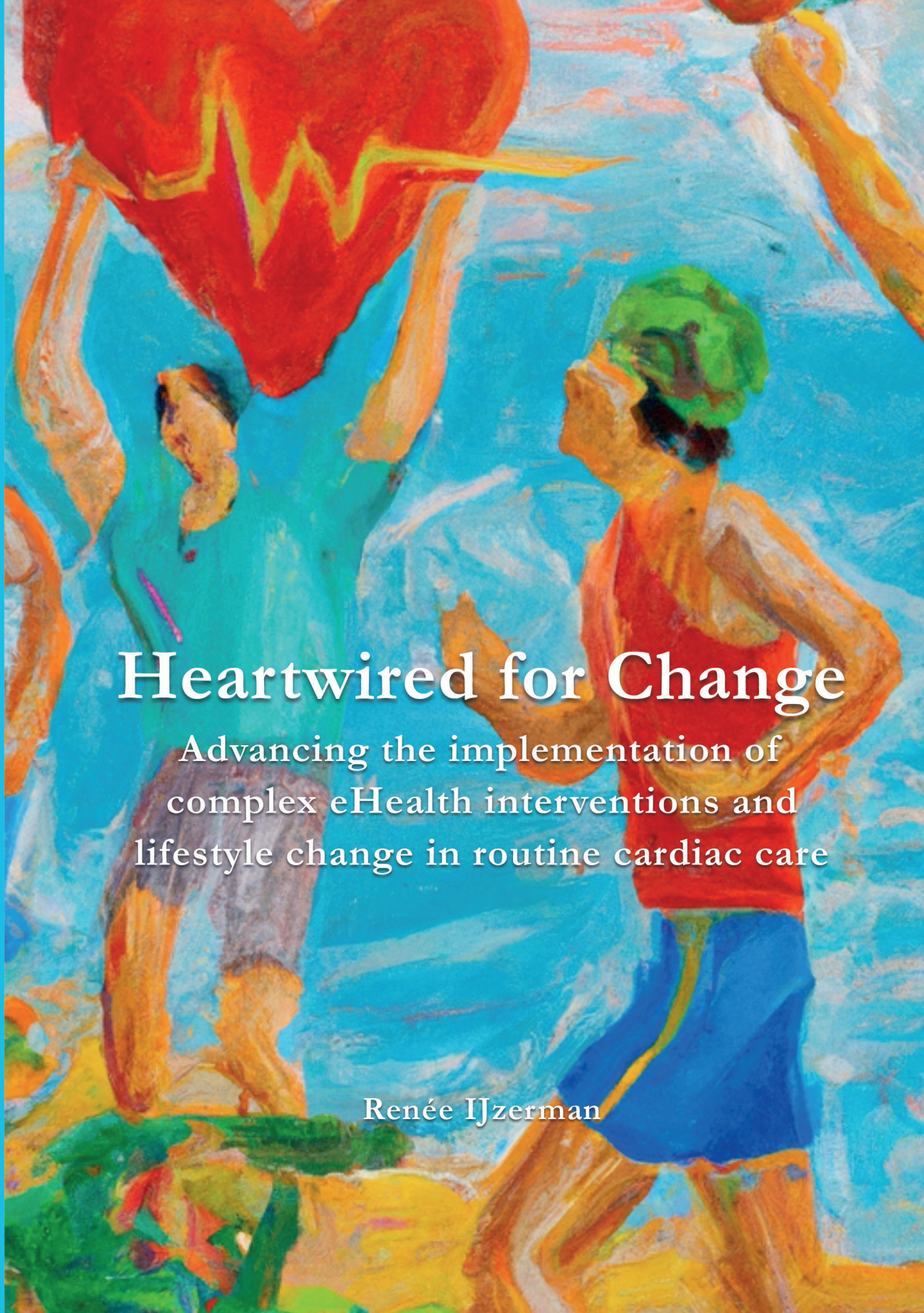


Heartwired for Change

Advancing the implementation of complex eHealth interventions and lifestyle change in routine cardiac care

Renée IJzerman

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Heartwired for Change

Advancing the implementation of complex eHealth interventions and lifestyle change in routine cardiac care

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad van doctor
aan de Universiteit van Amsterdam
op gezag van de Rector Magnificus
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ten overstaan van een door het College voor Promoties ingestelde commissie,
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Setting the stage

Chapter 1

General introduction

The silence in Eva's living room lingers in the days following her discharge from the hospital after her second heart attack. Now back home, this event forces her to confront a lifelong struggle to balance her health, work, and daily responsibilities. Now in her early sixties and approaching retirement, she sits on the sofa, faced with the reality that years of turning to cigarettes for relief and neglecting regular exercise have led her to this moment.

Her doctor has made it clear: quitting smoking and adopting daily physical activity are no longer optional but essential if she wants to prevent another health crisis. The scale of these changes feels overwhelming. How will she manage cardiac rehabilitation with her job and household responsibilities? How can she prevent history from repeating itself?

Eva also heard from her doctor that she will use digital health tools during rehabilitation, including a remote healthcare app with online therapy modules. Will she be able to access this, and will it be beneficial for her? As she attempts to make sense of all the uncertainty ahead, the weight of her loved ones' concerns only adds to the pressure. The physical demands of recovery, combined with the mental burden of adjusting to a new reality, leave her unsure of what the future holds.

GENERAL INTRODUCTION

1

Rising prevalence of chronic diseases worldwide

Eva's situation is increasingly common as chronic diseases continue to rise globally. Chronic diseases, also known as non-communicable diseases (NCDs), affect individuals across all demographics, regardless of age, sex, and income. Annually, NCDs are responsible for 41 million deaths, representing 74% of global mortality (1). Among these, several present the highest prevalence and socio-economic burden, namely cardiovascular disease (CVD) (nearly 18 million deaths), cancer (over 9 million), chronic respiratory diseases such as chronic obstructive pulmonary disease (COPD) and asthma (more than 4 million), and diabetes (1.5 million) (1). A major driver in this global health crisis is an unhealthy lifestyle, including lack of physical activity, unhealthy diet, excessive alcohol consumption, and tobacco usage. These behaviours contribute to the development of NCDs and related conditions such as obesity, high cholesterol, elevated blood glucose levels, and hypertension.

The rising prevalence of chronic diseases highlights the urgent need for effective interventions to address these pressing health challenges. Complex eHealth interventions have emerged as a promising approach in this regard. These interventions typically include programmes focused on lifestyle modification, personalised coaching, and online therapy, and have shown promise in promoting health behaviour change, improving quality of life, and reducing the burden on the healthcare system (2,3). Achieving sustainable behaviour change often requires continuous support, feedback, and monitoring; key aspects that complex eHealth interventions are intended to deliver. Their ability to be tailored to individual needs, scaled for broader populations, and integrated into daily routines makes them a vital component in addressing the growing burden of chronic disease.

Aims and objectives of this thesis

The personal and clinical urgency behind achieving sustainable lifestyle changes in the face of chronic disease underpins the primary aims of this thesis, namely:

1. Advance knowledge on the initiation and maintenance of sustainable health behaviour change in patients with CVD.
2. Identify and address the multifaceted barriers and facilitators to implementing complex eHealth interventions in routine clinical care, particularly within public-private partnerships (PPPs).
3. Integrate behavioural change and complex eHealth interventions into a holistic approach for chronic disease management, including psychosocial challenges faced by patients with CVD.

Aim 1 centres on enhancing understanding of how patients initiate and maintain health behaviour changes, whilst Aim 2 addresses the question of effectively integrating complex eHealth interventions into clinical practice to facilitate this change. Consequently, gaining insight into patient-level mechanisms (Aim 1) and system-level implementation dynamics (Aim 2) is essential for achieving meaningful impact in real-world settings. Aim 3 builds on these insights by focusing on a holistic model of chronic disease management that also incorporates psychosocial factors such as mental health and emotional well-being. Taken together, the three aims provide a comprehensive, multi-level perspective, ranging from individual engagement to systemic implementation, necessary for realising sustainable improvements in chronic disease care.

The three aims are supported by four research questions (RQ):

RQ1. How can brief lifestyle advice and the integration of life and health goals influence the intention to initiate and maintain lifestyle change in patients with CVD? (related to Aim 1)

RQ2. How can implementation science be applied to design and implement a theory-based, practice-tailored implementation strategy for implementing complex eHealth interventions into routine clinical care? (related to Aim 2)

RQ3. How can implementation science be applied to identify barriers and facilitators influencing the implementation of complex eHealth interventions into routine clinical care? (related to Aim 2)

RQ4. How can implementation science be applied to integrate behavioural change and complex eHealth interventions into a holistic approach for chronic disease management, addressing psychosocial challenges faced by patients with CVD? (related to Aim 3)

Sustainable health behaviour change

The challenges of sustainable health behaviour change

As many chronic diseases and conditions are linked to an unhealthy lifestyle, realising sustainable health behaviour change is vital for managing existing chronic diseases and preventing future ones (4,5). Lifestyle changes for CVD can enhance medical treatments, reduce reliance on medication, and improve overall treatment effectiveness. Such changes play a crucial role in disease management, leading to improved health outcomes and quality of life. Additionally, a healthy lifestyle has significant benefits on mental health, including a reduced risk of depression (6,7). However, achieving these lifestyle changes is challenging, both short-term and long-term, and thus requires significant support (8,9).

Behaviour change theories show that altering ingrained habits involves more than awareness and intention. It involves addressing a range of psychological, cognitive, emotional, social, and environmental factors (5). Moreover, whilst patients may understand the importance of a healthy diet and regular exercise, a combination of different factors often hinders actual behaviour change. These include, among others, lack of time, health-related and psychological limitations, influence of partners, previous experiences, or limited experiences (10). Additionally, research suggests that the effectiveness of lifestyle-related interventions tends to decrease over time (11). For example, patients who participate in weight loss programmes often experience high relapse rates (12). Many theories propose that constructs such as self-efficacy, outcome expectancies, or social support, explain both initiating and maintaining behaviour change. However, research also indicates that these constructs may operate differently at various stages of the behaviour-change process, with additional mechanisms emerging once a behaviour becomes established (13,14). For example, the motivation and strategies required to initiate a behaviour (e.g., setting a quit date for smoking) may differ from those required to prevent relapse or maintain long-term engagement (e.g., developing coping strategies to manage stress or forming long-term habits). This underscores the importance of tailored interventions that address distinct challenges of each phase of behaviour change.

Behaviour refers to simple, specific actions, such as brushing your teeth, washing your hands, or tying your shoelaces. However, in the context of health and chronic conditions, it typically refers to more complex sequences of actions. Behaviour may involve executing a complex series of actions over a more extended period (15). For instance, adhering to medication advice has been shown to involve at least four different behaviours in sequence. Moreover, the processes involved in a change of health behaviour, as well as the behaviour change techniques required for this behaviour change, may vary for each behaviour specifically, which further complicates the realisation of sustainable health behaviour change when diagnosed with a chronic disease (15). Therefore, to achieve sustainable health behaviour change, it is advisable to use a multifaceted approach that includes interventions at the policy, community, and individual levels, such as national policy changes, improved access to healthcare services, educational interventions, (complex) eHealth interventions, and community initiatives (16–18).

As short-term and long-term adherence to healthy behaviours is crucial, this thesis' first aim begins with initiating and maintaining healthy lifestyle change in CVD patients. The following subsections delve into two strategies, namely, (i) motivating patients to initiate lifestyle changes and (ii) goal setting to support short-term and long-term lifestyle changes, which set the stage for the research discussed in **Chapter 2** and **Chapter 3**.

Challenges in strategies to motivate initiation of lifestyle changes

Whilst sustainable behaviour change is critical for long-term health outcomes, the first step, motivating patients to initiate these changes, presents its unique challenges. As advised by the American College of Cardiology (ACC) and American Heart Association (AHA), healthcare professionals play a key role in this process (8,19), but they face several challenges, including limited time during consultations and difficulties in delivering personalised, impactful advice (19). Therefore, guidelines offer different strategies to initiate patient lifestyle changes efficiently. One such strategy is the use of Very Brief Advice (VBA) for smoking cessation, which enables healthcare providers to assess and address smoking status during a single consultation (20). The VBA method is an evidence-based 30-second clinical intervention that involves delivering key messages and practical advice in a short, structured conversation. This approach aims to quickly raise awareness, encourage reflection, and motivate patients to consider or initiate changes in their lifestyle behaviours, such as quitting smoking, but can equally relate to changing other lifestyle habits such as increased exercise or healthier eating. The VBA is designed to be easily integrated into practice without requiring extensive training or significant time investment from healthcare professionals. Research has shown that even brief lifestyle interventions can effectively prompt behaviour change and improve health outcomes (21,22).

Research indicates that despite various strategies to promote lifestyle changes, patient adherence remains a significant barrier to the effectiveness of lifestyle advice, with up to 50% of patients choosing not to follow recommendations (8). This underscores the need for a deeper understanding of the factors that influence the impact of healthcare providers' advice, with the goal of enhancing its effectiveness. Whilst VBA has been shown to be effective for smoking cessation, its broader applicability to general lifestyle behaviours remains unclear and requires further investigation. Addressing both of these gaps in the literature is essential for improving cardiovascular risk management. Therefore, **Chapter 2** of this thesis investigates how different types of general brief lifestyle advice influence CVD patients' intentions to change their lifestyle behaviour. By experimentally varying the message source (e.g., cardiologist vs. physiotherapist) and message framing (e.g., gain vs. loss framing), this study provides critical insights into how healthcare professionals can maximise the motivational impact of brief interventions within routine clinical care. This aligns with the first aim of this thesis: advancing knowledge on the initiation and maintenance of sustainable health behaviour change.

Challenges in goal setting to support short-term and long-term lifestyle changes

Sustaining healthy lifestyle changes over the long term remains a significant challenge, even for patients who initially succeed in adopting healthier lifestyle behaviours. To address this

issue, leading organisations such as the ACC/AHA and the European Society of Cardiology (ESC) recommend structured goal setting and periodic re-evaluation of goals to support adherence and improve outcomes in CVD management (8,19). Goal-setting theories can provide an understanding of how structured goals at different levels can interact and support each other, possibly enhancing adherence to ACC/AHA and ESC treatment recommendations. Goals affect one another hierarchically, showing top-down and bottom-up influences (23–25). Life goals, known as *superordinate goals*, are abstract, long-term goals reflecting broad objectives individuals strive for (26). Life goals indicate what is most important to individuals. They are indicative of a person's meaning in life, which can be expressed as a subjective evaluation of whether life is "worthwhile and significant, comprehensible and make sense, and marked by the embrace or pursuit of one or more highly valued, overarching purposes or missions" (p. 961) (27). For instance, Eva's life goal could be: 'Be there for my family and grandchildren.'. Subsequently, *intermediate goal*s are one level lower within the hierarchy, guiding specific behavioural contexts. For example, in Eva's case, 'Managing my stress levels.'. The lowest level includes concrete, short-term health goals, known as *subordinate goals*. Examples for Eva can be: 'Meditating for half an hour daily.' and 'Walking three times a week.', both contributing to her intermediate goal (24,28).

Within cardiac rehabilitation (CR), goal setting has been shown to improve disease management (28). Despite the recognised importance of linking goals, current research within this field lacks clarity on how the integration of life goals with health goals impacts CVD patients' behaviour change. As most studies on goal setting involve complex interventions, it is difficult to isolate the effects of goal combinations, making it difficult to provide precise advice on this matter to CVD patients. Therefore, **Chapter 3** of this thesis investigates how aligning life goals with health goals affects CVD patients' intentions to change their lifestyle behaviour. By examining this relationship, the chapter provides insights into how personalised, goal-oriented strategies may enhance adherence and improve cardiovascular care. These findings also contribute to the first aim of this thesis: advancing knowledge on the initiation and maintenance of sustainable health behaviour change.

Complex eHealth interventions

The use of complex eHealth interventions

Given the challenges many patients experience in realising and sustaining a healthy lifestyle, both physically and psychologically, the need for effective solutions has become increasingly urgent. Complex eHealth interventions are increasingly recognised as a promising means to foster sustainable health behaviour change, enhance quality of life, and alleviate pressure on the healthcare system (2,3). Unlike traditional health promotion strategies, complex eHealth interventions can be personalised and integrated into daily life, offering continuous support

and engagement. These interventions typically provide educational content, personalised feedback, goal setting, and progress tracking (29,30), enabling patients with chronic diseases to take an active role in their health management. This level of engagement is crucial for achieving sustainable behaviour change and improving long-term health outcomes.

Complex eHealth interventions are characterised by using multiple interacting features or user groups within dynamic social systems (2). An intervention is classified as complex based on factors such as the number of parts, the spectrum of behaviours it aims to modify, the professional competence and skills of professionals necessary for the implementation of the intervention, the groups, populations, and levels it aims, or the extent of adaptability that can be made to the intervention or its distinct parts. Additionally, complexity relates to the dynamics between the intervention and its environment, including all aspects of its conception, creation, implementation, and evaluation. To achieve optimal patient outcomes and maximise the benefits of such interventions, it is essential to successfully implement them into existing healthcare systems, and therefore, make them fit into the targeted surrounding environment (31).

These insights into the potential and nature of complex eHealth interventions set the stage for a closer look at a practical example in the next section, the BENEFIT programme, a complex eHealth intervention for cardiac patients in routine cardiac care.

A case study: the BENEFIT programme

The BENEFIT project (32,33) is a five-year research initiative employing a public-private partnership (PPP) to develop, implement, and evaluate the BENEFIT programme. This complex eHealth intervention supports CVD patients in adopting and maintaining healthy lifestyle behaviours such as a healthy diet, non-smoking, regular physical exercise, and sufficient sleep. The programme's core feature, a Personal Health Application (PHA), provides evidence-based lifestyle interventions, daily goal monitoring, personal coaching, and a rewards programme designed to incentivise healthy behaviour. The PPP integrates expertise and resources from academia, the private sector, and healthcare organisations. This collaboration leverages the strengths of each stakeholder to ensure effective development and implementation of the BENEFIT programme. Academic partners contribute scientific expertise, ensure the programme's foundation in evidence-based practices, and evaluate the programme's effectiveness. The private sector provides the technological infrastructure for the PHA, ensuring scalability, user-friendliness, and reliability. Meanwhile, healthcare organisations facilitate integration of the BENEFIT programme into routine care by offering coaching, patient support, and ongoing feedback.

Despite the potential of complex eHealth interventions such as the BENEFIT programme, effectively embedding them into daily clinical practice, particularly by public-private partnership, is challenging. Addressing their multifaceted barriers and facilitators to implementation (Aim 2) is essential to ensure these innovations lead to meaningful, real-world improvements for both patients and healthcare systems. The following subsections introduce implementation science as a structured approach to overcoming these challenges, highlighting both the theoretical frameworks available and the added complexities that arise in PPP-based eHealth implementation focussed projects. This sets the stage for the research discussed in **Chapter 4** and **Chapter 5**.

Implementation science to support (and address challenges in) implementing complex eHealth interventions

Ensuring the successful implementation of complex eHealth interventions into routine clinical care requires a comprehensive application of implementation science. Implementation science, which focuses on methods to facilitate the systematic integration of research findings and evidence-based practices into regular care, offers guidance for the adoption and utilisation of complex eHealth interventions such as lifestyle interventions and online therapy (34). This research field challenges the largely mistaken belief that stakeholders will automatically adopt an innovation if it proves effective (35). Historically, research primarily focused on the efficacy of interventions, often neglecting the complexities of translating these interventions from controlled settings to everyday, sustainable usage in clinical care (36). This oversight has resulted in a significant gap between theory and practice, mainly due to the lack of knowledge on how to successfully and sustainably implement these programmes (37). Moreover, to this day, the experimental testing, reporting, and mentioning of implementation strategies, which are techniques and methods used to improve the adoption, sustainable implementation, and scale-up of interventions for implementing innovations sustainably, remains rare (38).

Implementation science frameworks provide a structured approach to understanding these implementation-related working mechanisms (39). They offer methodologies to analyse and understand the multifaceted components of implementation, facilitating a more comprehensive and practical approach to deploying complex eHealth interventions. Specifically, within a research setting, these frameworks can guide the design and execution of studies, help guide how researchers think about and approach their research, and help in interpreting findings. In addition, within practice setting, frameworks can offer a shared language to familiarise stakeholders within the implementation ecosystem with the implementation process needed to realise sustained use of the intervention in practice, and even serve as practical tools for planning, carrying out, and assessing implementation efforts

in real-world healthcare settings (40). Various implementation frameworks are instrumental in this process (39), for example, process models structure the implementation process, determinant frameworks and models offer a lens through which the complexities of the implementation can be examined by providing insights into the barriers and facilitators that impact the success of a complex eHealth intervention, and evaluation frameworks offer support when evaluating the implementation of a complex eHealth intervention.

Frequently used implementation science frameworks within the healthcare setting are:

1. *The Implementation of Change Model* (41): this process model provides a systematic approach to planning and executing the implementation of complex health interventions within healthcare settings. It includes seven steps, namely (i) Development of a proposal for change, (ii) Analysis of actual performance and targets for change, (iii) Problem analysis of the target group and setting, (iv) Development and selection of strategies and measures to change practice, (v) Development, testing, and execution of the implementation plan, (vi) Integration of changes into routine care, and (vii) Continuous evaluation and (where necessary) adaptation of the plan.

2. The *Consolidated Framework for Implementation Research (CFIR)* (42,43): this determinant framework identifies five major domains influencing implementation of innovations, namely the Innovation itself, the Outer setting, the Inner setting, the Individuals (roles and characteristics), and the Implementation process. Each domain includes various constructs, enabling a thorough understanding of the factors that may influence implementation.

3. The *UTAUT model (Unified Theory of Acceptance and Use of Technology)* (44): this determinant model examines the factors influencing users' intentions to accept technology and their subsequent usage behaviour. The model highlights four key constructs: Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions, which collectively explain an individual's likelihood of adopting and using a technology-based intervention.

4. The *RE-AIM framework (Reach, Effectiveness, Adoption, Implementation, and Maintenance)* (45): this evaluation framework assesses the public health impact of interventions by evaluating the five key dimensions: Reach, Effectiveness, Adoption, Implementation, and Maintenance. The framework is useful for understanding the broader impact of complex eHealth interventions and ensuring their sustainability in real-world healthcare settings.

These frameworks are especially relevant for the implementation of complex eHealth interventions, as they account for the multiple interacting factors that influence both adoption and long-term effectiveness. Each of these 'moving parts' (46) can pose implementation challenges if not accounted for, necessitating a focus on stakeholder perspectives, including patients, healthcare providers, organisations, community, policy, and funders (40). Understanding the target population's needs and preferences is crucial since patient acceptance and engagement are key to success (37,47). Although chronic conditions such as CVD may start individually, multimorbidity increases with age (48), highlighting the importance of engaging patients in developing eHealth interventions to support their needs and influence lasting behavioural changes (49). Healthcare providers also significantly impact the recommendation and integration of these interventions into clinical workflows (37). At the organisational level, among others, readiness, leadership engagement, and resource availability are vital for successful implementation (37).

Despite significant advancements in the field, there is a lack of practical, empirically validated approaches tailored to real-world settings for designing effective implementation strategies for complex eHealth interventions. This thesis addresses this gap by presenting an iteratively developed implementation strategy, using the BENEFIT programme as a case study. The programme's multi-stakeholder environment, technological complexity, and integration into routine care make it an ideal case to explore the challenges and opportunities inherent in implementing complex eHealth interventions. By leveraging the BENEFIT programme as a case study, this thesis provides actionable insights into how to develop an implementation strategy that bridges the gap between theory and practice. **Chapter 4** outlines the development, evaluation, and refinement of the BENEFIT programme's implementation strategy, applying implementation science frameworks to guide the process, address barriers, and capitalise on facilitators. This aligns with the second aim of this thesis: identifying and addressing the multifaceted barriers and facilitators to implementing complex eHealth interventions in routine clinical care.

Challenges in public-private partnerships for complex eHealth implementation

Public-private partnerships (PPPs) add an extra layer of complexity to the implementation of complex eHealth interventions (50). These partnerships bring together expertise and resources from academia, the private sector, and healthcare organisations, offering valuable opportunities to develop and scale digital health solutions. However, they also introduce challenges, such as aligning diverse stakeholder priorities, balancing organisational objectives, and ensuring effective governance. As public health budgets become increasingly constrained, the World Health Organization (WHO) has emphasised the role of PPPs (51) in addressing specific implementation challenges by leveraging resources from both sectors

(52,53). By fostering interdisciplinary expertise, PPPs can help drive the development, implementation, and long-term sustainability of complex eHealth interventions. However, their success depends on strong governance structures and well-defined strategies (53), highlighting the need for more research into how these partnerships function in practice.

Despite their potential, there is still limited research on the specific dynamics of PPPs in complex eHealth implementation. This gap makes it difficult to establish and optimise sustainable collaborations, ultimately hindering the successful deployment of complex eHealth interventions in real-world healthcare settings. A deeper understanding of the organisational, contextual, and stakeholder-related factors that shape implementation outcomes is essential for improving these partnerships. The BENEFIT programme, developed and implemented within a PPP, offers a unique opportunity to explore these challenges in depth. Therefore, **Chapter 5** of this thesis focuses on these challenges by evaluating the real-world implementation of the BENEFIT programme. Using the CFIR, this chapter identifies key facilitators and barriers to implementation within the PPP context. Additionally, it provides evidence-based recommendations to enhance the scalability and sustainability of complex eHealth interventions in routine clinical care. These insights also contribute to the second aim of this thesis: identifying and addressing the multifaceted barriers and facilitators to implementing complex eHealth interventions in practice.

