather Than Using CHAPs Portal Issues IT
Has Done CR Previously F2F Felt Did Not Offer Him Anything New That He Didn't Already Know
Mental Health Issues, I Was Aware He Only Wanted To Attend One Session.
Missed Appointment, Did Not Reschedule
Moved House And Location
No Reason Supplied
Not Engaging
NOT INTERESTED
NOT READY TO MAKE LIFESTYLE CHANGE
Overserviced
Phone Follow Up Due To COVID Did Not Come In F2F
Received
Referred To Phone CR (catch) Currently In Adelaide
Referred To SONDER Exercise Program
REFERRED TO SONDER HEALTHY HABITS
Returned To Darwin
Returned To Her Home Quorn
Self-Manage
Self-Manage With GP And EP
Too Busy
Too Long Till Referral
TRAVEL
Unable To Contact
UTC, And Patient Unwell, Not Suitable For Program
Wants To Self Manage