Comprehensive chronic disease management

The third aim of this thesis centres on integrating behavioural change and complex eHealth interventions within a holistic approach to chronic disease management, addressing psychosocial challenges. The following sections examine the psychosocial challenges faced by patients with CVD and effective therapeutic strategies for mental health, which provide the foundation for the research presented in **Chapter 6**.

Psychosocial challenges in chronic disease management

Whilst lifestyle support offers significant advantages, achieving lasting behaviour change requires a comprehensive approach. This approach must take into account the psychosocial obstacles patients confront whilst managing chronic diseases such as CVD. Research indicates that patients living with chronic diseases such as CVD face a complicated array of challenges that influence their understanding of their disease and overall quality of life (54,55). These challenges often go unrecognised; up to 44% of patients with CVD experience depression, a rate significantly higher than in the general population (56,57). Eva's case illustrates this reality. Following her second heart attack, she not only faces the physical demands of recovery but also significant psychological distress, including anxiety about her future and the pressure to implement lifestyle changes.

Research highlights that mental health challenges in patients with chronic disease often stem from the ongoing burden of managing their condition, stress associated with their diagnosis, and fear of future health complications (58). Additionally, depression and anxiety have been directly linked to worse cardiovascular health, including higher rates of rehospitalisation, major cardiac events, and mortality, independent of traditional risk factors (59). This underscores the necessity of addressing mental health as a fundamental component of chronic disease management. Providing adequate psychological support can enhance patients' ability to adopt and sustain healthy behaviours, adhere to medical recommendations, and actively participate in rehabilitation programmes (60).

Therapeutic approaches for psychosocial challenges

Cognitive Behavioural Therapy (CBT), delivered either face-to-face or internet-based, known as internet-based Cognitive Behavioural Therapy (iCBT), is one of the most widely studied interventions for psychosocial support. Research has shown that iCBT is comparable to face-to-face CBT regarding effectiveness and has the potential to improve accessibility (61). It can be offered as a standalone or blended programme, featuring cognitive restructuring, behavioural activation, and stress management. However, adoption of such online therapy programmes by clinicians and patients remains underwhelming (34). Challenges include low familiarity with online therapy, inadequate training, uncertain reimbursement, and lack of support (62,63).

Understanding how technologies such as online therapy could gain acceptance in practice by researching what hinders non-users is essential. Therefore, **Chapter 6** of this thesis examines the implementation of online therapy (iCBT), by psychologists in hospitals to explore factors affecting acceptance and implementation among non-users. By applying UTAUT, we gain insights into how to overcome the practical barriers to adopting online therapy, advancing the third aim of this thesis: integrating behavioural change and complex eHealth interventions into a holistic approach for chronic disease management.

Thesis outline

This section provides an overview of the thesis structure, outlining each chapter and its role in fulfilling the main aims and research questions.

In **Chapter 2**, we examine whether patients with CVD exhibit differences in their intention-to-change-lifestyle based on receiving gain-framed or loss-framed brief lifestyle advice (message framing), delivered by either a cardiologist or physiotherapist (message source). By conducting an online experimental study, patients with CVD are randomly assigned to one of four textual scenarios, known as vignettes, after which the effect of both message source

and message framing on intention-to-change-lifestyle is analysed. This research directly relates to Aim 1 and RQ1 of this thesis.

Subsequently, **Chapter 3** investigates preferences in health and life goal domains in CVD patients, the impact of linking life goals to health goals on their intention-to-change-lifestyle, and explores socio-demographic and health-related variables influencing intention-to-change-lifestyle. By conducting a second online experimental study, patients with CVD are randomised into two conditions, the health-goal-group or the life-and-health-goal-group. The first condition sets a health goal, whereas the second condition establishes a life goal, followed by a corresponding health goal to support it. Then, patients' intention-to-change-lifestyle is examined along with secondary outcomes. This research also contributes to Aim 1 and RQ1.

In **Chapter 4**, we describe the iterative development, evaluation, and improvement of an evidence-based, practice-tailored implementation strategy for complex eHealth interventions such as the BENEFIT programme. This chapter shows, step by step, how to integrate theoretical approaches of implementation science, such as the Implementation of Change Model, CFIR, and RE-AIM, into practice, alternate between theory and practice to identify and address key implementation challenges with evidence-based strategies, subsequently translate a theory-based strategy into a practical one that fits the stakeholders, and transparently report the development process of the implementation strategy. This method serves as a blueprint for other researchers seeking to implement complex eHealth interventions sustainably, thereby addressing Aim 2 and RQ2 of this thesis.

Following this, **Chapter 5** evaluates the implementation process of the BENEFIT programme with key stakeholders within the implementation ecosystem. Utilising the CFIR, this chapter explores and clarifies the various factors influencing the implementation of the BENEFIT programme, offering deeper insights into the dynamics of PPPs. Additionally, it offers evidence-based suggestions aimed at improving the implementation, scalability, and sustainability of complex eHealth interventions in routine clinical care. This aligns with Aim 2 and RQ3.

In **Chapter 6**, the focus shifts to the evaluation of the adoption of online therapy by psychologists working within hospitals. By applying UTAUT, this chapter provides insights into the factors that impact the acceptance and implementation of online therapy among non-users, offering valuable information for improving the implementation of such innovations. This research ties into Aim 3 and RQ4 of this thesis.

In the concluding **Chapter 7**, we synthesise the key findings from each study, situate them within a broader context, explore their practical implications, discuss their limitations, and offer directions for future research. This chapter closes the loop on all three aims, demonstrating how understanding and facilitating behaviour change, overcoming implementation barriers, and integrating interventions into holistic chronic disease management collectively contribute to better health outcomes for patients facing the burdens of chronic disease.

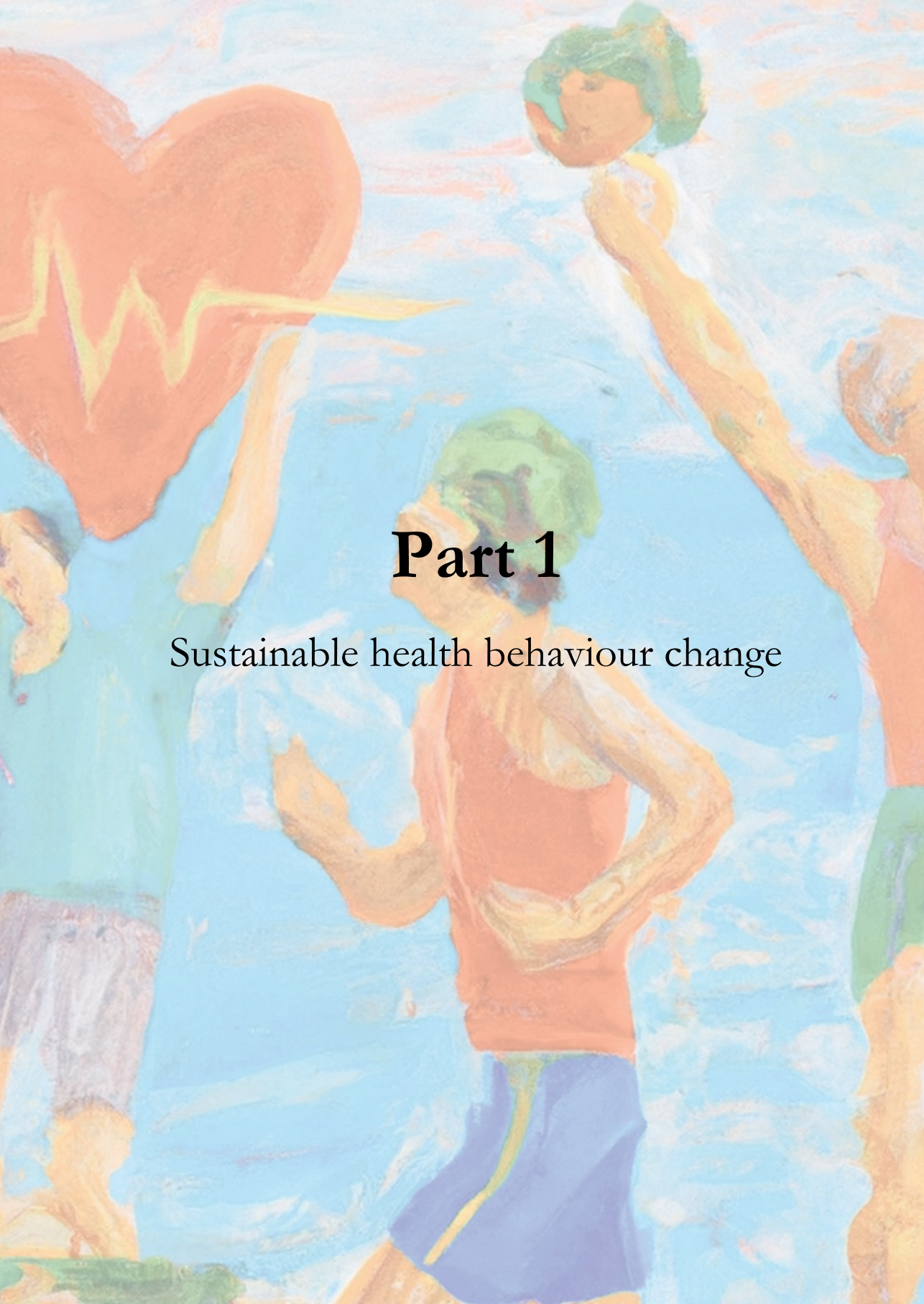
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Part 1

Sustainable health behaviour change

Chapter 2

Brief lifestyle advice in cardiac care: an experimental study on message source and framing

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Abstract

Objective: Communicating risk information and offering lifestyle advice are important goals in cardiac rehabilitation. However, the most effective way and the most effective source to communicate this information are not yet known. Therefore, we examined the effect of source (cardiologist, physiotherapist) and framing (gain, loss) of brief lifestyle advice on patients' intention-to-change-lifestyle.

Methods: In an online experimental study, 636 cardiac patients (40% female, 67 (10) yrs.) were randomly assigned to one of four textual vignettes. Effect of source and framing on intention-to-change-lifestyle (assessed using a 5-point Likert scale) was analysed using analysis of covariance (ANCOVA).

Results: Patients expressed positive intention-to-change-lifestyle after receiving advice from the cardiologist (M = 4.1) and physiotherapist (M = 3.9). However, patients showed significantly higher intention-to-change-lifestyle after receiving advice from the cardiologist (0.58 [0.54–0.61]) when compared with the physiotherapist (0.52 [0.48–0.56]), ($F[1,609] = 7.06$, $P = 0.01$). Gain-framed and loss-framed advice appeared equally effective. However, communicating risks (loss) was remembered by only 9% of patients, whereas 89% remembered benefits (gain).

Conclusions: Our study shows the value of cardiologists and physiotherapists communicating brief lifestyle advice, as cardiac patients expressed positive intention for lifestyle change after receiving advice, irrespective of framing. Lifestyle advice should include benefits due to better recall.

Introduction

Engaging in a healthy lifestyle is crucial for secondary prevention of cardiovascular disease (CVD) (1,2). The European Guidelines on Prevention of Cardiovascular Disease in Clinical Practice recommend addressing risk information before referring patients to lifestyle interventions (1). Using brief lifestyle advice, healthcare providers in cardiac rehabilitation can address modifiable cardiovascular risk factors such as smoking, physical activity, diet, and alcohol consumption in 2-3 minutes during a single consultation (3). However, up to 50% of patients consciously choose not to follow recommendations (1). Therefore, understanding the mechanisms influencing the effectiveness of brief lifestyle advice is essential to increase its impact (4,5).

Message source (6,7) and message framing (8,9) have proved to affect acceptance of brief lifestyle advice. Messages delivered by highly credible sources (e.g., medical professionals) are perceived as more persuasive than those from less credible sources (e.g., non-experts) (6). In the Netherlands, CVD patients often receive brief lifestyle advice from their cardiologist during quarterly consultations and from their physiotherapist during cardiac rehabilitation (CR). These healthcare professionals are both perceived as highly credible but differ in terms of frequency and duration of patient contact. However, possible differences in the effectiveness of brief lifestyle advice communicated by different credible sources are still unknown. Moreover, people have proved to respond differently to lifestyle advice communicated in terms of risks (loss-frame) or benefits (gain-frame) (10). For example, "Quitting smoking has a positive effect on energy, appearance, and sleep quality." (gain-frame) and "Continuing to smoke increases the risk of cardiovascular disease." (loss-frame). It is unclear, however, which message frame is most effective when conveyed by various credible sources in cardiac rehabilitation. Therefore, this study examined whether CVD patients differ in intention to change their lifestyle after receiving either gain-framed or loss-framed brief lifestyle advice communicated by either a cardiologist or physiotherapist.

Methods

Study design

This study was an online vignette experiment on patients' intention-to-change-lifestyle, using a 2-by-2 between-subjects design. Following recommendations on conducting vignette studies (11), four written vignettes were developed to represent variations in source (cardiologist, physiotherapist) and framing (gain, loss) of brief lifestyle advice. This study protocol was approved by the Psychology Research Ethics Committee of Leiden University (2020-06-05-A.W.M. Evers-V1-2474).

Patient population and recruitment

The study population consisted of members of the patient panel of Harteraad, the Dutch patient association for CVD, a voluntary database of approximately 2,600 CVD patients. Harteraad sent their panel members a survey invitation on 29 June 2020, with a two-week response period. The invitation described the study's purpose, duration, participation procedure, data protection, and the survey link (2020 Qualtrics, Provo, UT). Informed consent was obtained on the first page of the survey. Inclusion criteria were Dutch-speaking adults (≥18 years old). With a priori power analysis (two-sided, $\alpha = .05$, *power* = .80) (12), 128 participants were required to detect an effect of source and framing on intention-to-change-lifestyle with a small effect size (f = .25). To account for 10% of dropouts, we aimed for at least 141 participants in total.

Survey

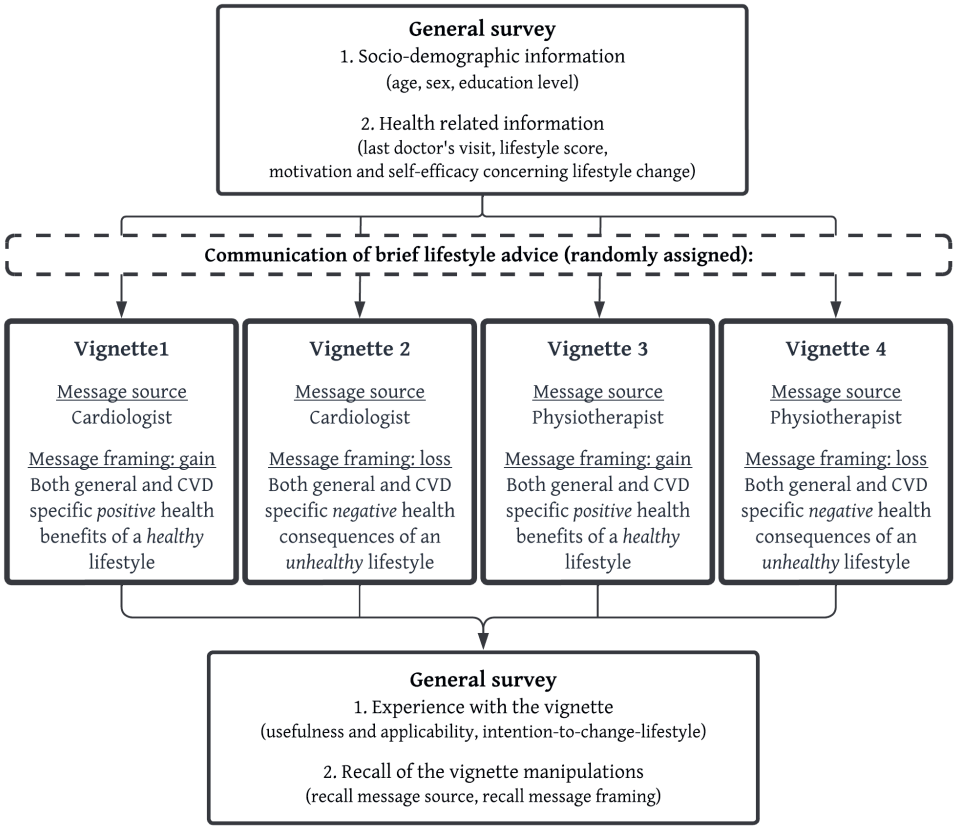
The survey first assessed patients' characteristics (age, sex, education level, last doctor's visit, current lifestyle score, motivation and self-efficacy concerning lifestyle change). Afterwards, patients were instructed to imagine having a consultation with their healthcare provider (11). Each patient was then randomly assigned one of the four vignettes (see **Figure 1**) which described brief lifestyle advice communicated by a cardiologist or physiotherapist (message source), using a gain-framed or loss-framed perspective on the health-related future (message framing). Vignettes (see **Appendix A**) had similar word counts, contained supporting images, and allowed reading the message aloud (11). Afterwards, the vignettes' applicability and meaningfulness were assessed, together with the primary outcome measure intention-to-change-lifestyle (13,14). Finally, used as manipulation check, patients were asked if they recalled which messenger delivered the brief lifestyle advice and what message was emphasised. After completing the survey, a debriefing explained the study's purpose.

Outcome measures

Main outcome

Similar to Taylor and colleagues (2005) (15), primary outcome measure intention-to-change-lifestyle was assessed using two items, "I want to change my lifestyle or continue to maintain my healthy lifestyle." and "I intend to change my lifestyle or continue to maintain my healthy lifestyle.", answered via a 5-point Likert scale, ranging from Completely disagree (1) to Completely agree (5) (16).

Figure 1. Design of the study.



CVD = cardiovascular disease.

Other measures

Based on previous research (17), motivation, self-efficacy, and current lifestyle score were assessed with the questions "At this moment, how motivated do you feel to change your lifestyle or maintain your healthy lifestyle?", "At this moment, how confident are you that you will be able to change your lifestyle or maintain your healthy lifestyle?", and "At this moment, how would you rate your current lifestyle?". Variables were rated on a 0-10 visual analogue scale (VAS) (18), representing a continuum between very unmotivated/no confidence at all/very unhealthy (0), and very motivated/a lot of confidence/very healthy (10). Perceived applicability and perceived meaningfulness of the vignette were assessed with the question, "Given your personal situation, how would you rate the conversation with the healthcare provider as just described?". Variables were rated on a 0-10 VAS, representing a continuum between not applicable at all/not meaningful at all (0) and very applicable/very meaningful (10). Recall of message source was measured by asking "Which messenger were you speaking to?" with the answer options: nurse, cardiologist, physiotherapist, or mental

health counsellor. Recall of message framing was measured by asking "What message did the healthcare provider emphasise?" with the answer options: a) "Positive effects of a healthy lifestyle" or b) "Negative consequences of an unhealthy lifestyle".

Statistical analysis

Data were analysed using IBM SPSS Statistics V.25. As the primary outcome intention-to-change-lifestyle was skewed, inverse transformation of intention was used. Two-way analysis of covariance (ANCOVA) examined the effect of source and framing on intention whilst controlling for sex, education level, motivation, and self-efficacy (19–22). Bonferroni post hoc analyses were used for multiple comparisons. A *p*-value of .05 or lower was considered statistically significant.

Descriptive statistics were used for patient characteristics. Internal reliability was checked by calculating the scale score and Cronbach's alpha for the intention scale, consisting of both intention items (α=.897). Pearson's correlations were used to assess the strength and direction of the relationship between the control variables education level, motivation, and self-efficacy, and the dependent variable intention-to-change-lifestyle. An independent t-test was used to assess the relationship between the control variable sex and dependent variable intention-to-change-lifestyle. Chi-squared tests were used to assess differences in recall between message source and types of message framing. Independent t-tests were used to investigate differences in perceived applicability and meaningfulness of the vignettes for both sources and types of framing. Data are reported as n (%), mean (standard deviation), or mean (95% confidence interval).

Results

Patient characteristics

Table 1 describes characteristics of the 636 patients who completed the survey (estimated response rate: 24.5%). Of these patients, 383 were male (60%); mean age was 67 (10) years. Patients' education levels were categorised as low (23%), medium (29%), high (47%). Intention-to-change-lifestyle was rated 3.9 (1.0) (range 1-5).

Recall and vignette perceptions

After 35.5 (303) minutes on average, when the experiment ended, patients' recall of source and framing was examined to determine the effectiveness of both manipulations. Significant associations were found between recall and source and between recall and framing, $\chi 2(1) = 399.890$, $P = .05$ and $\chi 2(1) = 399.680$, $P < .001$ respectively. Regarding source, 74% of the patients recalled the cardiologist, and 67% recalled the physiotherapist. Regarding framing, 89% of the patients recalled the gain frame, and 9% recalled the loss frame.

Concerning vignette perceptions (0-10 VAS), patients rated applicability 4.88 (2.69), and meaningfulness 5.22 (2.70). A significant difference in perceived meaningfulness between the cardiologist's vignettes, 5.44 (2.63), and the physiotherapist's, 4.99 (2.76), was found, t = 2.07, P = .04. No differences were found in other patient conditions.

Table 1. Socio-demographic and health-related characteristics.

Variable	
Age, years	67 (10)
Female sex	253 (40)
Education level	
Low[a]	144 (23)
Medium[b]	85 (29)
High[c]	298 (47)
Other	9 (1)
Last doctor's visit	
Past month	146 (23)
Past 2 to 6 months	238 (37)
More than 6 months ago	252 (40)
Current lifestyle score[a]	6.94 (1.75)
Motivation concerning lifestyle change[d]	6.89 (2.32)
Self-efficacy concerning lifestyle change[d]	6.88 (2.20)
Intention-to-change-lifestyle[e]	3.92 (1.00)

Data are n (%) or mean (standard deviation); mentioned when otherwise.

[a]No education, and primary and preparatory vocational secondary education.

[b]Vocational, senior general secondary, and university preparation education.

[c]Higher vocational education and research university.

[d]Question answered via 0-10 visual analogue scale (low (1) to high (10)).

[e]Statement answered via 5-point Likert scale (completely disagree (1) to completely agree (5)).

Effect of source and framing on intention-to-change-lifestyle

Table 2 presents the effect of message source and framing on intention-to-change-lifestyle. A two-way ANCOVA showed a significant main effect of source on intention, F(1,609) = 7.06, P = .01, whilst controlling for sex, education level, motivation, and self-efficacy. Patients expressed significantly higher intention after receiving advice from the cardiologist, .58 (.54 - .61), than from the physiotherapist, .52 (.48 - .56), P = .01. The main effect of framing on intention was non-significant, F(1,609) = .01, P = .92, as was the interaction effect between source and framing on intention, F(1,609) = .42, P = .52. Repeating the analysis without covariates showed similar results.

Table 2. Effect of message source and message framing on intention-to-change-lifestyle.

			Effect of the manipulations			
	Adjusted value	**Unadjusted value**	**Adjusted F (df=609)[a]**	**P**	**Unadjusted F (df=632)**	**P**
Message framing			.01	.92	.08	.78
Gain	.55 (.51-.59)	.61 (.58-.64)				
Loss	.45 (.51-.59)	.60 (.57-.63)				
Message source			7.06	.01	5.65	.02
Cardiologist	.58 (.54-.61)	.63 (.60-.66)				
Physiotherapist	.52 (.48-.56)	.58 (.55-.61)				
Message framing × message source			.42	.52	.04	.84
Gain x cardiologist	.57 (.52-.62)	.63 (.59-.67)				
Gain x physiotherapist	.53 (.48-.58)	.58 (.54-.63)				
Loss x cardiologist	.58 (.53-.63)	.63 (.58-.67)				
Loss x physiotherapist	.52 (.47-.56)	.57 (.53-.61)				

Values are estimated mean (95% confidence interval). *df* degrees of freedom.

[a]Adjusted for sex, education level, motivation, and self-efficacy.

Discussion

This study demonstrates the value of communicating brief lifestyle advice to cardiac patients, as they expressed positive intentions to change their lifestyle after receiving advice from either the cardiologist or the physiotherapist. Generally, however, a higher intention to change was expressed when the advice was communicated by the cardiologist; this difference in message source was found to be significant. Gain-framed or loss-framed advice appeared equally effective for patients' intention. However, gain-framed information was recalled better than loss-framed information.

Concerning message source, the fact that patients expressed a significantly higher intention after receiving advice from the cardiologist than the physiotherapist may be due to slightly different perceived credibility towards the healthcare providers. Possibly, patients make a subtle distinction between a cardiologist and physiotherapist when evaluating their expertise, trustworthiness, or caring (7). Specifically, patients appear more likely to adhere to treatment advice when communicated by credible physicians (23) and feel more satisfied with the healthcare received when they perceive the source as competent or caring (24). This may explain why patients rated the meaningfulness of the cardiologist's vignette higher, even though it was identical to the physiotherapist's vignette, and recalled the advice from the cardiologist better than the advice from the physiotherapist.

Concerning message framing, gain-framed and loss-framed brief lifestyle advice appeared equally effective on intention. This contrasts with prior research that showed a more positive influence of gain-framed health messages on patient evaluation of treatment advice and their intention to change preventive lifestyle behaviour (8,9). However, these studies mainly

focussed on specific lifestyle behaviour (e.g., smoking cessation) rather than generic lifestyle behaviour as we did. Moreover, in line with our results, meta-analyses have shown that communicating either gain-framed or loss-framed advice did not have significantly different advantages for patients' intentions to change lifestyle (10). Nevertheless, patients rated the vignette's applicability and meaningfulness as average, but this may have been different if it had been discussed in the consultation room and the advice had been tailored to the patient under the healthcare provider's guidance.

Subsequently, patients recalled gain-framed advice more often than loss-framed advice. This may be due to patients undergoing treatment for an extended period and probably already receiving similar lifestyle advice. Moreover, patients' memory representation may have affected memories of the received advice; exact details such as framing of words quickly become inaccessible because of rapid memory decline during the first 15 to 30 minutes after exposure to the message. After this period, an essential meaning of the message is remembered (25). Finally, the positivity effect, which is the tendency for older adults to remember positive information and disregard negative information, may also have played a role in this outcome (26).

Limitations and implications for practice

Concerning limitations, loss-framed lifestyle advice appeared challenging to recall. Possibly, the manipulation of message framing was not strong enough or insufficiently specified, or healthcare providers had already communicated the generic health-related information described in the vignette. As a result, message framing might not have been striking enough. Next, this study specifically explored the impact of source and framing on intention after providing generic brief lifestyle advice, using vignettes solely describing the advice. Future research could examine whether intention increases when vignettes convey the steps required to implement the desired lifestyle change. Furthermore, even though intention is an essential predictor of actual behaviour (27), there is a gap between intention and actual behaviour (28). Additionally, absence of direct face-to-face consultations may have influenced our findings' generalisability to real-world settings. Whilst our vignettes were developed based on scientific recommendations (11) and aimed to simulate realistic patient-provider interactions in cardiac care, we emphasise the need for future research to validate our findings in actual clinical settings.

Current ESC guidelines on cardiovascular disease prevention recommend providing risk information to stimulate attendance to lifestyle interventions (1). This study found that only 9% of patients remembered risk communication, whereas 89% remembered communication of benefits. To improve adherence to brief lifestyle advice, healthcare providers should

emphasise the benefits of healthy living in addition to risks. Additionally, the mere endorsement of a healthcare provider may bolster patients' intention-to-change-lifestyle. Given physicians' limited consultation time, emphasising the value of a healthy lifestyle without extensive discussion of associated behaviours can be effective. Easy referral to other healthcare providers using motivational interviewing techniques (29,30), for example, physiotherapists, generalist or specialist nurses, or healthcare providers working at lifestyle care counters, will further facilitate suitable treatment and sustainable lifestyle change.

Conclusion

Cardiac patients expressed the highest intention to change their lifestyle when brief lifestyle advice was communicated by a cardiologist. This was irrespective of message framing, but communicating benefits rather than risks appeared to be related to better recall. The results and associated practical implications can support healthcare providers in cardiac care in optimising the brief lifestyle advice they provide their patients to facilitate suitable treatment and sustainable lifestyle change.

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Appendix A

Textual vignettes.

Vignette 1: Cardiologist and gain framing.

Because of your cardiovascular disease, your cardiologist invites you to discuss your lifestyle.

The cardiologist greets you upon arrival, introduces themself, and asks how you are doing. The cardiologist will then advise you on how to change your lifestyle or maintain your healthy lifestyle.



The cardiologist tells you that a healthy lifestyle ensures that you feel well, both mentally and physically. Moreover, healthy living habits can improve your cardiovascular condition.

The cardiologist tells you that everyone can achieve some profit in terms of lifestyle, even if only a little. You can think of sufficient exercise, eating healthy, sleeping well, dealing with stress or tension, quitting smoking, and reducing/quitting alcohol consumption.

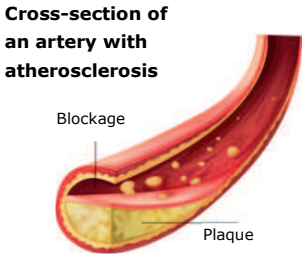
With the cardiologist, you can determine what would make the most sense to get started with. The cardiologist will be happy to refer you to a lifestyle programme that suits your needs and personal goals. You can discuss these next steps together at another time.

Vignette 2: Cardiologist and loss framing.

Because of your cardiovascular disease, your cardiologist invites you to discuss your lifestyle.

The cardiologist greets you upon arrival, introduces themself, and asks how you are doing. The cardiologist will then advise you on how to change your lifestyle or maintain your healthy lifestyle.

The cardiologist tells you that an unhealthy lifestyle ensures that you feel worse, both mentally and physically. Moreover, unhealthy living habits can worsen your cardiovascular condition.



The cardiologist tells you that everyone can achieve some profit in terms of lifestyle, even if only a little. You can think of sufficient exercise, eating healthy, sleeping well, dealing with stress or tension, quitting smoking, and reducing/quitting alcohol consumption.

With the cardiologist, you can determine what would make the most sense to get started with. The cardiologist will be happy to refer you to a lifestyle programme that suits your needs and personal goals. You can discuss these next steps together at another time.

Vignette 3: Physiotherapist and gain framing.

Because of your cardiovascular disease, your physiotherapist invites you to discuss your lifestyle.

The physiotherapist greets you upon arrival, introduces themself, and asks how you are doing. The physiotherapist will then advise you on how to change your lifestyle or maintain your healthy lifestyle.



The physiotherapist tells you that a healthy lifestyle ensures that you feel well, both mentally and physically. Moreover, healthy living habits can improve your cardiovascular condition.

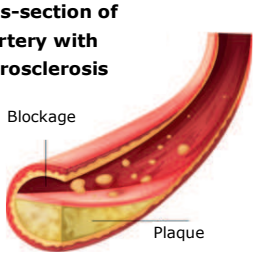
The physiotherapist tells you that everyone can achieve some profit in terms lifestyle, even if only a little. You can think of sufficient exercise, eating healthy, sleeping well, dealing with stress or tension, quitting smoking, and reducing/quitting alcohol consumption.

With the physiotherapist, you can determine what would make the most sense to get started with. The physiotherapist will be happy to refer you to a lifestyle programme that suits your needs and personal goals. You can discuss these next steps together at another time.

Vignette 4: Physiotherapist and loss framing.

Because of your cardiovascular disease, your physiotherapist invites you to discuss your lifestyle.

The physiotherapist greets you upon arrival, introduces themself, and asks how you are doing. The physiotherapist will then advise you on how to change your lifestyle or maintain your healthy lifestyle.



The physiotherapist tells you that an unhealthy lifestyle ensures that you feel worse, both mentally and physically. Moreover, unhealthy living habits can worsen your cardiovascular condition.

The physiotherapist tells you that everyone can achieve some profit in terms of lifestyle, even if only a little. You can think of sufficient exercise, eating healthy, sleeping well, dealing with stress or tension, quitting smoking, and reducing/quitting alcohol consumption.

With the physiotherapist, you can determine what would make the most sense to get started with. The physiotherapist will be happy to refer you to a lifestyle programme that suits your needs and personal goals. You can discuss these next steps together at another time.

Chapter 3

What matters to cardiac patients? The impact of linking life goals to health goals on patients' intention-to-change-lifestyle: an online experiment

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Abstract

Objectives: Guidelines advocate goal setting for promoting lifestyle changes in cardiovascular disease (CVD) patients. This study investigates 1) preferences in health and life goal domains in CVD patients, 2) the impact of linking life goals to health goals on intention-to-change-lifestyle, and explores 3) socio-demographic and health-related variables influencing intention-to-change-lifestyle.

Design: An online experimental study.

Methods: Patients with CVD (N=629, mean age 66.6; 39% female) were randomised to health-goal-group (HG) or life-and-health-goal-group (LHG). HG set a health goal, and LHG first established a life goal and then set a supporting health goal. Directly after goal setting, the primary outcome intention-to-change-lifestyle was measured and analysed using logistic regression (high: 9-10 vs lower: ≤ 8.5), as were the secondary outcomes.

Results: Exercise goals were most frequently selected in both LHG and HG (66.0% and 66.9%, respectively). Preference for selecting stress management was significantly higher in LHG (17.3%) than in HG (9.3%), $\chi 2(1)=8.85$, p=.003; OR 2.05, 95%CI 1.27–3.30. The direct effect of goal-setting condition on intention-to-change-lifestyle was non-significant (OR .98, 95%CI .71–1.34, p=.88). In exploratory analyses, lower- and medium-educated patients showed a significantly higher intention when life and health goals were linked (OR 2.55, 95%CI 1.03–6.27, p=.04, and OR 2.47, 95%CI 1.15–5.30, p=.02, respectively). Perceived meaning in life was also positively associated with intention.

Conclusions: No main effect of goal-setting condition on intention-to-change-lifestyle was found. Linking life goals to health goals increased preference for stress-management and, in exploratory analyses, was associated with higher intention-to-change-lifestyle among lower- and medium-educated patients. Findings emphasise the relevance of personalised, value-based goal setting within cardiac rehabilitation.

Introduction

Cardiovascular disease (CVD) remains the leading cause of global morbidity and mortality, underscoring the critical need for effective management strategies to enhance secondary prevention (1,2). Within cardiac rehabilitation (CR), health goal setting has shown improved disease management outcomes (3). Recognising this, American and European guidelines on preventing cardiovascular disease in clinical practice advocate for health goal setting to realise behaviour change in CVD patients (2,4). Building on these guidelines, a recent American Heart Association publication reaffirmed the significance of person-centred care in clinical practice, advocating for various models prioritising this approach. Central to the person-centred care approach is the collaborative establishment of health goals by clinicians and patients, augmented by integrating the patient's narrative into the assessment, jointly creating healthcare plans, and continuously reassessing and adjusting patient goals to align with the patient's evolving needs and preferences (5).

Whilst health goal setting is widely recommended, emerging evidence suggests that integrating health goals with life goals could enhance effectiveness in CR (6,7). Life goals, which are broad objectives that individuals strive to accomplish, maintain, or avoid (e.g., 'Spending more time with family', 'Living independently') (8), reflect what matters most to people; they are indicative of a person's meaning in life. Meaning in life can be described as subjective judgements on whether life is "worthwhile and significant, comprehensible and make sense, and marked by the embrace or pursuit of one or more highly valued, overarching purposes or missions" (p. 961) (9). Health goals, by contrast, tend to be more specific targets or behaviours (e.g., 'Walking for 30 minutes a day' (so I can stay active enough to go on family outings), or 'Doing a daily set of balance exercises' (so I can continue living independently), chosen to support these broader life goals.

According to goal-setting theories, goals are hierarchically organised (10). *Superordinate life goals* are abstract and long-term, *intermediate goals* represent broad behavioural approaches, and *subordinate health goals* are concrete, short-term actions (6,10). These different levels influence each other dynamically, reinforcing top-down (meaning-driven) and bottom-up (behaviour-driven) mechanisms (11,12). Research suggests that linking life goals to health goals may enhance motivation and dedication to pursue the defined goals (10,13), allowing individuals to benefit from the combination of various goal levels. Additionally, aligning health goals to life goals has shown potential in increasing *restorative* health behaviour (e.g., exercise regularly) and decreasing *deteriorative* health behaviour (e.g., smoking) (14,15). However, most studies predominantly involve complex interventions, making it challenging to isolate the direct effect of linking life goals to health goals, especially for CVD patients.

Furthermore, to our knowledge, little is known about the specific life and health goals that CVD patients prioritise, which is crucial for designing patient-centred interventions.

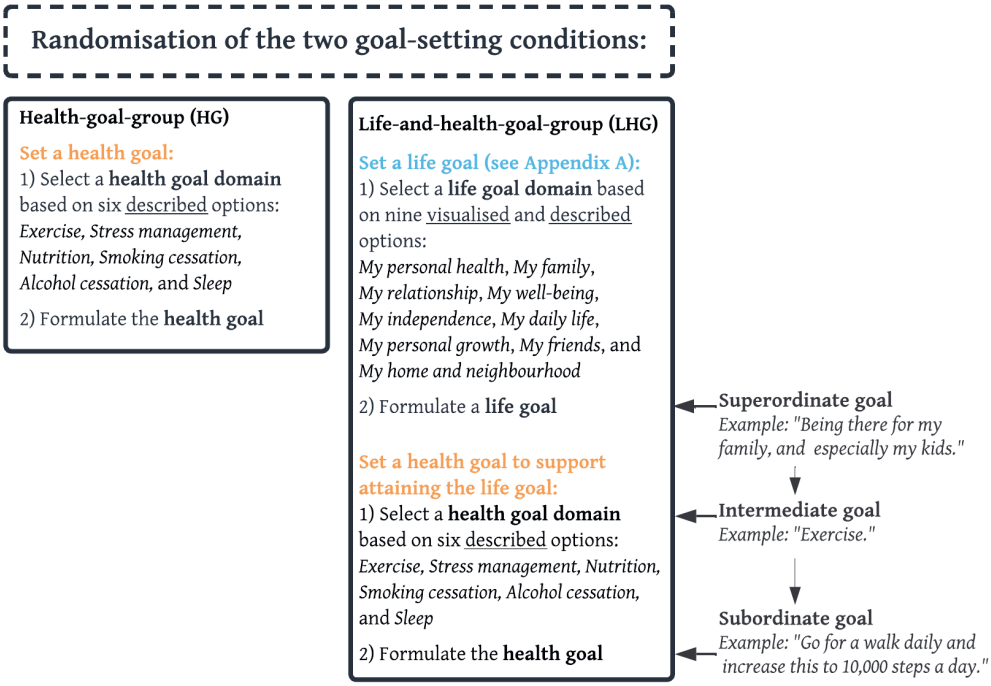
The study has several objectives. First, we explore CVD patients' preferences in selecting subordinate health goal domains and superordinate life goal domains. Second, we investigate the impact of linking life goals to health goals on intention-to-change-lifestyle, given that behavioural intention is commonly regarded as a predictor of actual behaviour (16). Intention can be understood as the subjective probability that one will engage in specific behaviour, reflecting the strength of one's commitment to act or one's motivational readiness or commitment to adopt new health behaviours (17). In the present study, intention-to-change-lifestyle is operationalised as our primary outcome measure, reflecting the degree to which patients are committed to adopt or maintain healthy lifestyle behaviours. We hypothesise that linking life goal to health goals has the most favourable effect on patients' intention to change their lifestyle, compared to setting a health goal alone. Third, we conduct exploratory analyses to examine whether known socio-demographic and health-related factors, such as education level (18), and perceived meaning in life (19), are associated with intention-to-change-lifestyle in our study population, and whether they modify the effect of goal-setting condition on intention-to-change-lifestyle.

Methods

Study design

We conducted a randomised online experimental study to assess the effectiveness of linking superordinate life goals to subordinate health goals on CVD patients' intention-to-change-lifestyle behaviour. Patients were randomly assigned (1:1 randomisation) to one of the two goal-setting conditions: the health-goal-group (HG, n = 323) or the life-and-health-goal-group (LHG, n = 306) (see **Figure 1**). Randomisation was conducted within the online survey platform (Qualtrics) using an automated random allocation function. In the HG group, patients set a subordinate health goal (hereafter referred to as health goal), within a specific lifestyle domain (e.g., exercise, nutrition, stress management), whilst those in the LHG group set a superordinate life goal (hereafter referred to as life goal) followed by a health goal within a specific lifestyle domain to support attaining their life goal. The life goal setting was a structured reflection and had a visualisation of life goals before setting a health goal. Directly afterwards, the primary outcome intention-to-change-lifestyle was assessed.

Figure 1. Patient randomisation.



Study participants and procedure

Patients were members of the patient panel of Harteraad (the Dutch patient association for CVD), a voluntary database of approximately 2600 CVD patients. Recruitment was facilitated through an advertisement on the website of Harteraad, posted during the first two weeks of April 2021. The advertisement explained the study's purpose, duration, participation procedure, data protection, and included the survey link. Before participation, all individuals received an information letter specifying that only people with a current or previous heart and/or vascular condition were eligible. Diagnoses were self-reported. Participation in the study occurred at once, without a break. Informed consent was obtained at the start of the survey.

Inclusion criteria were being a Dutch-speaking adult (≥ 18 years old) with a CVD diagnosis. Individuals were excluded if they were younger than 18 years of age, did not have a confirmed CVD diagnosis, had insufficient proficiency in Dutch to understand study materials, or were unwilling or unable to provide informed consent. Eligibility and diagnosis were self-reported; medical record verification was not possible in this online study. A priori power analysis (using G*Power) indicated a minimum of 197 patients (approximately 99 per condition) to detect a significant difference in intention-to-change-lifestyle (two-tailed, α = .05, *power* = .80).

The online experimental survey (Qualtrics) consisted of three parts. First, all patients provided demographic and health-related information (age, gender, education level, self-reported CVD diagnosis). Second, in the randomised goal-setting task (**Figure 1**), patients were assigned to either the HG group or LHG group. This ensured that assignment was unbiased and not influenced by individual preferences or prior experiences (e.g., previous participation in a CR programme). To support patients in determining their health goal, both groups were shown three illustrative examples within their chosen lifestyle domain (entry-level, advanced, maintenance). The LHG formulated their life goal by answering the first three questions from the Dutch shared decision-making tool *Wat ertoe doet* (20) (meaning: *What matters*) (**Appendix A**), which involved guided reflection and visual selection of life domains. The tool comprised different sequential screens: (i) patients viewed image tiles of nine life domains (e.g., family, personal health, independence, well-being) and selected up to three images representing what is important in their life; (ii) from these, they selected one image that is important to them now; (iii) they then typed, in a free-text field, what they want to be able to do within that domain (example prompts disappeared once typing started). This structured tool was designed to help patients clarify their overarching life goals before setting a health goal. The tool was systematically developed and tested extensively with different patient groups (21) and aims to support shared decision-making by helping patients clarify what matters to them in life and how to link their life goals to their health goals. In contrast, the HG group set a health goal without using the *Wat ertoe doet* tool first. This way, the HG group was used as an active usual-care comparator. In the third and final part of the survey, all patients completed the primary outcome variable intention-to-change-lifestyle (two items) and the variable meaning in life (six items). After completing the survey, patients were debriefed about the study design.

Measures

Primary outcome

Guided by the Reasoned Action Approach (17), the primary outcome variable intention-to-change-lifestyle was assessed using two items to capture different aspects of intention related to health behaviour change. The first item, "I want to start carrying out my health goal or continue maintaining my health goal", reflects the individual's attitude towards the behaviour. This item reflects the personal motivation or desire to engage in or maintain a health-related behaviour, rooted in the belief that the action will lead to a positive outcome. The second item, "I intend to start carrying out my health goal or continue maintaining my health goal", is more closely aligned with actual intention to perform the behaviour, which reflects a commitment to act. Using both items therefore allows for a nuanced understanding of the patients' intention-to-change-lifestyle. Both statements were rated via a 0-10 visual analogue scale (VAS) (22), representing a continuum between completely disagree (0) and

completely agree (10). The scores on these two items were averaged to obtain a score on the scale 'intention-to-change-lifestyle' (Cronbach's alpha = .83, inter-item correlation = .71). Due to a very negatively skewed distribution (**Appendix B**), and transformations to normal were not effective, intention was analysed dichotomously using a median split: scores up to 8.5 were considered lower intention, whereas scores from 9 up to 10 indicated high intention. This allowed for a clearer interpretation of effects.

Secondary outcomes

Socio-demographic (age, gender, education) and health related characteristics (self-reported cardiovascular diagnosis) were measured once at baseline (pre-randomisation). Meaning in life was collected once at the end of the survey (post-randomisation) as a potential moderator. Gender identification was answered via three multiple-choice options: male, female, or other. Age was entered in years by using numerical input and subsequently categorised for descriptive purposes only into four groups: 18-40 years, 41-60 years, 61-80 years, 81 and older. Education level was assessed based on nine multiple-choice options, resulting in three education-level categories: low (no education, primary education, pre-vocational secondary education, and other), medium (vocational education, senior general secondary education, and pre-university education) and high (higher vocational education and university), based on the Dutch Standard Education Classification 2021 Edition 2022/'23 (23). In consultation with an experience expert from Harteraad, patients were asked to self-report their cardiovascular diagnosis through three accessible multiple-choice options: cardiac disease, vascular disease, or cardiovascular disease. When unknown, one was able to leave the question unanswered. Self-reported diagnoses have been widely used in epidemiological research when medical records are unavailable. Whilst this method may introduce some uncertainty, it provides valuable insight into patient-perceived diagnoses. Finally, meaning in life was measured via a Dutch translation of the Meaning in Life Questionnaire-Short Form (MLQ-SF) (24,25). The questionnaire has two subscales Search and Presence, each containing three statements which were rated via a 4-point Likert scale, ranged not at all true to completely true.

Statistical analysis

IBM SPSS Statistics V.25 was used for statistical analyses. To address our first objective, assessing preferences in health goals and life goals, we explored preferred life goal domains among LHG patients and health goal domains among both HG and LHG patients, and performed chi-square tests to examine the association between goal-setting condition and selected health goal domains, identifying significant differences. All formulated health goals were categorised strictly based on the observed behaviour, regardless of the stated intention or selected domain. In cases where multiple or cross-domain goals were provided, only the

first stated behaviour was used and assigned to the corresponding category. This approach ensured consistency and avoided reclassification based on inferred intention. For the second objective, assessing the effect of goal-setting condition on intention-to-change-lifestyle, logistic regression analysis was performed to examine the effect of the goal-setting group (LHG vs HG) on the probability of expressing 'high intention' to change lifestyle. Subsequently, as part of our third objective, conducting an exploratory investigation into socio-demographic and health-related factors that may influence intention-to-change-lifestyle, we examined whether age, gender (reference group: man), education level (reference group: high education level), cardiovascular diagnosis (reference group: cardiovascular disease), and meaning in life were modifiers of the effect of goal-setting group on intention, by adding its simple effect (as block 2) and the interaction effect with goal-setting condition (as block 3) to the logistic regression model. In Table 3 of the results section, the results from each block will be displayed together (block 1: goal-setting condition, block 2: main effects of potential modifiers, block 3: interaction effects with goal-setting condition) to maintain focus on the key effects from each stage of the analysis. A *p*-value of .05 or lower was considered statistically significant.

Data management and ethical procedures

All data were collected electronically through web-based data entry using Qualtrics and stored under the provisions of the National Data Protection Regulations. This study was approved by the Psychology Research Ethics Committee of Leiden University (reference number: 2021-03-10-A.W.M. Evers-V1-3067). Digital informed consent was obtained from each patient prior to participation; the survey's first page explained the content of the survey and ended with informed consent.

Results

Patient characteristics

Of the 750 patients who started the survey after giving informed consent, 629 (84%) completed the survey. Among these, HG had n = 323 (51.4%) and LHG had n = 306 (48.6%). This 17-participant difference resulted from dropout at different stages of the survey. Detailed patient characteristics are shown in Table 1. Most patients identified as male (60.4%) with an average age of 66.6 years (SD: 10.2). Patients' education levels were categorised as low (19.7%), medium (23.8%), and high (47.5%). The overall perceived meaning in life (range 1-4) was rated at 2.67 (SD: .55). The subscale 'search for meaning in life' scored 2.42 (.76), whilst the subscale 'presence of meaning in life' scored slightly higher at 2.92 (.68). At the single, post-task assessment, primary outcome intention-to-change-lifestyle was high on average (M = 8.4 on a 0-10 scale, SD: 1.6), with 47.1% scoring 9-10.

Table 1. Patient characteristics.

Characteristics	Total	HG	LHG	Stat. comp.[d]	p-value
N.	629	323	306		
Age (years (SD))	66.6 (10.2)	66.9 (10.2)	66.3 (10.2)	$t(627) = .70$	.485
18-40 years	9 (1.4)	6 (1.9)	3 (1.0)		
41-60 years	142 (22.6)	68 (21.0)	74 (24.2)		
61-80 years	440 (70.0)	229 (70.9)	211 (68.9)		
81 and older	38 (6.0)	20 (6.2)	18 (5.9)		
Gender				$\chi^2(1) = .71$	.399
Male	380 (60.4)	200 (61.9)	180 (58.8)		
Female	248 (39.4)	122 (37.8)	126 (41.2)		
Other	1 (.2)	1 (.3)	0 (0)		
Education level				$\chi^2(2) = 2.4$	.302
Low	124 (19.7)	71 (22.0)	53 (17.3)		
Medium	206 (32.8)	100 (30.9)	106 (34.6)		
High	298 (47.5)	152 (47.1)	146 (47.7)		
Cardiovascular diagnosis[a]				$\chi^2(2) = 1.75$	.417
Cardiac disease	304 (48.3)	160 (49.5)	144 (47.1)		
Vascular disease	118 (18.8)	54 (16.7)	64 (20.9)		
Cardiovascular disease	189 (30.0)	99 (30.7)	90 (29.4)		
No response	18 (2.9)	10 (3.1)	8 (2.6)		
Perceived meaning in life[b]	2.7 (.6)	2.7 (.6)	2.7 (.5)	$t(627) = .73$	.468
Search	2.4 (.8)	2.5 (.8)	2.3 (.7)		
Presence	2.9 (.7)	2.9 (.7)	3.0 (.7)		
Intention overall score[c]	8.4 (1.6)	8.4 (1.6)	8.4 (1.6)	$t(627) = -.36$	.717
Lower (scores 0-8.5)	333 (52.9)	172 (53.3)	161 (52.6)		
High (scores 9-10)	296 (47.1)	151 (46.7)	145 (47.4)		

Data are presented as the number in proportion n (%) or mean (SD), unless stated otherwise. HG, health-goal-group; intention, Intention-to-change-lifestyle; LHG, life-and-health-goal group.

[a]Self-reported cardiovascular diagnosis; if unknown, no response was recorded.

[b]Assessed using a 4-point Likert scale (not at all true (1) to completely true (4)) (24,25).

[c]Assessed using 0-10 visual analogue scale ((VAS), ranging from completely disagree (0) and completely agree (10)) (22).

[d]Group differences (HG vs. LHG) were tested using independent-samples t-tests for continuous variables and chi-square tests for categorical variables, as reported in the "Statistical comparison" column.

Objective 1: Life goal and health goal domain preferences

Life goals

Patients in LHG most often preferred the domain *My personal health* (n = 106) as their life goal domain, such as 'Being able to move well.' and 'Being able to continue doing what I have been doing.'. The second most popular domain was *My family* (n = 97), for example, 'Being and remaining an active mother and grandmother.' and 'Seeing my grandchildren grow up.'. The third most popular domain was *My relationship* (n = 36), such as, 'Paying enough attention to each other' and 'Growing old together.'. **Appendix C** displays life goal domain prevalence and example formulations.

Health goals

Chi-square test showed a significant association between goal-setting condition and health goal domain (**Table 2**), $\chi^2(5) = 12.40$, $p = .03$. In both LHG and HG, *Exercise* was the most frequently selected health goal domain (LHG: 66.0%, HG: 66.9%). Patients set exercise goals such as 'Doing something in the garden every day. Large garden!' or 'One hour of daily exercise (walking, cycling, exercises).'. Additionally, the prevalence of selecting *Stress management* was higher in LHG (17.3%; n = 53) than in HG (9.3%; n = 30), $\chi^2(1) = 8.85$, $p = .003$; OR = 2.05; 95% CI [1.27–3.30]. Stress management goals were, for example, 'No phone or anything, just doing my thing without being bothered.' and 'Enjoying nature, art and music.'. **Appendix D** displays health goal domain prevalence and example formulations. **Appendix E** visualises the distribution of the selected life goal domains and health goal domains across both goal-setting conditions.

Table 2. Health goal domain preferences, divided by goal-setting condition.

Health goal domain	LHG (n = 306), n (%)	HG (n = 323), n (%)	χ^2	Effect size (Cramer's V)	OR (LHG vs HG); 95% CI
Exercise	202 (66.0)	216 (66.9)	.05	.01	.96; [.69–1.3]
Stress management	53 (17.3)	30 (9.3)	8.85*	.12	2.05; [1.27–3.30]
Nutrition	38 (12.4)	53 (16.4)	2.02	.06	.72; [.46–1.13]
Sleep	6 (2.0)	9 (2.8)	.46	.03	.70; [.25–1.98]
Alcohol cessation	4 (1.3)	8 (2.5)	1.15	.04	.52; [.16–1.75]
Smoking cessation	3 (1.0)	7 (2.2)	1.42	.05	.45; [.12–1.74]

The χ^2 (2×6) test assesses the overall association between the condition (LHG vs HG) and domain. Row-wise $\chi^2(1)$ and OR (LHG vs HG) compare, per domain, how often it was selected in LHG versus HG. 95% confidence intervals (CI) are shown; Cramer's V indicates effect size. *$p = .003$.

Objective 2: Effect of goal-setting condition on intention-to-change-lifestyle

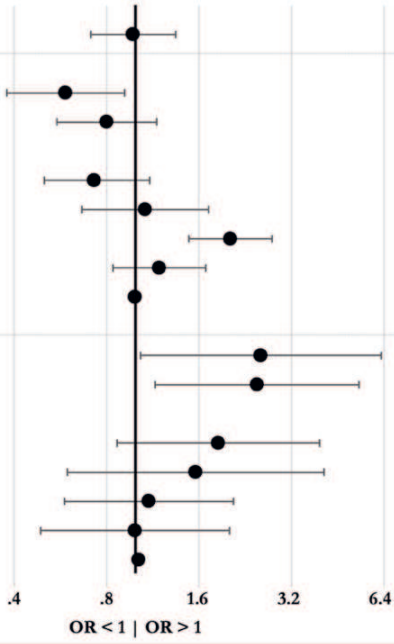
Logistic regression analysis (block 1) showed no significant main effect of goal-setting condition (LHG vs. HG) on intention-to-change-lifestyle, OR .98; 95% CI [.71–1.34], $p = .88$.

Objective 3: Effect of socio-demographic and health-related variables on intention-to-change-lifestyle

Logistic regression analysis (block 2) showed that lower-educated patients were less likely to express higher intention-to-change-lifestyle compared to higher-educated patients, OR = .59; 95% CI [.38–.92]; p = .02. As the Group x Education interaction was significant, p = .03, interpretation focuses on the within-education contrasts; relative to HG, LHG was associated with higher odds of high intention among lower-educated patients, OR = 2.55, 95% CI [1.03, 6.27], p = .04, and medium-educated patients, OR = 2.47, 95% CI [1.15, 5.30], p = .02, whereas there was no difference among high-educated patients, OR = .98, 95% CI [.71, 1.34], p = .88, see Figure 2. The overall model fit was significant, χ^2 (15) = 41.68; $p < .001$. Furthermore, meaning in life showed a significant main effect on intention-to-change-lifestyle, OR 2.03; 95% CI [1.48–2.76], $p < .001$, indicating that patients with higher perceived meaning in life were more likely to exhibit a high intention-to-change-lifestyle. Main effects of the other factors were not significant. Table 3 displays the OR and 95% CI from the logistic regression analysis predicting high intention-to-change-lifestyle.

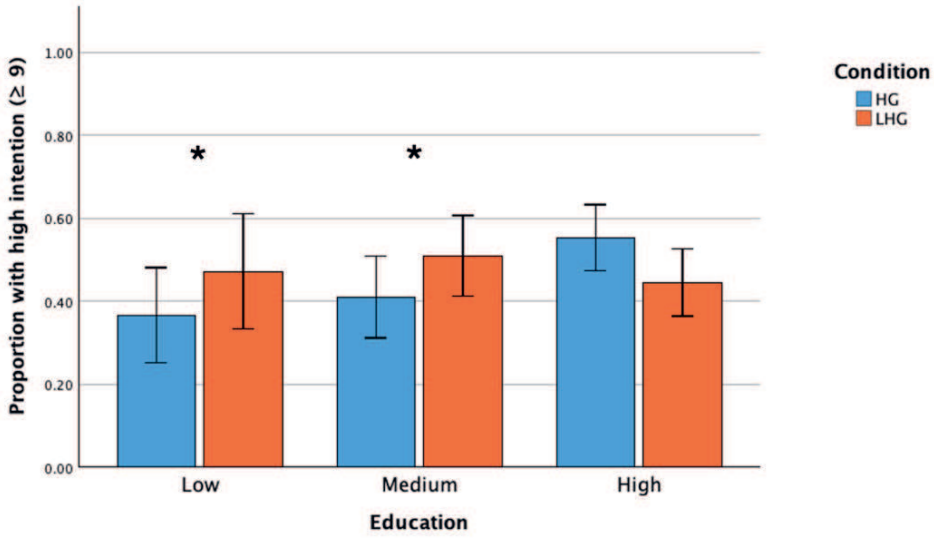
Table 3. Odds ratio for high vs. low intention-to-change-lifestyle.

	Variables	OR [95% CI]	P
Block 1	Health vs. Life goal group	.98 [.71–1.34]	.88
	Education (ref: high)		.06
	Low	.59 [.38–0.92]	**.02**
	Medium	.80 [.55–1.17]	.25
	Diagnosis (ref: CVD)		.12
Block 2	Cardiac disease	.73 [.50–1.06]	.10
	Vascular disease	1.07 [.67–1.72]	.78
	Meaning in life	2.03 [1.48–2.76]	**<.001**
	Gender (ref: man)	1.19 [.84–1.68]	.33
	Age	.99 [.97–1.01]	.27
	Group x Education (ref: high)		**.03**
	Group x Low	2.55 [1.03–6.27]	**.04**
	Group x Medium	2.47 [1.15–5.30]	**.02**
	Group x Diagnosis (ref: CVD)		.28
Block 3	Group x Cardiac disease	1.85 [.87–3.95]	.11
	Group x Vascular disease	1.56 [.60–4.08]	.37
	Group x Meaning in life	1.10 [.58–2.07]	.77
	Group x Woman	.99 [.49–2.01]	.98
	Group x Age	1.02 [.98–1.05]	.35



Logistic regression was entered in three blocks: Block 1 (goal-setting condition: HG vs LHG); Block 2 (main effects of socio-demographic/health variables); Block 3 (interactions between condition and those variables). For clarity, only effects from the relevant block are shown together. The x-axis shows direction: OR > 1 indicates higher odds of high intention; OR < 1 indicates lower odds. Group, goal-setting condition (0 = health-goal-group, HG; 1 = life-and-health-goal-group, LHG); Education, education level; Diagnosis, cardiovascular diagnosis; CVD, cardiovascular disease.

Figure 2. Proportion of patients with high intention (scores 9-10) by education and goal-setting condition.



Error bars show 95% confidence intervals. Asterisks indicate significant differences between HG and LHG within education level ($p < .05$). HG, health-goal group; LHG, life-and-health-goal group.

Discussion

This study examined goal setting in CVD patients. In brief, three patterns emerged. Patients mostly preferred life goals focused on their personal health, their family, and their relationship. Regarding health goals, exercise goals were most frequently selected, by over two-thirds of patients. When life goals were linked to health goal setting, the prevalence of selecting stress management as a health goal was higher. Contrary to our primary hypothesis, we found no significant direct impact of goal-setting condition on patients' intention-to-change-lifestyle, and we therefore reject the primary hypothesis of a main effect. In exploratory analyses, the linkage between life and health goals was associated with more than twofold higher odds of high intention among lower- and medium-educated patients.

The higher selection of stress management is clinically relevant as CVD patients frequently experience a broad spectrum of psychological distress, which has been shown to adversely impact their well-being (26) and can act as a trigger for acute CVD events (27). Therefore, addressing stress management as part of a comprehensive approach to managing CVD and promoting better health outcomes is highly advisable (28,29). Our findings also underscore the nuanced nature of goal setting in CR, emphasising the need to tailor strategies to encompass both medical and psychosocial aspects of patient care.

In contrast to our hypothesis, we observed no overall difference between HG and LHG in intention-to-change-lifestyle. This may be due to high post-task intention in our sample as well as sample characteristics such as higher wellbeing, older age and higher education (30), hence, adding an explicit life goal may have provided little additional benefit over standard health-goal setting. Still, further exploratory analyses indicated that linking life and health goals may be most beneficial for patients with lower and medium education levels, as it was associated with higher intention-to-change-lifestyle in these groups, but not among those with high education. This aligns with research suggesting that personalisation and contextualisation of health goals can motivate lifestyle changes (15,28,31–33). An explanation may be that daily demands and stressors may compete with attention to abstract, higher-order goals for some patients, particularly those with lower education levels (33,34). This, however, can lead to damaging health-related decisions in the long term (35). Consistent with this, patients with lower education were less inclined to demonstrate high intention than those with higher education. Making the link between life and health goals explicit might help translate personal values into concrete behavioural steps for this population. This tentative interpretation requires confirmation, including replication of subgroup findings, to determine whether effects extend beyond intention-to-change-lifestyle.

Finally, several socio-demographic or health-related factors impacted patients' intention-to-change-lifestyle. Higher perceived meaning in life showed a robust main effect, as it was associated with a twofold higher odds of high intention, and did not interact with group, indicating a consistent association across both conditions. This highlights the importance of patients' having a sense of purpose when motivating them to pursue lifestyle changes. However, it is also possible that a lower sense of meaning in life is associated with increased depressive symptoms, which are highly prevalent among cardiovascular patients (36). Given that depressive symptoms are known to reduce motivation for lifestyle changes, they may partially explain the observed association between meaning in life and intention-to-change-lifestyle. Future studies should include depression screening to clarify this link. Age and gender neither predicted intention nor moderated the group effect.

Taken together, these findings suggest the potential value of explicitly linking life and health goals in routine consultations. In line with patient-centred health care (5), by structuring conversations to deliberately relate life goals to health goals, health care professionals can create a more personalised health care plan to align treatment with individual priorities to encourage patients to commit to lifestyle changes, thereby potentially improving the efficacy of the management of CVD. Such tailoring is particularly important in behaviour-change programmes, where goal setting is a cornerstone technique (37), and differs by socioeconomic position (SEP) (38). In CR, the same pattern is seen: lower education, often

a marker of lower SEP, relates to poorer perceived health and outcomes (33). People with lower SEP report worse perceived health and health outcomes across multiple measures compared to those with a higher SEP (39). This discrepancy is concerning, as people with lower SEP are underrepresented, drop out more, and benefit less when they do participate (34,40). Our results add a new dimension to this research by revealing that patients with lower and medium education levels were associated with 57% and 44% lower odds, respectively, of having a high intention to change their lifestyle than those with higher education. This underscores the need for targeted, personalised goal-setting approaches to effectively address and reduce socioeconomic health disparities (2,41).

Strengths and limitations

Our study had several strengths and limitations. We examined a large sample of CVD patients across the Netherlands. The design pioneers the investigation of contextual factors that influence goal setting in real-life cardiac care, helping to fill a significant knowledge gap. Finally, this study utilises the current European Guidelines on Prevention of Cardiovascular Disease in Clinical Practice, with specific recommendations for goal setting in CVD patients.

Concerning limitations, the sample was mostly men and highly educated, limiting the generalisability to other populations. Whilst the gender distribution is representative of CR patients in the Netherlands (42), the educational background may not be. Second, the *Wat ertoe doet* tool, used in the LHG group, may have facilitated structured reflection, potentially influencing engagement. Third, health goals were categorised based on the observable behaviour described, regardless of the lifestyle domain selected by the participant. Whilst this behaviour-based coding allowed for consistent analysis of goal content across participants, it may obscure how participants themselves intended to link certain behaviours with specific lifestyle domains. Future research could analyse domain choice and behavioural goal content separately to better understand these subjective linkages. Fourth, the HG group functioned as an active usual-care control; without a no-goal or information-only group, absolute effects versus no intervention cannot be estimated. In addition, we did not include a self-report manipulation check; future studies should add a brief item to verify perceived linkage. We also measured Meaning in Life only post-task, which precludes mediation tests and limits inferences about change; future studies should assess Meaning in Life both pre- and post-task and include longitudinal behavioural outcomes. Fifth, intention-to-change-lifestyle was already high at the single post-task assessment in our sample. Whilst intention is a known predictor of behaviour (16), there is an intention-behaviour gap (43). Future research could assess whether linking life goals to health goals translates into measurable health outcomes (e.g., weight loss, blood pressure improvements, fitness levels) (44). Finally, to limit burden we did not assess current behaviours, time since diagnosis or CR

participation, and, as an online experiment, we lacked detailed clinical data (e.g., BMI, comorbidities, prior rehabilitation). Including these factors in future studies will help optimise timing and clarify effectiveness across patient subgroups.

Future directions

Successful implementation of goal-setting strategies in CR requires a structured life-goal tool (e.g. *Wat ertoe doet*) that supports both patients and health care providers, with attention to intake procedures, staff training, and optimal timing within the CR pathway. Future studies should include an information-only/no-goal arm to estimate the absolute added value of goal setting.

Our findings also align with Motivational Interviewing (MI), which links behaviour change to personal values and goals. Explicitly linking life and health goals may enhance intrinsic motivation, particularly among lower- and medium-educated patients, consistent with their higher intention-to-change-lifestyle. Similar to MI, this approach empowers patients to take an active role in managing their health, including factors such as stress levels. This, in turn, may increase the likelihood that intention translates into action. However, as seen in MI interventions, an intention-behaviour gap remains. Future work should test life-health goal linkage combined with goal monitoring, feedback, cognitive restructuring, and stress management to optimise outcomes. As with MI preceding more intensive therapy, this goal-setting method could serve as a first step in personalised CR before interventions such as Cognitive Behavioural Therapy (45), setting the stage for more profound behaviour change.

Finally, our findings share similarities with concepts from structured stress-management programmes (46), as our approach focuses on improving well-being by integrating personal life goals into behaviour change strategies. The greater uptake of stress-management goals in the LHG suggests potential benefits for stress-related outcomes. Future research could test our goal-setting approach in combination with validated stress-management techniques (e.g., mindfulness-based stress reduction) to enhance CR effectiveness.

Conclusion

Whilst the direct effect of goal-setting condition on intention-to-change-lifestyle was non-significant, this study provides valuable insights for cardiac clinical practice. It suggests the potential utility of personalised goal-setting approaches in facilitating lifestyle changes in patients with CVD. We observed practice-relevant signals: life-goal linkage was associated with a higher prevalence of selecting stress management, and exploratory analyses showed a higher intention-to-change-lifestyle among patients with lower and medium levels of education. This may imply a need for more structured conversations between health care

professionals and patients, especially for those with lower and medium education levels. This individualised approach to health care may enhance disease management and overall patient well-being. To implement personalised goal-setting strategies within clinical practice, health care providers benefit from practical information on goal setting at different hierarchical levels, its interconnecting impact, and the significance of personalised, value-based goal setting for different patient groups.

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Appendix A

What matters tool by Harteraad (2013).

What matters

"NOW I **know what matters** to me!"

Answer the **4 questions** on this website. Then, you will know better **what matters to you** in your life. This helps when you **talk** to your **healthcare provider** and the people around you. This way, you can make **choices** more easily. And receive the **healthcare** that **suits your life NOW**.

Start the questions

Question 1	Question 2	Question 3	Question 4
What is important to me in life?	What is important to me in life NOW?	What do I want to be able to do?	What do I need, to be able to do this?

After clicking on the 'Start the questions' button, the first question appears on a new screen.

Question 1. What is important to me in life?

View the **9 topics**. **Click** on up to **3 images**.

My family



My personal health



My mental health



My home and neighbourhood



My daily life



My independence



My relationships



My friends



My personal growth



After selecting up to three images, for instance, 'My personal health' and 'My independence', and clicking the 'Next question' button, the second question appears in a new screen.

Question 2. What is important to me in life NOW?

Click on **1 image**.*

My personal health



My independence



**All selected options from Question 1 are displayed, for example, 'My personal health' and 'My independence'. After selecting one final option, for example, 'My personal health', and clicking the 'Next question' button, the third question appears on a new screen.*

Question 3. What do I want to be able to do?

'My personal health' is important to me in life **NOW**.

Type below what you want to be able to do:

Examples from others*

'Picking up my sport.', 'Being able to walk the dog.', 'Cycling to school with my child.'

**When typing something in the yellow text box, all given examples disappear.*

After typing an answer in the yellow bar, for example, 'Walking in the woods with my family.' and clicking the 'Next question' button, the last question appears on a new screen.

Question 4. What do I need, to be able to do this?

Click on up to **2 images**.

Having energy



Being able to exercise or play sports



Feeling relaxed



Being content with myself



Speaking fluently



Thinking clearly and being able to remember things



Feeling confident



Being able to do things by myself



Having fewer symptoms



Being able to have fun



After selecting 1 or 2 images and clicking on the 'Next question'-button, the final page of the tool appears.

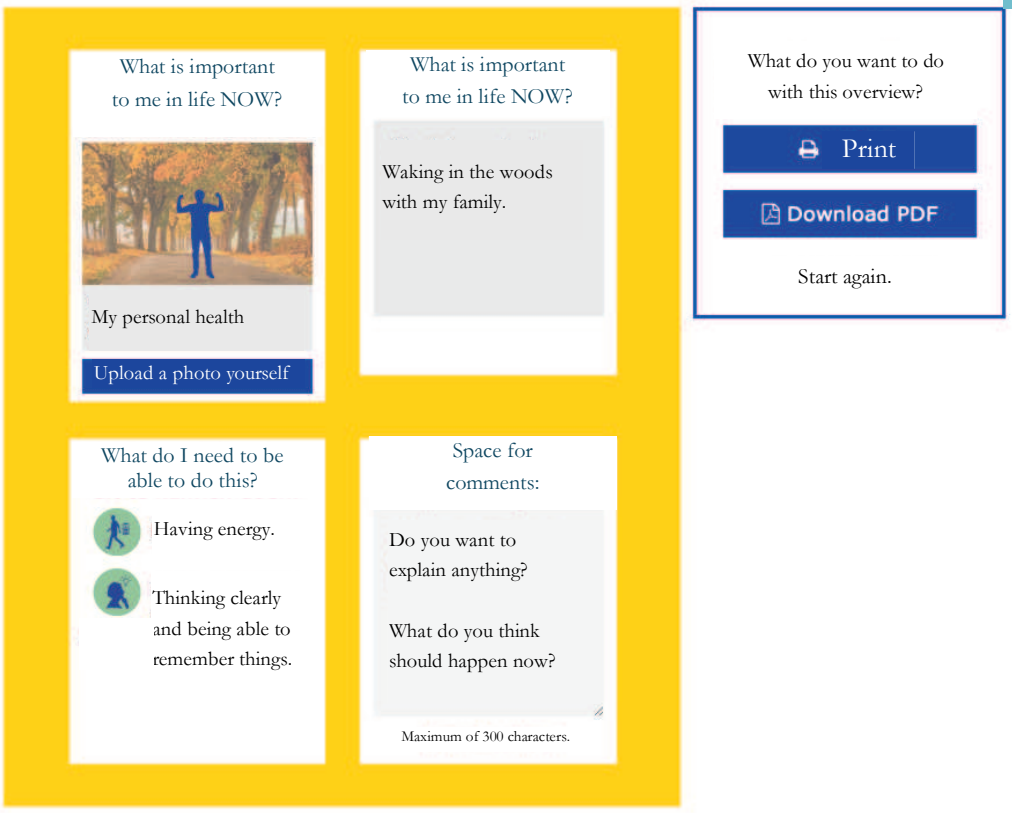
Overview: What matters in my life

You're done! Below are the **answers** to questions 1 to 4.

You can also **type** in **comments**.

Keep the summary for **yourself**.

Or **talk** about it with your **healthcare provider** and the **people around you**.



- ✅ Discuss 'What Matters' with your loved ones
- ✅ Keep the printout in a visible place (message board, fridge door, home screen laptop...)
- ✅ Every now and then, reflect on whether you are doing enough of what matters to you
- ✅ Repeat the 4 steps if something else is (also) important in your life now
- ✅ Take the printout to your healthcare professional
- ✅ Discuss it together, explain where necessary
- ✅ Keep the printout as a basis for further discussion

Appendix B

Chosen life goal domains and life goal examples in the life goal group (n = 306).

Life goal domain	n (%)	Examples of formulation of life goals
My personal health	106 (34.6)	'Being able to move well.' 'Being able to continue doing what I have been doing.' 'Living without physical discomfort.' 'Being able to fully resume my work and still have energy to spare.' 'I want to improve my physical condition to make it easier to recover after physical activity.'
My family	97 (31.7)	'Being and remaining an active mother and grandmother.' 'Seeing my grandchildren grow up.' 'Being there for my family members in times when things are not going well, enjoying when things are going well, enjoying my grandchildren.' 'Creating a beautiful life with my family.' 'Keeping in touch with my kids and grandkids often.'
My relationship	36 (11.8)	'Paying enough attention to each other.' 'Growing old together.' 'Taking care of my partner when they need it and allowing her to care for me when necessary. Looking out for each other and enjoying our time together.'
My well-being	29 (9.5)	'I want to feel relaxed and free to fill my days. No stress, no harm.' 'Having more mental energy, feeling relaxed and happy. From there, other things that I find important come into motion. Otherwise, it will not work in those areas either.' 'Feeling calm and balanced.'
My independence	17 (5.6)	'Being able to go anywhere and meet people, meet again for outside drinks, and hold meetings not via the omputer.' (due to covid) 'Being able to go anywhere independently.'
My daily life	13 (4.2)	'Being meaningfully engaged in voluntary work.' 'Being in harmony with my surroundings.'
My personal growth	5 (1.6)	'Being able to follow a new training course.' 'Gaining more confidence in my faith.'
My friends	2 (0.7)	'Being in contact with friends frequently.' 'Being able to sing with my quintets. Was important, is important, but I'm not able to right now.' (due to covid)
My home and neighbourhood	1 (0.3)	'Staying at home and socialising with my neighbours during this covid time.'

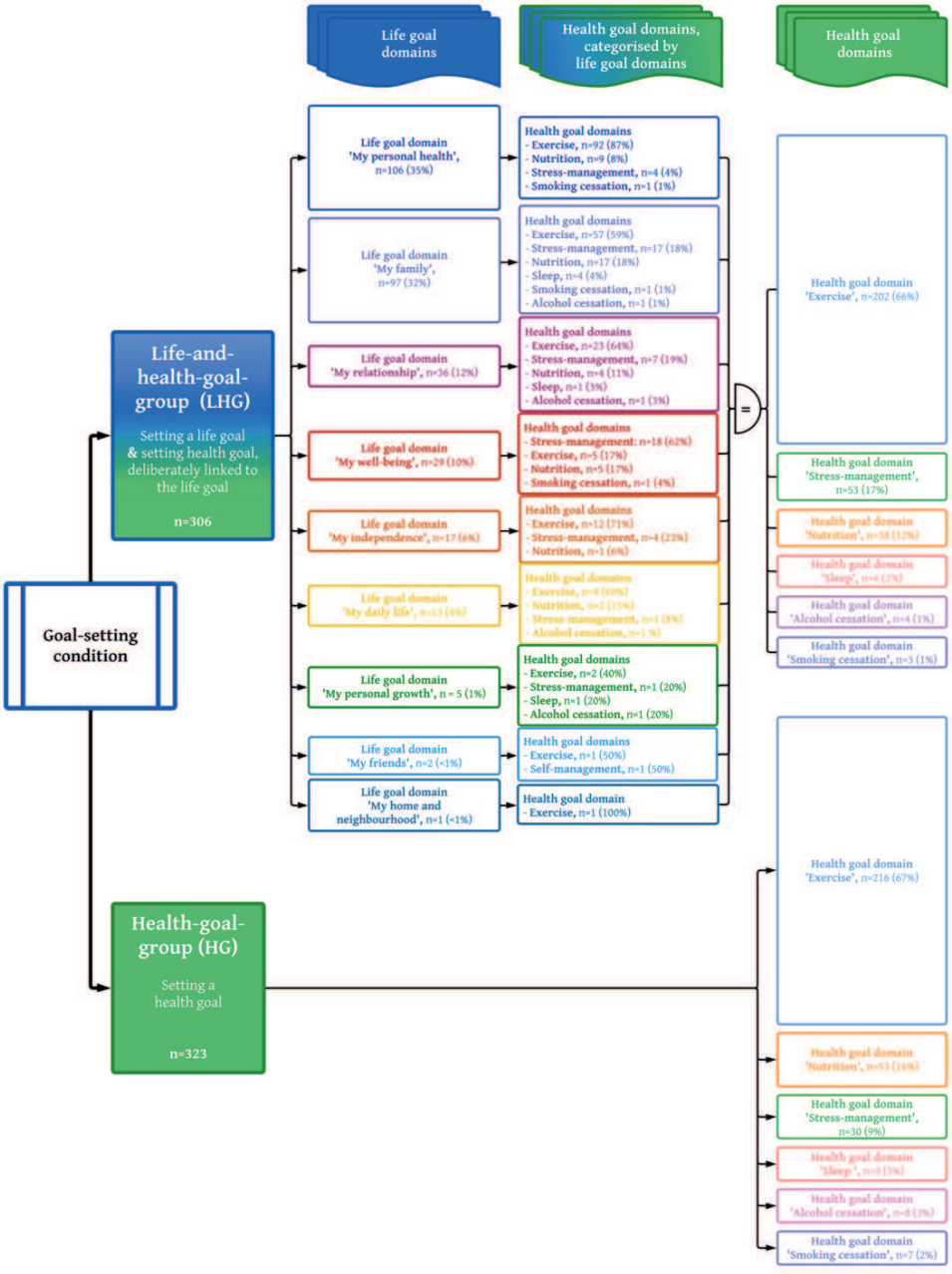
Appendix C

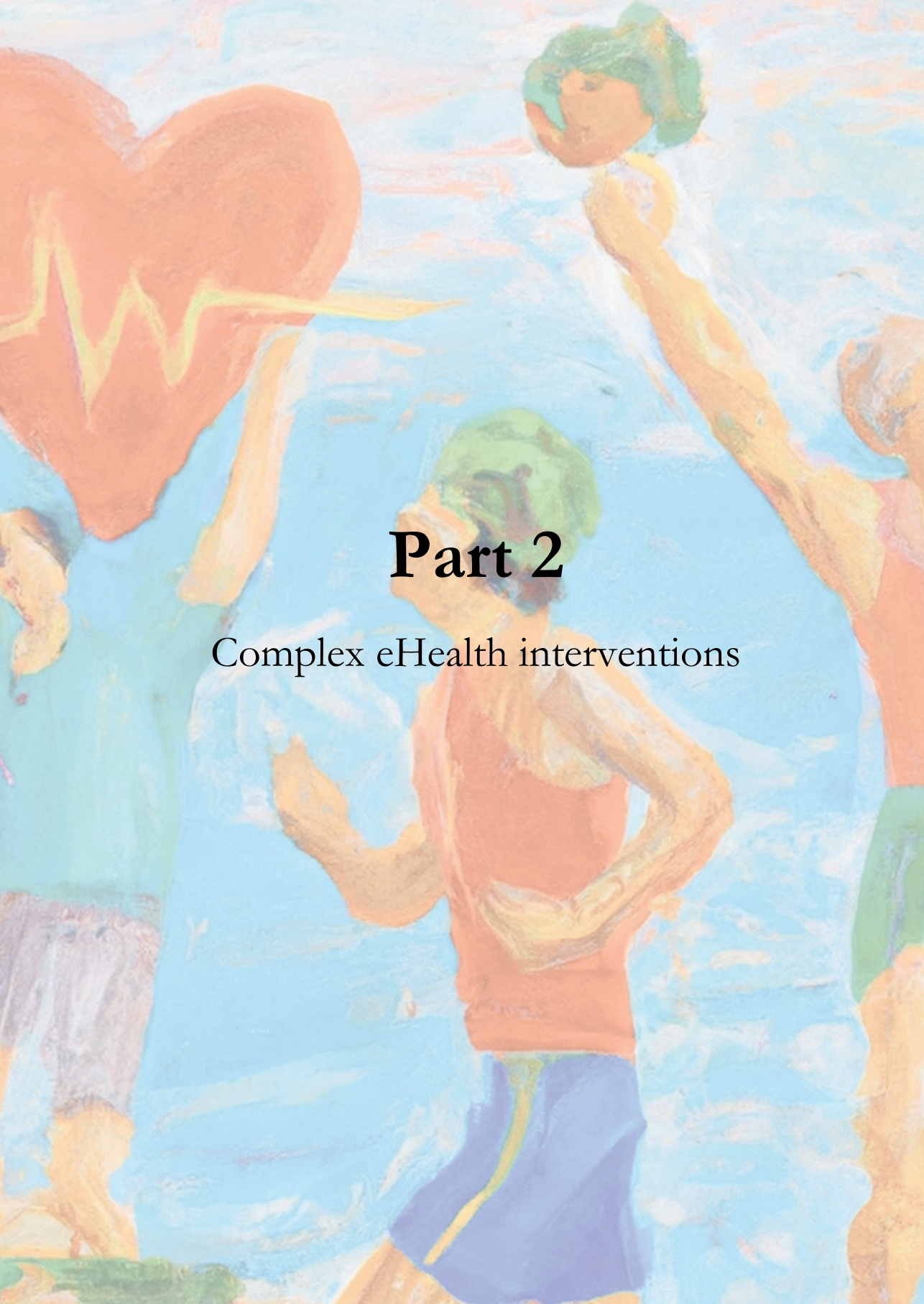
Chosen health goal domains and health goal examples in both goal-setting groups (N = 629).

Health goal domain	n (%)	Examples of formulation of health goals
Exercise	418 (66.5)	'Doing something in the garden every day. Large garden!' 'One hour of daily exercise (walking, cycling, exercises).' 'Go for a walk every day. Doing morning exercises. Practising tai-chi.' 'Keeping my physical condition in good shape by walking, cycling and eating healthy.' 'Exercising every day, walking in winter and cycling in summer.' 'Staying active and avoid sitting on the couch, running errands on foot when I can.'
Stress management	83 (13.2)	'No phone or anything, just doing my thing without being bothered.' 'Enjoying nature, art and music.' 'Learning to let go of my work more by doing relaxation exercises or joining a yoga group.' 'Building in daily moments of relaxation.' 'Taking more rest, not always going on and on.'
Nutrition	91 (14.5)	'Putting fewer tablespoons of food on my plate a few meals a week.' 'No eating fatty sweets, except on special occasions. Not indulging in too many biscuits, chocolate, etc.' 'I do not eat meat, and almost everything is organic, few dairy products, only cheese, hardly any alcohol, I do eat liquorice, but that is not good for your blood pressure... well…' 'Eating fruit and vegetables every day, and don't overeat.' 'No more unhealthy snacks in between meals.'
Sleep	15 (2.4)	'Going to bed on time.' 'Do not start worrying when I wake up at night.' 'Sleeping through the night.'
Alcohol cessation	12 (1.9)	'No alcohol during the week.' 'Only an occasional glass of wine.' 'During the week, no more than one glass of alcohol a day.'
Smoking cessation	10 (1.6)	'Trying to smoke one cigarette less every day.' 'Quitting smoking.' 'Keeping up the habit of never lighting a cigarette again.'

Appendix D

Selected life goals and health goals, divided by goal-setting group.





Part 2

Complex eHealth interventions

Chapter 4

An iterative approach to developing a multifaceted implementation strategy for a complex eHealth intervention within clinical practice

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Abstract

Background: The number of complex eHealth interventions has increased considerably. Despite available implementation theory outlining well-designed strategies, implementing complex interventions within practice proves challenging and often does not lead to sustainable use. To improve sustainability, theory and practice should be addressed during the development of an implementation strategy. By subsequently transparently reporting the executed theory-based steps and their corresponding practice findings, others can learn from these valuable lessons learned. This study outlines the iterative approach by which a multifaceted implementation strategy for a complex eHealth intervention in clinical practice was developed, tested and refined.

Methods: We implemented the BENEFIT programme, an advanced eHealth platform with Personal Health Portal facilitating healthy living in cardiac patients. In six iterative phases alternating between theory and practice, the implementation strategy was developed, tested and refined. The initial implementation strategy (phase 1) was drawn up using the Implementation of Change Model and RE-AIM. Subsequently, this strategy was further updated in brainstorming sessions and group discussions with twenty key stakeholders from three cardiac care centres and then evaluated in a pilot (phases 2 and 3).

Results: The pilot of the programme led to the identification of (context-specific) key challenges in practice (phase 4), which were subsequently connected back to broader theory (phase 5) using the Consolidated Framework of Implementation Research (CFIR). In the final phase, practice recommendations tackling the key challenges were formulated (phase 6) based on CFIR theory, the CFIR-ERIC Matching Tool, and stakeholders' input and feedback. These recommendations were then added to the refined strategy. Thus, executing this approach led to the realisation and use of a multifaceted theory-informed practice-based implementation strategy.

Conclusion: This case study gives an in-depth description of an iterative approach to developing an evidence-based, practice-tailored strategy for implementing a complex eHealth intervention in cardiac care. As such, this study may serve as a blueprint for other researchers aspiring to implement complex eHealth interventions.

Background

Reducing cardiovascular disease (CVD) is a global health priority. Through innovative use of technology-based interventions, known as complex eHealth interventions, patients with CVD can be supported in improving their health and lifestyle behaviour at various stages. During hospitalisation (phase I), eHealth can offer tailored information and resources, preparing patients for future trajectories and providing personalised health information and communication channels with healthcare providers. During cardiac rehabilitation (CR) (phase II), eHealth interventions and remote monitoring can stimulate recovery. They significantly benefit duration of physical activity, daily steps, quality of life, and re-hospitalisation during this phase (1). As achievements of CR should be consolidated in the long term (phase III), eHealth interventions offer ongoing support, medication reminders, and telehealth consultations to ensure continuity of care to further empower patients and improve CVD healthcare delivery. During this phase, research has shown significant benefits of eHealth interventions on health outcomes; they stimulate physical activity, improve exercise, increase quality of life, and decrease systolic blood pressure (2).

In the last decade, the number of eHealth interventions has increased considerably. Unfortunately, these initiatives often do not lead to sustainable use, as implementation within practice proves challenging, even when using available implementation theory. Lack of knowledge about conditions for sustainable use within practice has been labelled as "one of the most significant translational research problems of our time" (p.2) (3). Understandably, implementing innovative and complex interventions has been shown to pose several challenges. One primary reason is that deployment of complex eHealth interventions is characterised by using multiple interacting features or user groups, within the context of social systems and structures that evolve continuously (3,4). These external factors significantly influence individual characteristics and behaviours (4). Furthermore, the complexity arises from the multiple interplay of behavioural, technological, and organisational components (5), which have unclear, non-linear dynamics and thus require coordination on many levels to become effective (5–7). Other challenges regularly include costs, lack of fit within the organisation, stakeholders not collaborating closely, and poor planning (6,8–11).

Research has shown that multifaceted implementation strategies tailored to the targeted environment and population contribute to the adoption of interventions and sustainable use in the long term (12–14). An implementation strategy has been described as "a systematic intervention process to adopt and integrate evidence-based health innovations into usual care." (Powell et al., 2012, p.124) (15). Implementing interventions using well-designed multifaceted implementation strategies is especially relevant for complex eHealth

interventions. Moreover, as recently stated by the Standards for Reporting Implementation Studies (StaRI) initiative (16,17), there is an urgent need for transparent and thorough reporting of strategies used to implement complex health interventions. Since then, a growing group of researchers and stakeholders reported the development and execution of their implementation strategies to let others build on their lessons learned (18,19). This way, the adoption and implementation of new interventions can become more effective and efficient, which contributes to improving health at the individual and societal levels (20). Building on the call for transparency and thorough reporting, our case study describes the iterative approach by which a multifaceted implementation strategy for a complex eHealth intervention in routine cardiac care was developed, tested and refined.

The BENEFIT programme

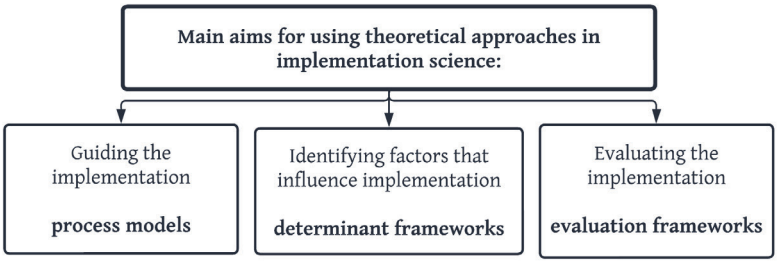
The BENEFIT for all intervention programme (in short: BENEFIT programme) is a complex eHealth intervention, designed as a blended care approach, aimed at promoting and supporting sustainable healthy living among people with CVD in the Netherlands. Patients are actively engaged in following online lifestyle interventions and challenges. In addition, healthcare providers play a pivotal role by providing healthcare services, guidance, and coaching throughout the entire process.

Core to the BENEFIT programme is access to an advanced eHealth platform with Personal Health Portal (PHP). The PHP provides access to (evidence-based) lifestyle interventions, daily goal monitoring, personal coaching, and a rewards programme aimed at encouraging a wide range of health behaviours and adherence. These lifestyle interventions can be tailored to end-users' needs and preferences. Moreover, self-management of a healthy lifestyle is promoted by encouraging patients to measure health indicators (such as blood pressure) themselves at home (21,22). Patients enrolled in cardiac CR receive the BENEFIT programme from the start of their CR trajectory (phase II) as an addition to standard care. This way, healthcare providers can provide patients with information, feedback, and remote healthcare, and facilitate them in selecting suitable lifestyle interventions. After the standard rehabilitation programme has ended, patients can continue to use the BENEFIT programme (phase III). As a structured process combines patient input and clinical assessment to align lifestyle interventions with the patient's needs, this process can therefore take place without the guidance of a healthcare provider. Patients are asked to complete questionnaires that focus on health-related topics and actively monitor their health-related values from the start and throughout the use of the programme. These data serve as valuable data points for personalisation. For instance, if a patient indicates smoking in their questionnaire responses, this information is captured and flagged within the system, and the patient is then offered a smoking cessation programme as part of their personalised intervention plan.

Selection of suitable theoretical approaches

As the BENEFIT programme concerns a complex eHealth intervention implemented within routine cardiac care, it was crucial to develop a multifaceted implementation strategy firmly rooted in theory. Subsequently, the strategy needed to be adaptable to the unique dynamics of stakeholders' environments, work settings, daily routines, and expectations. To establish a strong theoretical foundation, our selection of relevant implementation frameworks was guided by a review by Nilsen and colleagues (12) which identifies three aims of using theoretical approaches in implementation science (see **Figure 1**). These goals are to guide the implementation using a process model, identify factors influencing the implementation process using a determinant framework, and evaluate the implementation using an evaluation framework. By choosing a multi-deployable approach for the development of the BENEFIT implementation strategy, support and guidance would be given during all parts of the process; the development and operationalisation of the implementation strategy, implementation of the intervention programme in routine cardiac care, as well as adaptation of the developed implementation strategy.

Figure 1. Main aims for using theoretical approaches in implementation science, described by Nilsen et al. (2015).



Three frameworks were selected as the foundation for the BENEFIT implementation strategy: the Implementation of Change Model (23) (process model), the Consolidated Framework of Implementation Research (CFIR) (24) (determinant framework), and RE-AIM (25,26) (evaluation framework). The Implementation of Change Model was selected to provide a systematic approach to implementation planning and execution. As leading authors within implementation science, Grol and Wensing's Implementation of Change Model contains seven steps that guide the implementation of complex interventions within the healthcare setting whilst considering the practice's complexity; (i) Development of proposal for change, (ii) Analysis of actual performance, targets for change, (iii) Problem analysis of target group and setting, (iv) Development and selection of strategies and measures to change practice, (v) Development, testing and execution of implementation plan, (vi) Integration of changes in routine care, and (vii) (Continuous) evaluation and (where necessary) adapting

plan. As combining top-down and bottom-up approaches is essential to realise implementation within practice, all steps of the Implementation of Change Model were considered during the development and refinement of the BENEFIT implementation strategy.

Subsequently, the CFIR was selected to identify key factors and conditions influencing implementation. The CFIR is a meta-theoretical framework; it comprises several determinant frameworks and relevant theories from different disciplines, leading to the identification of five domains and 39 associated constructs, namely (i) Intervention Characteristics: such as Complexity and Adaptability, (ii) Outer Setting: such as Peer pressure and External policies and incentives, (iii) Inner Setting: such as Network and communications and Culture, (iv) Characteristics of Individuals: such as Knowledge and beliefs about the intervention and Self-efficacy, and (v) Process: such as Planning and Engaging. As the CFIR facilitates systematic analysis and consistent use of its constructs, it can be adapted to many contexts and has often been used to implement and evaluate complex health implementations. Therefore, the CFIR is suitable for identifying influencing factors during the implementation process of the BENEFIT programme. Subsequently, the selection of discrete implementation strategies (i.e., frequently described implementation actions consisting of one specific process or action to facilitate implementation, such as technical assistance, digital reminders, and educational training) is possible. By adding discrete implementation strategies to the implementation strategy, influencing factors within practice can be anticipated, and further optimalisation of the multifaceted implementation strategy is realised. Finally, the widely used evaluation framework RE-AIM, an acronym for Reach, Effectiveness, Adoption, Implementation, and Maintenance, was selected to provide a systematic approach to the operationalisation of different aspects of the implementation evaluation by using their online planning tool (27). To illustrate, indicators for Implementation included a timeline for implementation of the programme, user (patient) inclusion, interim feedback moments, evaluations from both health care provider perspective and patient perspective, and the number of adjustments that are made.

Aim of the study

This case study describes the iterative development, evaluation, and improvement of the implementation strategy for the BENEFIT intervention programme, a complex eHealth intervention within routine cardiac care.

The objectives of our case study are:

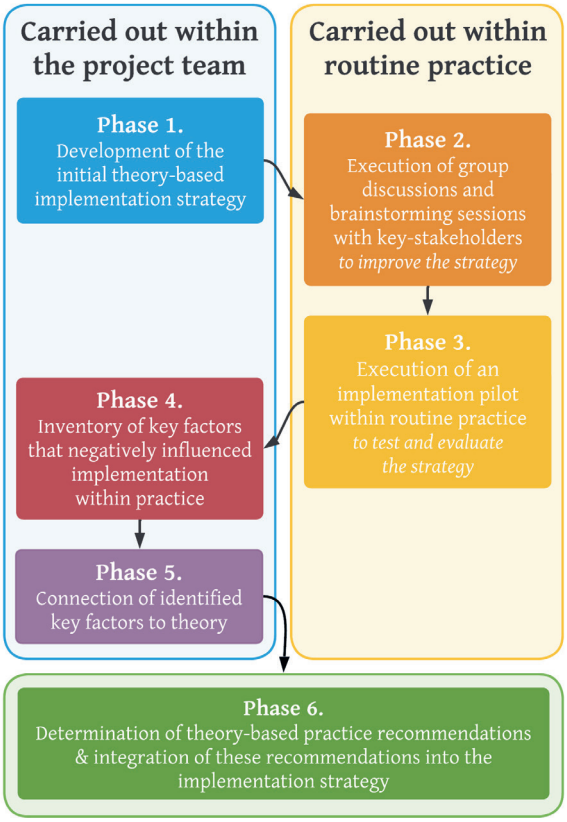
1. Combining theoretical approaches of implementation science within practice, and alternating between theory and practice during the development process of the implementation strategy, to identify key challenges, named key factors, negatively influencing the implementation within practice, and anticipate them by adding evidence-based discrete implementation strategies.
2. Using this iterative approach, the translation of a theory-based strategy into a strategy that also works in practice because it fits the stakeholders' environment, working conditions, daily operations, and expectations can be realised.
3. Transparently and thoroughly reporting of the entire development process of the BENEFIT implementation strategy, our presented approach can be used as a blueprint for other researchers who aspire to implement a complex eHealth intervention sustainably.

Methods

Developmental phases of the BENEFIT implementation strategy

The development of the implementation strategy comprised six chronologically executed phases in which the three selected implementation frameworks are integrated. **Figure 2** shows all development phases of the implementation strategy. The phases in which elaboration or application of theory takes place, namely 1, 4, 5, and 6, are solely carried out by members of the BENEFIT research project team (due to a public-private partnership, the project group consists of both researchers and health care providers). The remaining phases, namely 2 and 3, are carried out in collaboration within organisations within routine practice, namely two CR clinics and a hospital's cardiac department, to improve, test, and evaluate the implementation strategy.

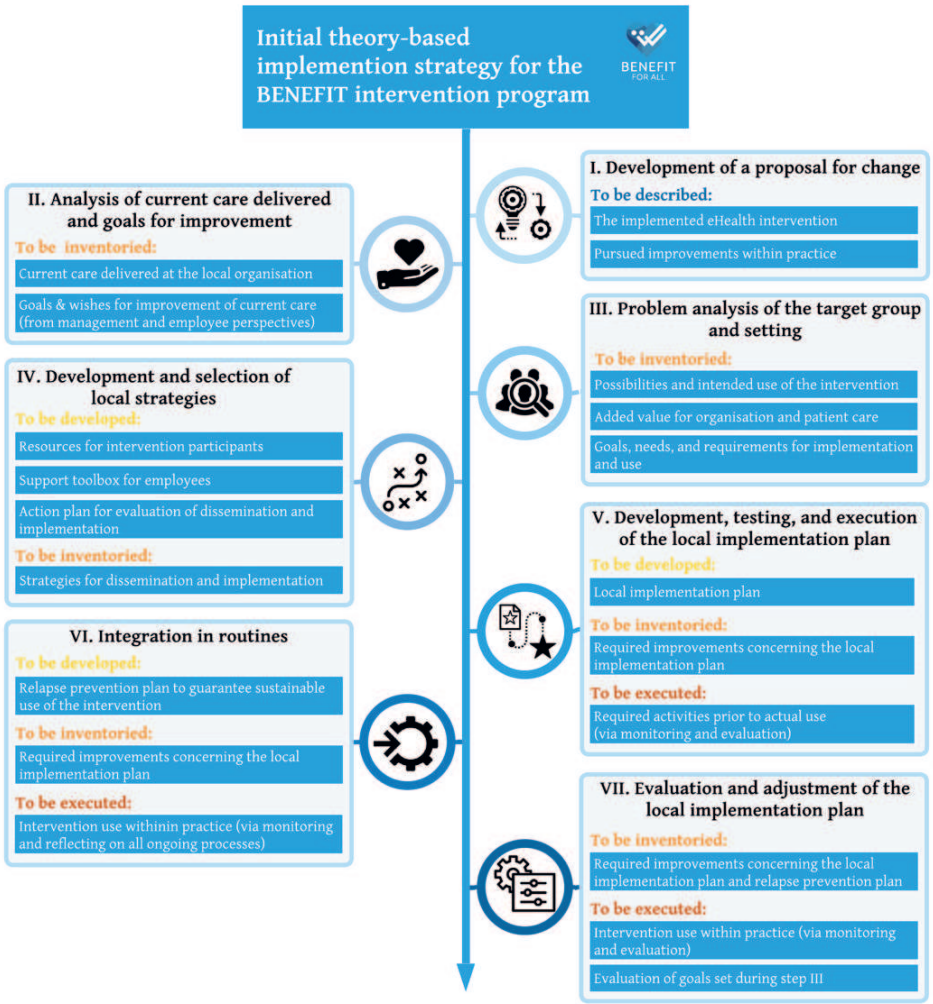
Figure 2. Six-phase approach to developing the BENEFIT implementation strategy.



Phase 1. Development of the initial theory-based implementation strategy

The foundation of the initial implementation strategy, carried out by three researchers from the BENEFIT research project team in 2018, was based on combining the Implementation of Change Model by Grol and Wensing and the evaluation framework RE-AIM. All seven steps of the Implementation of Change Model were elaborated to develop a clear step-by-step plan for the initial implementation strategy. In addition, RE-AIM was used by integrating its relevant implementation outcome indicators into the strategy (27) and expanding and substantiating the parts in the 7-step process that focus on adoption, implementation, and maintenance. **Figure 3** depicts the initial implementation strategy (see Phase 1 in **Figure 2**).

Figure 3. Result of phase 1: the initial theory-based implementation strategy.



Phase 2. Execution of group discussions and brainstorming sessions to improve the strategy

After developing the initial strategy, input from twenty key stakeholders was asked to further operationalise and adapt the implementation strategy (see Phase 2 in Figure 2). To illustrate, in our case study, three organisations were involved during this phase (spread over a year from the second half of 2018): two CR clinics and a hospital's cardiac department. These organisations met the established inclusion criterion, namely financial agreement by the organisation's management regarding purchasing the necessary software for the BENEFIT programme. Key stakeholders held various positions, namely, (i) health care professional roles (e.g., cardiologists, internists, (specialised) nurses, surgeons, a medical doctor, a physician assistant, a lifestyle coach, and physiotherapists), (ii) administrative and supportive

roles (such as clinic assistants), and finally (iii) the combination of management positions with health care positions (e.g., general directors, directors of business development and operations, combined with the position of, for instance, cardiologist, internist, physiotherapist, and nurse). Depending on their position and the specific focus of the sessions, all key stakeholders participated in (part of) six group discussions and brainstorming sessions to provide input and feedback. During these sessions, members of the BENEFIT research project team executed and tested steps I-IV of the initial implementation strategy. These sessions aimed to assess the overall practicality of the developed initial implementation strategy by the BENEFIT project members involved, and to directly discuss perceived barriers or unclarities in the operationalisation of the developed strategy with the participating stakeholders. Among others, it was found that healthcare providers desired more comprehensive information regarding the BENEFIT programme. They also wished for clear communication that lifestyle change is not a replacement for current care, but rather a complement that can lead to even better outcomes. Additionally, they sought an extensive explanation of how behavioural and lifestyle changes operate at the meta-level. By executing Phase 2 of the six-phase approach, the first round of improvement of the operationalisation of the initial strategy, tailored to the needs and contexts of the stakeholders within practice, was realised. These adjustments and improvements made by the BENEFIT team members were set out in different working documents.

Phase 3. Execution of an implementation pilot to test and evaluate the strategy

After improving the initial implementation strategy, an implementation pilot took place at one of the CR clinics in 2019 (see Phase 3 in **Figure 2**). Eleven employees were involved, namely health care providers and support, administrative and management employees. To demonstrate, the implementation pilot of our case study started with an introductory meeting in which BENEFIT team members presented the benefit intervention programme presentation that was specifically developed for future introductory meetings with other organisations. At the beginning of the introductory meeting, employees were asked whether they agreed to listen to the presentation alternately from two perspectives. In the largest part of the meeting, they were asked to listen to the presentation and to learn about the BENEFIT programme and its' added value for their organisation. However, the presentation would be paused a few times to ask employees to put on their cardboard party hats renamed 'thinking hats' to reflect on how they liked a specific part of the presentation and where improvement was desired. All employees provided input and feedback on the process and content of the introductory meeting.

Following the introductory meeting of the implementation pilot, those employees responsible for the local implementation process carried out the first steps of the initial implementation strategy within practice. To illustrate, local employees formed several small working groups to develop, pilot test, and evaluate specific materials (e.g., patient and health care provider material and resources such as supporting documents, developed protocols, and manuals). During several working group sessions, which were spread over several months following the introductory meeting, members of the BENEFIT research project team were present to report employees' responses directly to help improve the implementation strategy, and by scheduling a fixed feedback moment at the end of each working group session. For example, one of the sessions focussed on evaluating patients' referral to the BENEFIT programme which had taken place in the weeks before. Patients were referred to the BENEFIT programme with a preconceived advice communicated by health care providers, after which they handed over a registration voucher and information folder to the patient. Afterwards, these patients were asked to provide feedback on both the process and the materials. By evaluating the experiences from patients' and health care providers' perspectives, it was possible to optimise the developed materials further. Hence, by conducting Phase 3, it was possible to further test and evaluate the developed implementation strategy in collaboration with key stakeholders within practice.

Results

Phase 4. Inventory of key factors negatively influencing implementation within routine practice

To further tailor the initial implementation strategy to practice, five members of the BENEFIT research project team made an overview of all influencing factors in practice observed during Phases 2 and 3 (which was set out in a working document shared internally). These influencing factors comprised positive ones that facilitated implementation success and thus did not need resolving, and negative ones that needed to be changed to increase implementation success. In several meetings with members of the BENEFIT research project team and other stakeholders, the barriers were discussed and analysed according to their perceived negative influence on implementation success. Thus, four essential barriers, names key factors, were identified as leading influencers that needed to be anticipated during the implementation. To illustrate, one of these key challenges constituted the finding that implementing all features of the BENEFIT programme proved a challenge in some organisations, as some elements were better suited to certain settings than others. **Table 1** describes the key factors and their influence during the implementation within routine cardiac care (see Phase 4 in **Figure 2**).

Table 1. Result of phase 4: key factors negatively influencing implementation of the BENEFIT programme.

Identified key factor	Explanation of negative influence during the implementation
Implementing all features of the BENEFIT programme proved undesirable within some organisations.	• Whilst pilot testing the programme, some elements of the programme appeared better suited to certain settings than others. • Some organisations preferred blended care, a combination of health care on location and programme use, which required certain programme adaptations.
The way the initial implementation strategy was presented to the target audience proved unsuitable.	• During the first stakeholders' sessions, the presented process steps overwhelmed employees. • They became demotivated or annoyed and stated they did not have enough time available for the required preparation time before using the intervention within practice.
Unclear assignment of roles, responsibilities, and agreements proved an obstacle.	• At the start of the implementation within some organisations, it was difficult to set clear goals and come to mutual agreements. • This brought insufficient clarity of the urgency and execution of specific tasks, which took speed out of the process and caused a decrease in motivation and commitment within the local team.
Employees experienced that their management imposed the BENEFIT programme on them.	• Within some organisations, management had not first discussed the intervention's relevance for employees or their patients, and had not involved their employees in deciding whether to implement the programme. • This made some employees feel unmotivated, not heard, seen, or taken seriously.

Phase 5. Connection of key factors to theory

To further improve the implementation strategy and its effectiveness within practice, the identified key challenges, named key factors, were connected to relevant theory to guarantee scientific substantiation for subsequent strategy adjustments based on these key factors. In our case study, relevant constructs of the Consolidated Framework of Implementation Research (CFIR) that address the key factors were identified using the constructs' detailed description and theoretically substantiated rationale for inclusion in CFIR. To reach a consensus on all relevant constructs, three researchers of the BENEFIT research project team discussed the rationale for possible influencing constructs for each key factor. **Table 2** describes all key factors and their identified relevant domains and constructs (see Phase 5 in **Figure 2**). For example, the first identified key factor, "Implementing all features of the BENEFIT programme proved undesirable within some organisations.", was connected with, among others, construct D. Adaptability (of domain 1. Intervention Characteristics). Since some organisations preferred blended care, programme adaptations such as the integration of the local technological patient system with the patient system of the BENEFIT programme were required. This led to the conclusion that the adaptability of an intervention programme is an important point of attention, since failure to address context-specific needs during implementation reduces the likelihood of successful programme implementation.

Table 2. Result of phase 5: key factors connected to relevant CFIR domains and constructs.

Key factors within practice	CFIR domain	CFIR constructs
Implementing all features of the BENEFIT programme proved undesirable within some organisations.	Intervention characteristics	D. Adaptability E. Trialability F. Complexity
	Characteristics of individuals	B. Self-efficacy C. Individual stages of change
	Process	A. Planning C. Executing
The way the initial implementation strategy was presented to the target audience proved unsuitable.	Intervention characteristics	E. Trialability G. Design quality and packaging
	Characteristics of individuals	B. Self-efficacy E. Other personal attributes (motivation, learning style)
	Process	A. Planning C. Executing
Unclear assignment of roles, responsibilities, and agreements proved an obstacle.	Inner setting	D. Implementation climate
	Characteristics of individuals	B. Self-efficacy E. Other personal attributes (motivation)
	Process	A. Planning B. Engaging
Employees experienced that their management imposed the BENEFIT programme on them.	Intervention characteristics	A. Intervention source
	Inner setting	B. Networks and communications C. Culture D. Implementation climate
	Characteristics of individuals	A. Knowledge and beliefs about the intervention D. Individual identification with the organisation E. Other personal attributes (motivation)
	Process	A. Planning B. Engaging D. Reflecting and evaluating

Phase 6. Determination of practice recommendations to optimise the implementation strategy

After connecting the identified key factors within practice to the corresponding CFIR domains and constructs described in **Table 2**, we identify additional discrete implementation strategies. These identified strategies, referred to as 'practice recommendations', were meticulously crafted to enhance and fine-tune the initial implementation strategy. This refinement was undertaken to ensure that the strategy was better aligned with and more

anticipatory of the identified constructs. This way, further tailoring the initial strategy to the stakeholders' local contexts was realised.

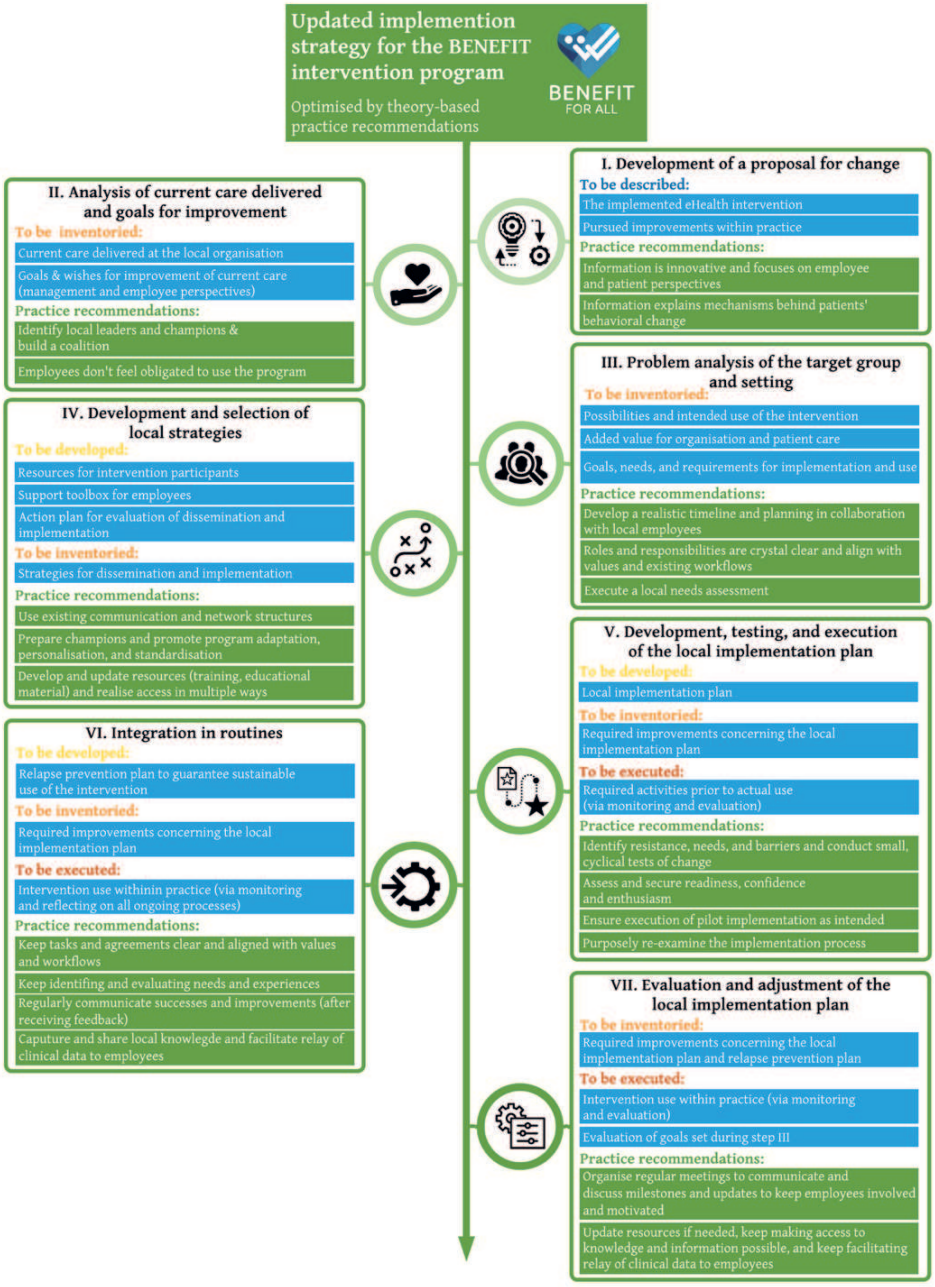
The practice recommendations were collected from both theory and practice by (i) searching the detailed description of all respective constructs (as described in Phase 5) on the official CFIR website for recommended evidence-based implementation strategies to anticipate these constructs, (ii) selecting evidence-based implementation strategies by using the CFIR-Expert Recommendations for Implementing Change (CFIR-ERIC) Matching tool (http://www.cfirguide.org/; accessed on September 6, 2021) (28,29), and (iii) adopting already received input and feedback from key stakeholders during Phases 2 and 3. Subsequently, all practice recommendations were combined to identify which were suitable for multiple constructs. Three BENEFIT research project team members then discussed the practice recommendations and the best place to add them within the initial BENEFIT implementation strategy. Hence, by conducting Phase 6 of the six-phase approach, it was possible to select practice recommendations and integrate them into the initial implementation strategy, to better anticipate the key factors faced during the implementation. **Table 3** describes all selected practice recommendations to anticipate the key factors. **Figure 4** illustrates how these theory-based practice recommendations were integrated into the original initial implementation strategy, thus providing a new, updated implementation strategy (see Phase 6 in **Figure 2**). To demonstrate, in our case-study, during the execution of Phase 2, healthcare providers expressed the need for a comprehensive understanding of how behavioural and lifestyle changes operate at a higher level. In response, we have incorporated the practice recommendation of "Information explains mechanisms behind patients' behavioural change" in Step 1, which involves 'Development of a proposal for change'. Additionally, in Step 4, which pertains to 'Development and selection of local strategies', we have added the practice recommendation of "Prepare champions and promote programme adaptation, personalisation, and standardisation". This practice recommendation aligns with the identified key factor "Implementing all features of the BENEFIT programme proved undesirable within some organisations". For a detailed description of all the steps of the updated implementation strategy, see **Appendix A**.

Table 3. Result of phase 6: practice recommendations to anticipate key factors.

Key factors	Practice recommendations to anticipate the identified key factors[1]
Implementing all features of the BENEFIT programme proved undesirable within some organisations.	• Promote **adaptability of the intervention** (to anticipate the identified constructs) (1D,1F,4C), **tailoring** of strategies (1D), conduct local needs **assessment** (1D,5A), **consensus** of **strategies** (1D) • Identify and prepare **champions** (4B,5A), assess for **readiness** and identify barriers and facilitators (1D,1E,5A,5C), conduct small **cyclical tests** of change (1E,1F) • Develop and implement tools for quality **monitoring** (5A,5C), develop a formal implementation **blueprint** (1F,5A) and a stage implementation **scale-up** (1F) • Develop a **dynamic training** (4B,4C), conduct **ongoing training** (1F,4B,5C), and provide ongoing **consultation** (4B) identify and prepare **champions** (4B,5A)
The way the initial implementation strategy was presented to the target audience proved unsuitable.	• Adaptability (1G), assessment (5A), readiness (1E,5A,5C), blueprint (5A), cyclical tests (1E), dynamic training (4B), ongoing training (4B;5C), champions (4B,5A), consultation (4B), monitoring (5A,5C) • Create learning **collaborative** (4B), develop educational **materials** (IG), develop and implement quality **monitoring** tools (IG), model and **simulate** change (1E), provide technical **assistance** (5C), consumers **feedback** (IG), **re-examine implementation** (5C)
Unclear assignment of roles, responsibilities, and agreements proved an obstacle.	• Conduct local consensus **discussions** (3D), collaborative (4B), team meetings (3D), readiness (3D,5A,5B), assessment (3D,5A), blueprint (3D,5A,5B), ongoing training (4B), consultation (4B), dynamic training (4B), champions (4B,5A,5B), clinical data (3D), monitoring (5A) • Obtain formal **commitments** (5B)
Employees experienced that their management imposed the BENEFIT programme on them.	• Champions (1A,3C,3D,4A,4D,5A), collaborative (3B,3C), feedback (1A,4E,5D), assessment (3D,5A), discussions (3D,4D) materials (4A), adaptability (1A), tailoring (3C), readiness (3C,3D,4D,4E,5A), blueprint (5A), monitoring (5A,5D), re-examine implementation (5D) • Recruit, design and train for **leadership** (3C,3D), build a **coalition** (1A,3B,4D), inform local **opinion leaders** (1A), use **workgroups** (1A,4A), **educational meetings** (1A,4A), organise clinician implementation **team meetings** (3B,3D,5D), capture and share local **knowledge** (4A), facilitate relay of **clinical data** to providers (5D)

[1]The first time a practice recommendation is described, it is described fully with the most crucial keyword(s) displayed in bold. If the same practice recommendation is mentioned again to anticipate another construct that influences another key factor, only that recommendation's boldly presented keyword(s) is/are mentioned. This truncation of the practice recommendations is made to keep the table content manageable.

Figure 4. Final result of phase 6: the updated implementation strategy, optimised by theory-based practice recommendations.



Discussion

This study presents a multifaceted approach for developing an evidence-based and practice-tailored multifaceted implementation strategy. To date, reporting on the development of an implementation strategy for complex eHealth interventions is scarce. By thoroughly describing and reporting the executed iterative developmental process, our presented approach may be used as a blueprint for those who aspire to implement complex eHealth interventions within clinical practice sustainably. During this iterative development process, we have generated knowledge on some of the essential barriers, named key factors, to implementing the BENEFIT programme within routine practice. Four key factors were identified, namely, (i) 'Implementing all features of the BENEFIT programme proved undesirable within some organisations.', as some elements of the programme were better suited to specific settings than others, (ii) 'The way the initial implementation strategy was presented to the target audience proved unsuitable.', as the number of presented theory-based process steps overwhelmed employees from practice, (iii) 'Unclear assignment of roles, responsibilities, and agreements proved an obstacle.', as it brought insufficient clarity of the urgency and execution of specific tasks, which took speed out of the implementation process, and (iv) 'Some employees experienced that their management imposed the BENEFIT programme on them.', as their management had not involved them in deciding whether to implement the programme.

The process of developing and refining a sustainable multifaceted implementation strategy for the BENEFIT programme proved to be quite time-consuming. This was due to several aspects, including selecting suitable implementation frameworks for the initial multifaceted implementation strategy, maintaining contact with the involved organisations within practice, managing and evaluating all implementation phases performed within practice, identifying and anticipating influencing key factors within practice, selecting suitable implementation strategies to anticipate these emerging key factors, and reaching consensus within the BENEFIT research project team throughout the entire development process. However, utilising this iterative approach was vital to realise a practical, realistic, and tailored strategy. It helped confirm which parts of the initial strategy were appropriate and suitable for the local implementation environment, and in addition helped to identify key factors that negatively influenced implementation within practice. Implementation of the BENEFIT programme would have been less successful without anticipating these identified key factors using carefully selected additional evidence-based implementation strategies. Among others, studies have shown that risks of failed implementation are reduced by managing the implementation process adequately, adapting the intervention programme if needed, aligning new roles and responsibilities to existing workflows, and ensuring optimal preparation before using the intervention programme within daily practice (9). To demonstrate, in our case

study, the second key factor 'The way the initial implementation strategy was presented to the target audience proved unsuitable.' was anticipated by developing a different practical strategy that fitted our stakeholders' thinking and working method in collaboration with them. In terms of content, the strategy was still theory-based, however, the way in which the strategy was presented to local organisations was significantly different. To illustrate, after consultation with several key stakeholders, our initial seven-step implementation strategy was conveyed to the local organisations in a simplified three-phased format, namely the self-confidence phase (a), self-regulation phase (b), and self-management phase (c), as these phases are commonly used within patients' CR trajectories and are thus recognisable for the employees from the intended local organisations. Importantly, the content of the strategy remained unchanged; only the mode of communication to employees in the workplace was adapted. This modification, however, rendered the presented theory-based initial implementation strategy more practice-tailored by being recognisable, understandable, and manageable for those involved. In the future, it should become apparent whether this indeed is an effective approach to use within practice.

Lessons learned for future implementation processes within routine practice

The execution of our case study has taught us several lessons. When developing a multifaceted implementation strategy for a complex eHealth intervention, we experienced that it is essential to alternate between theory and practice to create a tailored, realistic, and feasible strategy. Using such an iterative approach ensures that the final multifaceted implementation strategy is theoretically substantiated and fits well with the local organisations where the programme needs to be implemented sustainably. Even though using such an approach can be experienced as inefficient at the time, it is nevertheless strongly recommended by experts because tailoring increases the adherence of health care providers to an intervention by up to 14% (30). Our presented approach, the six-phase development process, may be a blueprint for researchers who aspire to implement a complex eHealth intervention successfully and sustainably. It is worth noting that significant intervals naturally occurred in our approach's development process, as each phase required thorough establishment, elaboration, practical implementation, and findings processing before determining the next phase(s). When utilising a well-developed approach like our six-phase development process, the phase completion timeline substantially shortens. For example, the six phases of our approach can be completed in 4 to 6 months, this includes part of implementation.

Furthermore, when developing an implementation strategy, we found that it is crucial to communicate all implementation steps in a recognisable and manageable way to the intended local organisation. Using this approach increased adherence to the outlined implementation

strategy. Keeping the implementation steps recognisable and manageable can be realised by, for example, conveying it to local organisations in a simplified format that fits the thinking and working method of the stakeholders. This is possible by, for instance, matching the implementation process as closely as possible to a working method that is familiar to employees within the targeted field.

Concerning the execution of an implementation strategy, our research project team has learned several valuable lessons. When executing an implementation strategy, we learned the importance of paying significant attention to successfully communicating the programme's added value for all different groups involved (i.e., patients, health care providers, and other stakeholders) as straightforwardly as possible to the local organisations that will offer the programme to patients. We experienced that if employees involved are not convinced of the programme's added value, their effort and investment needed to practise new tasks will be insufficient to optimise and consolidate the new workflow, regardless of the potential success of an intervention programme. Therefore, we realised that it is essential that the programme's implementation process will be facilitated by involving stakeholders from the field as early as possible to consider their needs and wishes and anticipate potential challenges within organisations.

Finally, when pilot testing an intervention programme within local organisations, we observed the value of ensuring proper embedding of new tasks into pre-existing workflows and secure employees' readiness, confidence, and enthusiasm concerning the use of the programme. The realisation of these factors significantly influenced whether the programme's roll-out will be successful and, therefore, also influenced the implementation and use of the programme in the long run.

Strengths and limitations of the study

One of the strengths of our case study was the theoretical foundation used to develop the BENEFIT implementation strategy. By applying three theoretical implementation frameworks, it was possible to create an implementation strategy that guided the implementation process, helped identify factors that influenced the process, and provided guidance on how to adapt the implementation strategy. Furthermore, by choosing to use an iterative approach for the development of the implementation strategy, it was possible to alternate between theoretical framework and clinical practice to tailor the theory-based implementation strategy to the stakeholders' environment, working conditions, daily operations, and expectations.

A limitation of our study relates to generalisability, as certain findings from practice constituted in our case study do not necessarily apply to other implementation practices. To illustrate, this research project was performed and executed in Netherlands. It is therefore important to note that different countries and cultures may require unique approaches for eHealth development and implementation. Also, our identified key factors do not mention the importance of financial support since one inclusion criterion for participating organisations was financial agreement by the organisation's management. Funding, however, was an important determinant of whether to implement the BENEFIT programme within several other organisations not included in this case study. However, as our main aim was to transparently describe the iterative development process of the BENEFIT implementation strategy to serve as a blueprint for other researchers, the described findings of our specific case study were used for illustrative purposes, and are thus inherently not generalisable.

Future research and implications for practice

Concerning future research and implications for practice, various follow-up steps may be desirable. To begin with, in collaboration with stakeholders, it may be valuable to focus on ways to present the developed six-phase approach to organisations, for example, by using a website or (digital) toolkit where organisations can consult and go through all steps of the implementation approach. This further development of the approach ensures that it is made accessible to others interested. By allowing more people to use an approach that has taken several years to develop and refine, other researchers and health care providers from within practice are no longer obligated to invest significant time thinking out a suitable iterative development process themselves.

On top of that, by gaining other user experiences, the content of the approach can be further optimised for practice. Thereby, follow-up research can also focus on the financial aspect of using the tool, specifically the required time investment and commitment of all those involved when using this approach. In doing so, it can be examined whether the benefits of using the approach, namely sustainable implementation of a care innovation within practice, outweigh the financial investment.

Finally, in developing the BENEFIT implementation strategy, we initially focused on a theory-based approach, leveraging implementation science frameworks and models to guide our efforts. However, it is vital to acknowledge that implementing and deploying complex eHealth interventions involves various factors and user groups. As mentioned, complex eHealth interventions exist within a constantly changing social and structural context, significantly influencing individual behaviours and characteristics (3,4). Therefore, including a systems-thinking perspective is crucial to comprehend the complex interplay

between an intervention and the environment in which it is implemented and evaluated. This broader perspective necessitates thoroughly examining factors such as acceptability, feasibility, scalability, transferability of the intervention across different contexts, and cost-effectiveness (7).

Conclusions

This case study gives an in-depth description of an iterative approach to developing an evidence-based, practice-tailored strategy for the implementation of the BENEFIT programme, a complex eHealth intervention in cardiac care. In six iterative phases moving from theory to practice and back, the implementation strategy was developed, tested and refined. As such, this study may serve as a blueprint for other researchers aspiring to sustainably implement complex eHealth interventions within clinical practice.

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Appendix A

Detailed description of the updated implementation strategy (Phase 6).

Regarding step I. Development of a proposal for change

As shown in Fig. 4, during step I of the implementation process, the project team is advised to describe a clear and comprehensive programme outline of the implemented eHealth intervention, including a rationale for the programme's added value and its' expected improvements for the targeted setting. Findings gathered during brainstorming sessions and the implementation pilot within practice led to identifying two additional discrete implementation strategies, described as practice recommendations. These strategies were then added to the updated implementation strategy. To illustrate, in our case study, it was found that it is preferable to provide programme information from patient and health care provider perspectives to pique the audience's interest in the programme. This way, the programme's value to both groups is shown, encouraging health care providers to adopt the programme. Moreover, it is recommended to provide more background information on the mechanisms behind lifestyle change (behavioural change) and elaborate on different layers (theory, practice, SES differences).

Regarding step II. Analysis of current care delivered and goals for improvement

When executing step II, two themes are advised to inventory at the local organisation: current patient care and goals and wishes for improving routine cardiac care. Throughout this inventory, perspectives of the management, health care providers, and other employees are covered. After execution of the inventory within practice, several additional practice recommendations were drawn up. We found, for example, that it is recommended to stimulate local leaders inside the organisation to take part in the process as drivers for change, keep local opinion leaders informed about plans for programme implementation, and identify and notify suitable champions. Moreover, to increase effective implementation, we found that attracting employees to inspire, motivate, and enthuse others was effective, as was building a group to support one another when going through the process. Finally, it became apparent that creating an environment where employees feel free to use the programme was very important, as imposing it from a management perspective appeared to hamper implementation success.

Regarding step III. Problem analysis of the target group and setting

Step III, as described in Fig. 4, comprises an inventory of several themes. First, employees are advised to discuss how the programme will improve their patient care and workflows. Also, it is preferable to explore local possibilities further and subsequently identify concrete

programme implementation goals. Then, it is recommended to define all needs and requirements for successful implementation and use. Following the completion of the pilot, several practice recommendations were drafted. As an example, in our case study, it appeared that it is preferable to a) let all employees jointly prepare and approve a timeline and planning (taking a 5-10% delay into account) as well as role descriptions and resulting responsibilities and agreements that correspond to personal values and existing workflows, and b) identify and evaluate needs and associated challenges as this helps to anticipate them in the next step effectively.

Regarding step IV. Development and selection of local strategies

Step IV of the implementation process involves developing support material and compiling a list of local strategies for dissemination and implementation. First, a toolbox for employees (e.g., webinar, protocols for inclusion of participants, step-by-step plan with instructions for using the program) and materials for future participants (e.g., explanation of the programme, instructions for registration) are developed. Furthermore, drafting an action plan for evaluating the dissemination and implementation process is recommended. Findings gathered during the pilot within practice led to the identification of several practice recommendations. By way of illustration, the following findings emerged from our evaluation: a) stimulate local implementation managers to state that the programme can be customised, personalised, and standardised to meet employees' needs, b) since employees differ in needs and requests for help, it is advisable to provide information in multiple ways and to update these resources regularly, c) by utilising existing communication and network infrastructures, chances of miscommunication and implementation delays will be reduced, and finally, d) by stimulating and preparing local champions to lead the implementation process and act as a source of information, employees are encouraged to engage in the process and receive support if necessary.

Regarding step V. Development, testing, and execution of the local implementation plan

As shown in Fig. 4, during step V, the local implementation plan is developed and tested to improve the developed implementation plan further. Several practice recommendations were added after piloting our initial implementation strategy. For example, we found that securing employees' readiness, confidence, and enthusiasm is important to roll out the intervention programme successfully. Moreover, we experienced that it is advised to realise a pilot implementation that is executed as intended, and to regularly assess employees' resistance, needs, barriers, and enablers to re-examine and enhance the implementation process if necessary.

Regarding step VI. Integration in routines

At the start of step VI, the intervention programme will be implemented within practice. As described, processes are actively monitored and reflected on to determine which ones need to be changed to optimise embedding within practice. Necessary improvements will be incorporated into the implementation plan. Over time, a relapse prevention plan will be developed with all involved to provide further support in pursuing sustainable implementation and usage of the intervention in practice. Based on practice and theory, practice recommendations were included. To demonstrate, in our case study, it was found that already drawn tasks and agreements should be revised if required to match the employee's values and workflows. Also, needs, experiences, feedback, and successes are advised to be assessed regularly. In addition, it is recommended to routinely communicate gathered input, clinical data, or knowledge to keep employees informed and involved. By sharing improvements made in response to employees' feedback, employees are assured that their suggestions are valued.

Regarding step VII. Evaluation and adjustment of the implementation plan

Finally, as shown in Fig. 4, the last step of the implementation strategy comprises further improvements to the implementation process, implementation plan, and relapse prevention plan. By monitoring and reflecting on all ongoing processes and evaluating the earlier specified goals, chances of long-term programme integration into routine practice will be increased. Based on findings gathered from practice and theory, practice recommendations were added to the implementation strategy. By way of example, we found that it was strongly beneficial to keep resources regarding training and education updated regularly. Also, it is recommended to realise access to knowledge and information permanently and in various ways, and keep employees involved and motivated using frequent meetings. During these meetings, news, successes, and milestones can be communicated from an employee, organisation, and patient perspective, and discussing developments and conveying clinical data is recommended.

Chapter 5

Implementation of a complex eHealth intervention by a public-private partnership in clinical practice: a qualitative multicentre analysis using CFIR

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Abstract

Background: Complex eHealth interventions, featuring multiple components within dynamic systems, are used for healthcare improvement. Public-private partnerships (PPPs), combining resources, expertise, and technology, are crucial in this context. Yet, integrating these interventions into practice remains challenging. This study identifies barriers and facilitators affecting implementation of the BENEFIT programme, a complex eHealth intervention targeting cardiovascular disease patients, by PPP within practice.

Methods: A qualitative study design was employed. Ten key stakeholders from four cardiac rehabilitation (CR) sites, who were all PPP partners involved in developing and implementing the BENEFIT programme, were interviewed semi-structured. Transcripts were analysed using Consolidated Framework for Implementation Research.

Results: Facilitators included programme adaptability, communication and planning within teams, digital healthcare needs, dedicated PPP leadership, PPP meeting structure and PPP's ability to quickly modify the implementation strategy. Barriers involved specific PPP challenges (frequently changing roles, unclear roles and responsibilities and limited staffing), workplace disruptions, poor information technology (IT) integration, and ambiguous implementation goals amongst CR sites. This case study highlights challenges in implementing complex eHealth interventions by PPPs within practice.

Conclusions: The findings underscore the need for a comprehensive implementation approach considering specific PPP dynamics, including combined expertise and resources, transparent role definition, sufficient staffing, clear goal communication and adaptable strategies for sustainable implementation.

5.1 Introduction

Introduction

Complex eHealth interventions are promising in promoting healthy lifestyle behaviours to improve individuals' health and quality of life and alleviating the healthcare system (1). Integrating complex eHealth interventions in routine practice, however, presents a multifaceted challenge since implementing complex eHealth interventions is inherently difficult (2–4). One primary contributor is the eHealth interventions complex nature (1) based on different elements, such as the kind of health behaviours it aims to modify, the groups or populations it aims to reach, the extent of intervention adaptability, and the professional competence and skills needed to implement the intervention (5). Thereby, complexity is based on the dynamics between the intervention and its surrounding environment. This encompasses all aspects in which an intervention is conceptualised, created, implemented, and evaluated. Furthermore, implementing complex eHealth interventions is challenging due to the multiple interactions of behavioural, technological, and organisational intervention components (6), which must be coordinated at various levels to work effectively (1,6,7). Frequently identified challenges are poor planning, cost of (implementing) the intervention, organisational misalignment, and ineffective collaboration between key stakeholders (2,3,7,8).

To unlock complex eHealth interventions' full potential, a collaborative approach is necessary. Public-Private Partnerships (PPPs) have emerged as a vital approach to improving healthcare services worldwide (9–11). PPPs often involve public authorities, for example, governments or government organisations such as universities or academic medical centres, researching to systematically enhance and evaluate innovations, and the private sector developing innovative healthcare solutions, infrastructure, or other assets critical for delivering public services (10), among others, focused on treatment or prevention of chronic illnesses such as cardiovascular disease (CVD) (12,13). Successful PPPs provide infrastructure, funding, expertise, and technology (9,14). They contribute to increased healthcare system efficiency and access, decreased costs, and enhanced innovation (9). Research has shown that PPPs are instrumental in addressing resource shortages by improving public health systems' quality, provision, and performance of health services (11,14). This helps integrate public and private sector facilities and strengthen health systems (11). However, despite their potential, PPPs require specialised skills such as effective governance and strategies (14). Effective organisation and government support are essential for successful PPPs, yet ambiguities surrounding the private sector's role and the extent of its benefits in these alliances often impede stakeholder confidence. This is particularly true among healthcare policymakers, who are still hesitant to initiate such partnerships (11). Moreover, initial financial assessments rarely account for unforeseen complexities that are specific to PPP collaborations, which can lead to budgetary overruns and extended timelines

(15,16). Evidence has shown a tendency for future revenues to be excessively committed, such as entering contracts that are too expensive for government bodies, leading to the costs being passed on to the consumers (13). Nevertheless, as public health budgets are increasingly under pressure, the World Health Organization recommends using PPPs (13). Therefore, the need for comprehensive research into the dynamics of a PPP when implementing complex eHealth interventions becomes even more pressing. This knowledge stimulates effective and efficient collaboration within PPPs and supports implementing complex eHealth interventions into existing healthcare systems, thereby optimising patient outcomes and maximising the benefits of such interventions (17).

Implementation science can be used to systematically evaluate challenges of implementing complex eHealth interventions by PPPs within clinical practice (18). By applying the Consolidated Framework for Implementation Research (CFIR) (19), we can systematically analyse the nuanced layers of PPP operations and explore multifaceted factors that influence the implementation of complex eHealth interventions, encompassing both barriers and facilitators inherent in the process. Therefore, this study uses CFIR as a guiding framework to delve into the implementation process of a complex eHealth intervention by a Dutch PPP, aiming to enhance our understanding of PPP dynamics to optimise future implementations of complex eHealth interventions into clinical practice.

Methods

Case study

The BENEFIT for all intervention programme, referred to as the BENEFIT programme, is developed by a PPP as an addition to cardiac rehabilitation and aims to promote and support sustainable healthy living at home among individuals with CVD in the Netherlands (20,21). This PPP brings together contributions from academia, a private party, and healthcare: academia provided evidence-based input for the BENEFIT programme and the associated eHealth platform, the private party developed a Personal Health Application (PHA) and provided a reward ecosystem and the digital infrastructure essential for implementing the intervention, and healthcare facilitated the implementation and use of the intervention within routine clinical practice, specifically, cardiac rehabilitation.

Central to the BENEFIT programme is the PHA, which offers various features that are part of an ecosystem and link different necessary pillars to facilitate sustained healthy living. This includes access to evidence-based lifestyle interventions, daily goal monitoring, coaching, and a rewards program designed to incentivise health behaviours and adherence. This way, healthy living is made more appealing by introducing challenges and rewards for, among others, attending healthcare appointments and monitoring lifestyle behaviours. Rewards can

be redeemed for discounts on health-related goods and services. Given the different pillars and options, the PHA can be tailored to the specific needs and preferences of end-users. In the context of CR, the BENEFIT programme is implemented as a complementary component to standard care. The intervention enables healthcare providers to offer patients information, feedback, remote healthcare services, and assistance in selecting suitable lifestyle interventions. Patients could continue using the BENEFIT programme after their CR was completed to facilitate long-term maintenance of new health behaviour changes. This aims to permanently perpetuate newly learned healthy lifestyle behaviours (20,21).

Due to the COVID-19 outbreak in March 2020, a rapid transition to digital healthcare delivery was necessary, and telerehabilitation was provided using the PHA. Standard cardiac rehabilitation care resumed in February 2021, integrating in-person care and digital care using the BENEFIT programme.

Study population and design of the current study

A formative evaluation (22) was conducted to identify barriers and facilitators affecting the implementation of the BENEFIT programme developed by a PPP in clinical practice. The purposeful sample consisted of 10 stakeholders (researchers, company board members, healthcare providers) from four CR sites, representing key roles during the implementation process, i.e., they formed the core implementation team in various CR sites and consisted of both the public and private sector of the PPP, ensuring that essential insights from academic, business, and healthcare perspectives were represented. The sample included a researcher/coordinator (academia), a researcher/clinical psychologist (academia), a CR director/medical specialist (business), two implementation managers (business), a site manager (healthcare), a specialised nurse/coordinator of patient care (healthcare), a hospital department head/medical specialist (healthcare), a physiotherapist (healthcare), and a specialised nurse (healthcare).

When implementation tasks of the BENEFIT programme were being completed, invitations were sent via e-mail along with an information letter (description of the purpose of the interview, the use of the data, and the duration of the interview) and the requirement for online informed consent using Qualtrics, in-depth understanding of the implementation process from their perspective was gained. Using a qualitative study design, between May 2022 and September 2022, one-on-one semi-structured interviews were executed with the participants. This provided flexibility in our questioning and enabled thorough exploration of topics based on the five implementation domains of the CFIR (6–8): 1) Innovation: the intervention that is implemented, such as design features, perceived advantages, and potential adaptations within clinical practice, 2) Outer setting: the environments in which the

inner setting operates, such as a hospital system, healthcare policies, economic forces, and patient needs, 3) Inner setting: the organisation adopting the intervention, for example, hospital unit(s), and its culture, structural characteristics, and intervention readiness, 4) Individuals: the individuals involved, considering their roles, interests they represent, beliefs, and behaviours when interacting with the intervention, and 5) Implementation process: activities and strategies used by the PPP to implement the innovation, including detailed planning, assessing context, execution, and ongoing evaluation. This approach enabled the systematic examination of facilitators and barriers that impacted the implementation process in the different healthcare sites (19). Building on CFIR research (23,24), primary author RIJ, a female researcher with a background in psychology and trained in questioning and interviewing, developed the interview protocol (**Appendix A**), which was subsequently improved in collaboration with RV, VJ, and WS. Our semi-structured interview approach was designed to balance comprehensive coverage of all CFIR domains whilst maintaining participant engagement. We began with open-ended questions to allow participants to reflect on their experiences freely, followed by tailored follow-up prompts to ensure that all CFIR constructs were discussed if relevant. For each domain, a detailed list of all CFIR constructs was visible to participants on paper or screen, facilitating a structured yet conversational discussion after we first reviewed them together. Interviews were performed in Dutch by RIJ. All interviews took place face-to-face at the healthcare site or via Microsoft Teams. Interviews lasted approximately 60-90 minutes, were audio recorded, and transcribed verbatim afterwards.

Content of the interviews

Before the start of the interview, RIJ discussed the purpose of the study and the interview setup. Subsequently, the interview consisted of two parts. The first part consisted of an examination of the participant's general role within the PPP and the tasks involved, their assigned implementation role(s) and the tasks involved, possible implementation tasks outside their assigned role(s), their vision of the main reason of implementing the BENEFIT programme within their organisation, and their perspective on conditions needed to implement the BENEFIT programme successfully. The second part consisted of questions based on the five CFIR domains (19) to systematically identify facilitators and barriers of the PPP and the implementation of the BENEFIT programme. Discussing each domain separately, participants reflected on their experiences with the implementation successes and challenges. Follow-up questions were asked to ensure all subjects were discussed.

Data analysis

Data analysis was conducted using MAXQDA 2023 (25). The template analysis method is a variant of thematic analysis, which underscores hierarchical coding and offers a structured

approach to textual data analysis whilst providing the adaptability required for specific research requirements, which was used to interpret the data (26). Initially, the 48 CFIR constructs and subconstructs were used as preliminary codes in our coding manual. Five additional codes were derived from the data: (i) Goals and clarity of the programme (added to Innovation), (ii) Communication local organisation (added to Inner setting), (iii) PPP role(s) and task(s) (added to Individuals), (iv) Communication implementing organisation (added to Implementation process), (v) Structural characteristics (added to Implementation process). The codes added to Innovation, Inner setting, and Individuals were integrated based on their emerging significance in clarifying influential factors at different levels within the implementation context. For clarity during the coding process, we opted to categorise influencing factors related to the PPP under the domain Implementation process and influencing factors related to the cardiac sites where the implementation occurred under the domain Inner setting. Since two constructs of the Inner setting also proved relevant to the PPP during data analysis, they were incorporated into the domain Implementation process. Appendix B outlines the coding structure.

Interview analysis proceeded in three steps. First, RIJ and VJ independently categorised interview fragments to CFIR constructs. Every discrepancy in the choice of construct and domain was discussed until consensus was reached. Summaries for each construct were then independently done by RIJ and RV for the first constructs. Then, any discrepancies in summaries for each construct were discussed until consensus was reached. Finally, summaries of all constructs from each domain were merged. Influencing factors for each domain were categorised as either facilitators or barriers. Guidelines provided by the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist (Appendix C) were used as guidance to ensure quality and accuracy of the findings (27).

Results

Participants characteristics

Of the ten participants, eight were female and two were male. Most participants had dual PPP roles, which added a multidimensional perspective to the study. Participants' tasks included clinical care, patient counselling, implementing new systems, programme coordination, involvement in research and healthcare innovation, and financial and management functions. The sample represented a wide range of implementation roles, as defined by CFIR, and tasks that contributed to implementing the BENEFIT programme. High-level leader participants had programme coordination responsibilities, project management involvement, substantive contributions regarding development and implementation of the programme, and decision-making responsibilities. Mid-level leaders monitored, coordinated, and facilitated implementation with attention to problem

identification, communication, and healthcare provider support. Implementation leads were responsible for system design, coordination, and adjustments, and successful programme implementation. Implementation facilitators streamlined workflows, provided user training, and customised the used systems. Innovation deliverers helped evaluate, guide, and adapt processes to implement the BENEFIT programme more effectively.

Influencing factors

To provide a thorough and systematic understanding of the factors that impacted the PPP and the implementation of the BENEFIT programme, each CFIR domain is described separately. Tables outline influencing factors for each domain. Factors that exerted the most notable influence on the implementation process or were frequently cited by participants are termed 'key barriers' and 'key facilitators'. Other factors identified (**Appendix D**) as having an impact are simply referred to as 'barriers' and 'facilitators'.

CFIR domain 1: Innovation

This section outlines participants' views on the influence of the domain Innovation: the BENEFIT programme, developed and implemented by the PPP within clinical practice. **Table 1** describes all key factors that proved relevant during the implementation, along with exemplary quotes from participants illustrating these factors.

A key facilitator was programme adaptability; the programme proved capable of being tailored to various environments, situations, and patient needs. This was key in ensuring the relevance of the intervention across different contexts. A key barrier was the lack of clarity and uniformity regarding the main reason for programme implementation in different organisations. Some thought it was implemented as an alternative to regular healthcare, whilst others considered it an additional resource on top of their routine cardiac care, or mentioned its goal was to reduce healthcare costs and physical space requirements in regular cardiac care. The board's emphasis on cost reduction created misalignment with healthcare providers' principal aim of improving patient care, leading to confusion about the programme's purpose within the organisation. Furthermore, within the PPP, determining the most optimal programme role within standard care (such as whether it should be optional or standard part of routine care) was a protracted effort which possibly affected clear communication of the programme's main objective to external partners.

Table 1. Key factors within CFIR domain 1 Innovation influencing implementation.

Theme	Quotes
Key facilitator	
• Programme adaptability	"We have been remarkably flexible with the programme; we were able to highly adapt and fine-tune it to align with the environmental context as well as the patients' needs."
Key barrier	
• Lack of clarity and uniformity about the main reason for implementing the programme within organisations	• "The most significant obstacle has been the ambiguity surrounding the exact nature of the BENEFIT programme. This was not clear." • "We were very much supported in the implementation and use of digital healthcare, predicated on the assumption of cost savings and space efficiency. However, without framing it as a quality enhancement, a new improvement will not succeed. Initially, it always demands more time, resources, and financial investment."

CFIR domain 2: Outer setting

This section outlines participants' views on the influence of the domain Outer setting: the environment in which the inner setting operates. **Table 2** presents all identified key factors, along with exemplary quotes.

The COVID-19 pandemic had a dual impact. A key facilitator was the acute need for digital healthcare due to sudden unavailability of face-to-face contact caused by the COVID-19 pandemic. The private party was well positioned compared to most hospitals in the Netherlands in this regard. Therefore, thanks to the PPP, it was possible to quickly scale up the digital healthcare programme. As a result, the Dutch Heart Foundation recommended using the BENEFIT programme at a national level. However, the pandemic also introduced significant workplace disruptions, which were identified as a key barrier. The healthcare environment experienced drastic changes, requiring staff to suddenly adapt to new working methods. Combined with the use of the BENEFIT programme in a different way than initially planned, all changes and obligations were experienced as a huge challenge. The main underlying reason for these challenges were the conflicting PPP interests; the academic partner wanted a scientific evaluation and, therefore, the implementation of a baseline measurement was required. Current healthcare circumstances dictated otherwise, given the need for digital healthcare. This presented logistical challenges which were resolved by first switching to digital healthcare, and later, after COVID-19 restrictions, switching back and still conducting the baseline measurement. Extra time and effort to bring everyone on board with these new methods was needed.

Table 2. Key factors within CFIR domain 2 Outer setting influencing implementation.

Theme	Quotes
Key facilitator • The need for digital healthcare	• "When direct contact in cardiac rehabilitation was no longer possible, the availability of an online programme was exceptionally fortunate. So, the COVID-19 pandemic served as a good incentive." • "In this specific instance, it was the Dutch Heart Foundation that was particularly instrumental in promoting the programme, as they were very pleased with the availability of this option. This has certainly yielded benefits."
Key barrier • Workplace disruptions	• "There was a considerable flux. Not solely within the BENEFIT programme, but the healthcare landscape and its personnel had also undergone a huge transformation. Such extensive change is overwhelming." • "Initially, we compared a supplement/control condition with a face-to-face and online intervention. However, the advent of COVID-19 necessitated a large-scale shift to telerehabilitation. This turnaround in implementation had significant consequences. An organisation that is naturally resistant to rapid change needs time to build consensus. Changing even one protocol meets resistance; staff need to be retrained and reoriented to new procedures. Therefore, try to keep changes to a minimum." • "We were compelled to revert to the control condition, a process that required considerable effort. We devised a strategic plan addressing the involved parties: who are they, what resources do they require to facilitate this transition, and what is the underlying justification? Within the PPP, this led to a negotiation, balancing the ideal with the practical, and finding a middle ground where both could meet. Ultimately, we succeeded in incorporating a control group in such a manner that it was acceptable to the organisations involved."

CFIR domain 3: Inner setting

This section outlines participants' views on the influence of the domain Inner setting: the organisations where the BENEFIT programme was implemented. **Table 3** describes all identified key factors, along with exemplary quotes.

A key facilitator within certain organisations was effective communication within the local team. They organised regular meetings, reflections, and evaluations to ensure alignment and progress. Using tools such as Trello for planning and oversight was also mentioned as instrumental in keeping the team organised and on track. A key barrier found was poor IT integration; participants reported significant challenges due to duplicate filing and the need to work across multiple systems, which led to increased workload and inefficiencies.

Table 3. Key factors within CFIR domain 3 Inner setting influencing implementation.

Theme	Quotes
Key facilitator	
• Communication and planning in local team	"We convened at regular intervals, engaging in reflective practice and evaluation. Meticulous planning was evident, with all tasks meticulously catalogued on the Trello board, affording our team leader a comprehensive overview."
Key barrier	
• Poor IT integration	• "Using two systems was not conducive to a successful implementation, it was rather counterproductive." • "It led to duplicate filing, which emerged as a formidable challenge. The labour and time involved were unsustainable, to be candid."

CFIR domain 4: Individuals

This section outlines participants' views on the influence of the domain Individuals: all roles and characteristics. **Table 4** describes all identified factors, along with exemplary quotes.

A key facilitator was the presence of dedicated PPP leaders with multiple roles. For example, on the one hand, they were involved in programme development, but at the same time closely involved in programme implementation because they oversaw implementation sites. This PPP construction brought great advantage because individuals were involved from different PPP perspectives, and coordination of internal and external matters could occur within the steering committee itself. A key barrier identified was the need for individuals to frequently switch roles. This was prevalent within smaller organisations and within the PPP. Individuals were often required to adapt to different roles, sometimes abruptly and without adequate preparation or understanding of the underlying issues. This put pressure on them to perform tasks for which they might not felt of were fully equipped.

Table 4. Key factors within CFIR domain 4 Individuals influencing implementation.

Theme	Quotes
Key facilitator	
• Dedicated PPP leaders with multiple roles	• "As a [B1] and the founder and director (..), my primary focus is on medical oversight, fostering collaboration, and the development of our programme, ensuring that I remain actively engaged with the content. (…) In addition, I continue to practice clinically. I also serve as the lead cardiologist at our cardiac rehabilitation sites. This role involves being accountable for the financial health of our organisation, which includes obligations to both health insurers and shareholders. Regarding the BENEFIT programme, as project leader, I am a member of the steering committee. My position as the lead [B1] for our cardiac rehabilitation sites also entrusts me with the final decision-making authority regarding the programme's implementation." • "As a [B14] and [B19] within the (..), my role encompasses patient care, leading various hospital projects, active involvement in numerous healthcare innovation initiatives, and overseeing the academic progress of several PhD students. In relation to the BENEFIT project, I hold the position of one of the project leaders, so I am part of the steering committee. My responsibilities in this capacity include steering the project towards a successful finish. This involves various tasks, such as being accountable for the research design, managing both the project and the broader research programme, contributing to the execution and supervision of research activities, and overseeing the communication strategy. I have also played a significant role in the implementation process of the BENEFIT programme."
Key barrier	
• Changing roles within the PPP	• "Due to our team's size, we frequently had to alter roles. We are fulfilling more than a fixed set of tasks. Recently, I assumed the position of [B13]." • "The most challenging aspect, I believe, pertains to [L0]'s domain. Occasionally, I was drawn into situations where the programme faltered, and I was asked to intervene without knowledge and context, yet expectations remained."

CFIR domain 5: Implementation process

This section outlines participants' views on the influence of the domain Implementation process: the activities and strategies used to implement the innovation. **Table 5** describes all identified factors, along with exemplary quotes.

A key facilitator was the diligent meeting structure within the PPP, which included monthly review sessions, weekly meetings, and regular bilateral discussions among PPP leaders. This ensured that all three parties and perspectives were consistently considered during implementation; the programme was scientifically evaluated, the perspectives of healthcare and patient interests were considered, and the private party focused on creating sustainable funding for the programme and tapping into relevant contacts within the ecosystem. For example, there were weekly consistent meetings on Tuesday mornings involving research

leaders and staff members, ensuring ongoing dialogue at multiple organisational levels. Since project teams worked across disciplines, implementation ideas could be tested scientifically and then implemented within practice quickly. Also, in case of challenges, they could collaboratively devise solutions and swiftly implement necessary actions. This ensured the continuity and smooth implementation of the intervention. Additionally, there was steady engagement with the stakeholder committee, including the chairperson, as well as with a patient panel and healthcare providers from various locations. Another key facilitator was the PPPs adaptability regarding the programme's implementation strategy in response to emerging needs. Also, a facilitator was conducting regular check-ins with external sites. This strategy was key for gathering information and maintaining proactive communication. Participants highlighted the critical role of being engaged and consistently checking in to identify and address potential issues early on, ensuring the process did not stagnate.

The implementation faced several barriers, mainly due to the establishment of a newly formed PPP. A key barrier was the substantial effort needed to lay down the PPP's operational structure and ensure all team members were informed and committed to the agreed procedures. Participants explained that transparent communication and dialogue were essential to overcoming political complexities and aligning goals, as it reduced common PPP frustrations, enhancing the PPP's impact. Additionally, another key barrier was unclear roles and responsibilities among PPP team members, especially regarding implementation tasks, which led to confusion and a lack of clarity on who was accountable for specific tasks. Finally, a key barrier was the limited PPP staffing capacity, which hindered effective programme implementation. This shortage in staffing capacity resulted in a lack of continuity and consistency throughout the process. Participants highlighted the necessity of having a dedicated and well-trained team, with adequate time allocated for implementation activities to ensure the successful implementation of the BENEFIT programme. The dynamic nature of the external environment and internal staff changes (i.e., illness and turnover) were also explained as contributing factors to the challenges, emphasising the need for a stable and well-supported team to navigate the complexities of the implementation process. However, another reason was the lack of a predetermined agreement on budget allocation for implementation between the public and private entities and the division of financial and personnel contributions.

Table 5. Key factors within CFIR domain 5 Implementation process influencing implementation.

Theme	Quotes
Key facilitators	
• A diligent PPP meeting structure	"Our schedule included monthly evening sessions dedicated to comprehensive reviews, alongside weekly gatherings, and bilateral meetings between research leads. Furthermore, meetings between research leaders and staff were a regular occurrence, facilitating frequent consultations at all levels. Additionally, we maintained consistent communication with the stakeholder committee, its chairperson, and naturally, with the patient panel and healthcare providers at various sites."
• The PPPs adaptability regarding the programme's implementation strategy	"With people needing healthcare but unable or reluctant to visit facilities in person, remote care became essential. Fortuitously, the environment provided by the BENEFIT programme was well-prepared, prompting us to deploy the intervention immediately. To have persisted with the control condition, as initially planned, would have been unethical."
Key barriers	
• A newly established PPP	• "In the context of a public-private partnership, which is in line with establishing a whole new organisation, substantial investment is required. We must deliberate on collaborative methods, communication channels, and decision-making processes, and ensure their execution. This essentially means constructing a new organisation from the ground up, a vital learning curve for us." • "Transparent communication about objectives and interests is critical, though simultaneously challenging due to the inherent political dynamics. I am convinced that focussing on open dialogue and aligning on shared goals will lead to greater clarity, efficiency, and satisfaction, ultimately conserving resources and reducing frustration." • "The engagement of an organisational consultant from the outset would have been advantageous, to guide us through the complexities of such collaboration, which we were navigating together."
• Unclear roles and responsibilities within the PPP	P3: "I had no specific tasks related to implementation. Other than my sole duty being to inform those who would utilise the BENEFIT programme.". *This contrasts with others:* • P2: "[P3] was chiefly responsible for the implementation across various sites." • P4: "Indeed, [P3] was instrumental in the implementation alongside [P2]. They visited the sites to conduct training sessions. From what I gather, these efforts were successful, but beyond that, my knowledge is limited." • RIJ: "Had there been a premeditated plan detailing individual responsibilities for the implementation tasks and their execution?" P2: "There was a strategy in place, though in retrospect, it warranted further refinement. We got [P3] involved from the outset, and my involvement was equally deliberate and considered."

	• "Of course, there was also a lot still going on, on the outside, necessitating adaptations due to staff turnover and dynamic circumstances." • "Effective implementing and executing hinge on the availability of a competent team with the necessary time allocated. It is imperative that projects must be budgeted and staffed to facilitate feasible execution."
• Limited staffing capacity within the PPP to implement the programme	• "It was an oversight on our part, as a public-private partnership, not to have predetermined the budget allocation for the implementation itself. Clarifying the financial and personnel contribution from the private party, as well as the role of researchers, would have been prudent. A more transparent division of responsibilities and resources between research funding and private contributions was needed."

Discussion

This study evaluated the implementation of the BENEFIT programme, a complex eHealth intervention developed by a PPP. Barriers and facilitators encountered during its implementation within routine cardiac care were explored. Key facilitators identified included programme adaptability, communication and planning within local teams, acute need for digital healthcare, dedicated PPP leadership, a diligent PPP meeting structure, and the PPPs ability to quickly change the implementation strategy. By leveraging these facilitators, sustainable implementation of complex eHealth interventions by PPPs can be realised, supporting better chronic disease management and improved quality of life. Key barriers identified, based on their significant impact on the implementation process and the times they were mentioned, were: specific PPP challenges (i.e., frequently changing roles, unclear roles and responsibilities, limited staffing), workplace disruptions, poor IT integration, and different programme implementation goals among CR sites.

Based on the identified key barriers, we identified several areas for improvement. Regarding the key barrier *specific PPP challenges*, issues identified were frequent role transitions, unclear roles and responsibilities, and limited staffing capacity. Also, maintaining open PPP communication regarding goals and interests was found to be a challenge, largely due to its inherently political nature. Such issues are well-known challenges within PPPs (28–30). Several approaches are possible to anticipate these challenges. First, PPP efficiency lies in effective risk management before the start of a project (29), by identifying potential risks, doing a risk analysis and evaluation of the potential impact, and execute risk mitigation. To mitigate the identified challenges, among others, transparent budgeting and staffing agreements are helpful, alongside a clear definition of roles and responsibilities to avoid role strain, impaired job satisfaction, emotional exhaustion, and diminished organisational efficiency and commitment (31–33). Second, participants' insights, corroborated by existing literature, highlight the importance of fostering an environment that prioritises clear, honest

dialogue to navigate political complexities and align goals and motives of PPP parties. This approach builds trust and leads to consensus, higher efficiency, and cost-effectiveness due to more effective and efficient collaboration (33). Third, to enhance the PPP's foundation, early engagement of expert advice (33), such as an organisational consultant, could be beneficial to provide strategic guidance on establishing efficient workflows, communication methods, and collaboration techniques. Finally, additional strategies include promotion of autonomy (34), ensuring leadership commitment (35), encouraging collaborative team building and task mastery (36,37), and regularly assessing and adapting team roles (37). Implementing effective feedback systems, consistent education, training, and access to information are also crucial strategies to move intervention deliverers from unengaged to fully committed users of the intervention (38).

Concerning the key barrier *workplace disruptions*, the COVID-19 pandemic significantly disrupted the participating healthcare organisations. This was compounded by the need to employ the BENEFIT programme differently than initially planned due to rapid tele-healthcare necessity. This extra time and energy investment led to workplace resistance, which hindered the implementation of the BENEFIT programme. The capacity of organisations to endure and thrive amidst chaotic conditions greatly depends on how well information system (IS) strategies are aligned with the organisation's core operations (39). To realise effective adaptation to changing circumstances, compatibility of all systems with current clinical workflows and technical infrastructures is crucial; seamless integration between different IS systems and infrastructures is necessary for smooth data flow and user experience. Additionally, organisations stay flexible, adaptive, and well-prepared for changing circumstances by encouraging the use of different systems or programs, such as complex eHealth interventions, as an integral part of healthcare delivery (40) and fostering a culture of innovation where staff can propose and test new ideas (41). Concerning workplace resistance, excessive recent changes within organisations can result in an overwhelming sense of yet another implementation, also known as 'initiative fatigue' (42). Despite an understandably limited capacity, higher-ups had to make difficult choices, which led to top-down decision-making. Even though top-down decision-making is prevalent, bottom-up communication is essential to gather employee feedback during the initial stages of change processes and empower employees to contribute to the change process (43). Furthermore, a strong implementation climate is needed to realise implementation success, which can be reached by organisational endorsement, supportive behaviours, rewarding cooperation, timely training, and knowledge dissemination (44). In response to challenges such as COVID-19, supportive management strategies and organisational endorsement could include providing mental health support services adapted to the needs of healthcare professionals, such as weekly group sessions with a counsellor (45), providing targeted,

timely training sessions tailored to the new telehealth requirements to help staff feel prepared and confident in adapting to the sudden changes (46,47), establishing rapid, transparent communication channels to keep all employees informed and engaged, and mitigate potential uncertainties and ambiguities (48), and reallocating resources to areas of urgent need, for example, by using an ethical decision-making tool (49).

Regarding the key barrier *poor IT integration*, integrating the BENEFIT programme into existing work structures was challenging due to poor programme integration within local IT systems. When implementing new eHealth initiatives, there often is a discrepancy between the eHealth innovation and the technological infrastructures present within healthcare organisations. eHealth adoption depends on the compatibility with current workflows and technical infrastructures (50–55). Workflow-related issues play a major role in adopting eHealth innovations, as does effort expectation (e.g., ease of use). When eHealth innovations fit well within current workflows and infrastructure, they are easier to use and, thus, more effective. Studies also show that incompatibility can lead to improvised solutions, reduced operational efficiency, and potential adverse effects on patient care (54,55). To facilitate eHealth technology integration, healthcare organisations can adapt their operational protocols by applying strategic change management to address the multifaceted nature of healthcare delivery and the varied spectrum of professional roles involved (56). Moreover, alignment of IT infrastructures should be a key focus in the early stages of designing eHealth innovations to ensure interoperability of systems. Using an iterative process involving end-user feedback significantly improves usability and adoption of eHealth innovations (57).

Finally, concerning the key barrier *different programme implementation goals among CR sites*, we found that the primary reason for implementing the BENEFIT programme within organisations was found to be a source of confusion among participants, limiting engagement and involvement of healthcare providers in the process. This ambiguity may have resulted from the programme's complexity and continuous development during the research project. Whilst the development allowed customisation to local needs, it introduced elements of unpredictability and confusion. Interventions, especially within healthcare, can be inherently complex due to their multiple features, parties involved, and varying contexts in which they are implemented (1). This multiplicity can make the intervention ambiguous. Nevertheless, the complexity of such programs can foster commitment when they are seen as fundamental changes rather than mere add-ons (37). To address ambiguity, strategies such as developing a communication strategy that clearly defines and restricts the programme's vision and use and ensures a shared understanding among all parties involved is essential (58), together with early involvement of key stakeholders, for example, using participatory approaches to build consensus, to help define the primary way of using of the intervention

within the organisation (59). Furthermore, establishing a transparent documentation process that records the evolution of programme vision and use is vital. This ensures that all changes are communicated promptly and clearly, aligning stakeholder perceptions and maintaining the programme's relevance and effectiveness in practice.

Strengths and limitations

A strength of our study lies in conducting semi-structured interviews to collect rich, context-specific dynamics within the PPP and the BENEFIT programme implementation. Additionally, using the CFIR in our analytical approach was central to the systematic identification and categorisation of influencers across multiple levels of the BENEFIT programme implementation. Moreover, this study represents one of the first instances where CFIR has been employed to evaluate a PPP, paving the way for its broader application in similar research contexts. The multi-layered nature of PPPs, with their complex interplay of public and private sector dynamics, makes CFIR particularly suitable for evaluation in such settings.

A limitation of our study is a potential recall bias among participants since the interviews occurred after the BENEFIT programme implementation had just ended, a process which took two years. Evaluation at the end could have influenced the accuracy of participants' recollections regarding the implementation activities at the start of the process. This also meant that some potentially interesting participants were no longer available to interview because they had been employed elsewhere. Additionally, the focus on CFIR constructs through template analysis, apart from three added constructs, might have constrained the identification of new themes beyond the CFIR framework. This approach could have omitted factors not covered by CFIR, which may have influenced the implementation process. However, we tried to mitigate this by adding extra constructs during coding. Finally, our study featured a relatively small sample size. Nevertheless, we captured a diverse array of perspectives by involving all key stakeholders, among others, many participants with dual roles within the PPP, ensuring a broad representation of viewpoints. This choice, however, might have limited the generalisability of the results, as these individuals were deeply involved in the implementation process. They may have had different perspectives from stakeholders who were, for example, within the consortium but not part of the implementation process, or end-users such as individuals with CVD. Nevertheless, because we aimed to conduct a thorough evaluation of the implementation process, we intentionally selected participants who were actively engaged in the implementation process, ensuring rich and detailed insights into the challenges and facilitators experienced firsthand.

Future perspectives

After realising the successful implementation of the BENEFIT programme or similar complex eHealth interventions, ensuring long-term sustainability is critical for continued success and impact. Maintenance strategies must be embedded in routine clinical practice to support lasting usage. This can include continuous training and education for healthcare providers to keep them engaged and proficient in using the intervention (44). Integrating the eHealth intervention into existing clinical workflows and IT systems should also be revisited periodically to ensure compatibility and ease of use, as seamless integration reduces friction and enhances the likelihood of sustained use (52,55). Moreover, ongoing stakeholder engagement, including input from both end-users and healthcare providers, is crucial for adapting the intervention to evolving needs and preferences (33). Collecting regular user feedback through surveys or focus groups can guide iterative improvements (38,57). Finally, fostering a culture of innovation and support within healthcare organisations, where staff are encouraged and empowered to contribute ideas for enhancement, can further bolster the intervention's maintenance within practice (41). By implementing such strategies, the BENEFIT programme and comparable initiatives can achieve lasting impact, supporting chronic disease management and improving patient outcomes over time.

Conclusion

This case study systematically examined facilitators and barriers encountered during the implementation of the BENEFIT programme, a complex eHealth intervention within routine cardiac care developed and implemented by a PPP. Our findings underscore the complexity of deploying such interventions within healthcare systems and offer critical insights for future endeavours. Key facilitators identified include the programme's inherent adaptability, communication and planning within local teams, acute demand for digital healthcare, dedicated PPP leadership, a diligent PPP meeting structure, and the PPP's implementation strategy flexibility. These elements were instrumental in navigating implementation challenges and enhancing the programme's acceptance and effectiveness. The study also identified key barriers that posed challenges to implementation, with the newly formed nature of the PPP mainly introducing specific challenges. Among others, frequently changing roles, unclear roles and responsibilities, and limited staffing capacity were found to be PPP challenges. Additionally, workplace disruptions, poor IT integration, and ambiguous implementation goals among different CR sites were found key barriers. Our findings provide valuable insights for future implementations of complex eHealth interventions, developed by PPP. The need for a comprehensive approach that accounts for the specific dynamics of PPPs appears essential, which includes the benefits of combined expertise and resources alongside the necessity for importance of clear role definition and resource allocation, and the need for flexible, adaptive strategies to navigate diverse political

landscapes within PPPs. This way, healthcare organisations can gain a deeper understanding of the specific dynamics involved in PPPs and use these insights to optimise the implementation of complex eHealth interventions into clinical practice. By addressing both barriers and facilitators systematically, future efforts can be better informed, enhancing the potential for successful integration and long-term sustainability of these interventions.

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Appendix A

Interview questions implementation evaluation BENEFIT programme.

A: General and implementation-assigned roles, responsibilities, and tasks

1. What position do you have within your organisation?
2. Can you briefly tell what tasks are involved?
3. What is or was your task when it comes to the implementation of the BENEFIT programme?
4. Did you have tasks within the implementation process that fell outside your regular role as a health care provider/employee?
5. Did you have any other tasks in the implementation process?
6. From an organisational perspective, what is or was your primary goal regarding the use of the BENEFIT programme?
7. When would implementing the BENEFIT programme be successful; what conditions are needed to be met?

B: BENEFIT programme implementation, questioning barriers and facilitators

Innovation domain (at the time: Intervention characteristics)

1. What have been the most significant successes regarding the innovation?
2. What are the biggest challenges you encountered regarding the innovation?
3. Regarding your role:
    a. Can you indicate what succeeded thanks to your contribution?
    b. Can you provide some reason(s) for this?
    c. And what went less well and why?

Outer setting domain

1. What have been the most significant successes regarding the outer setting?
2. What are the biggest challenges you encountered regarding the outer setting?
3. Regarding your role:
    a. Can you indicate what succeeded thanks to your contribution?
    b. Can you provide some reason(s) for this?
    c. And what went less well and why?

Inner setting domain

1. What have been the most significant successes regarding the inner setting?
2. What are the biggest challenges you encountered regarding the inner setting?
3. Regarding your role:
    a. Can you indicate what succeeded thanks to your contribution?
    b. Can you provide some reason(s) for this?
    c. And what went less well and why?

Individuals domain (at the time: Characteristics of individuals)

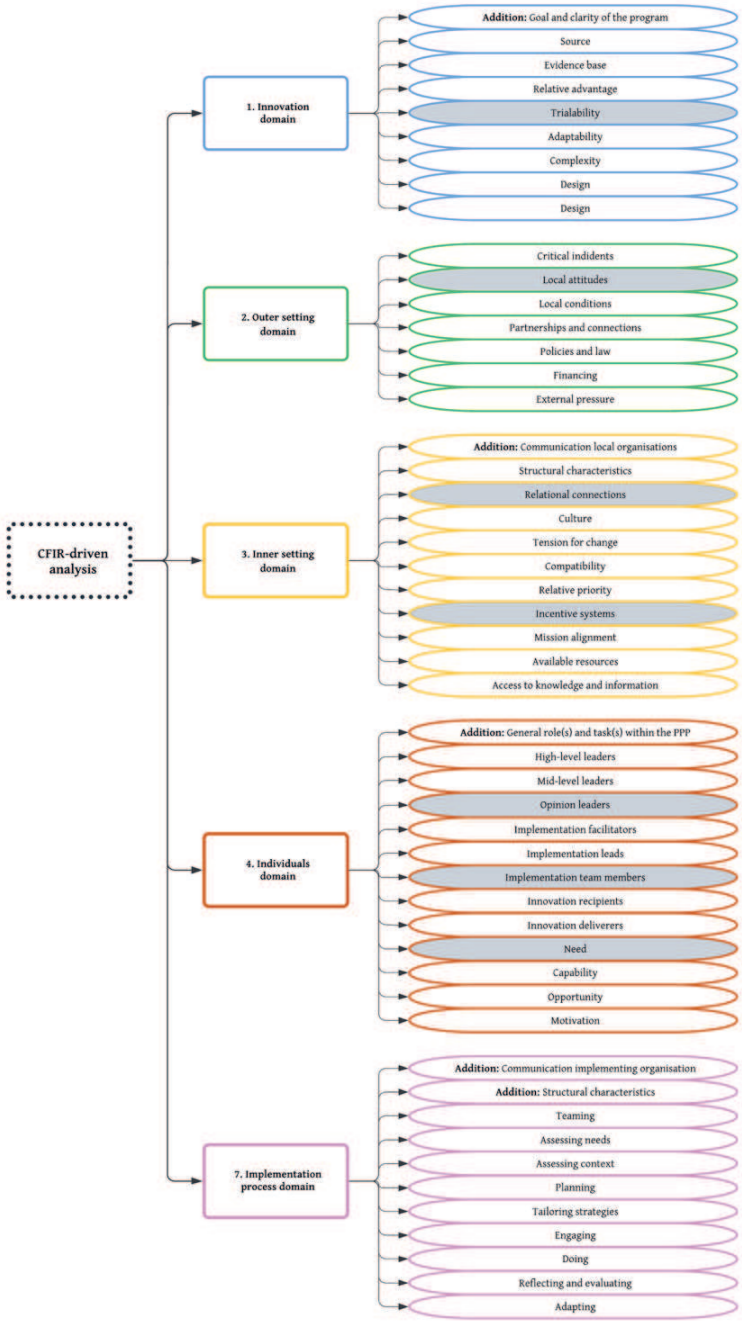
1. What have been the most significant successes for you personally? And for your team?
2. What are the biggest challenges you encountered personally? And for your team?
3. Regarding your role:
    a. Can you indicate what succeeded thanks to your contribution?
    b. Can you provide some reason(s) for this?
    c. And what went less well and why?

Implementation process domain (at the time: Process)

1. What have been the most significant successes regarding the implementation process?
2. What are the biggest challenges you encountered regarding the implementation process?
3. Regarding your role:
    a. Can you indicate what succeeded thanks to your contribution?
    b. Can you provide some reason(s) for this?
    c. And what went less well and why?

Appendix B

Coding tree based on the CFIR constructs.



Appendix C

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist.

Item number		Guide questions/description	Page
Domain 1: Research team and reflexivity			
Personal Characteristics			
1.	Interviewer/facilitator	Which author(s) conducted the interview or focus group?	112
2.	Credentials	What were the researcher's credentials? E.g., PhD, MD	MSc
3.	Occupation	What was their occupation at the time of the study?	112
4.	Gender	Was the researcher male or female?	112
5.	Experience and training	What experience or training did the researcher have?	112
Relationship with participants			
6.	Relationship established	Was a relationship established prior to study commencement?	112
7.	Participant knowledge of the interviewer	What did the participants know about the researcher? E.g., personal goals, reasons for doing the research	112
8.	Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? E.g., bias, assumptions, reasons and interests in the research topic	112
Domain 2: Study design			
Theoretical framework			
9.	Methodological orientation and Theory	What methodological orientation was stated to underpin the study? E.g., grounded theory, discourse analysis, ethnography, phenomenology, content analysis	111-12
Participant selection			
10.	Sampling	How were participants selected? E.g., purposive, convenience, consecutive, snowball	111
11.	Method of approach	How were participants approached? E.g., face-to-face, telephone, mail, email	112
12.	Sample size	How many participants were in the study?	112
13.	Non-participation	How many people refused to participate or dropped out? Reasons?	112
Setting			
14.	Setting of data collection	Where was the data collected? E.g., home, clinic, workplace	112
15.	Presence of non-participants	Was anyone else present besides the participants and researchers?	112

16.	Description of sample	What are the important characteristics of the sample? E.g., demographic data, date	113-15
Data collection			
17.	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	App A
18.	Repeat interviews	Were repeat interviews carried out? If yes, how many?	112
19.	Audio/visual recording	Did the research use audio or visual recording to collect the data?	112
20.	Field notes	Were field notes made during and/or after the interview or focus group?	112
21.	Duration	What was the duration of the interviews or focus group?	112
22.	Data saturation	Was data saturation discussed?	112
23.	Transcripts returned	Were transcripts returned to participants for comment and/or correction?	112
Domain 3: Analysis and findings			
Data analysis			
24.	Number of data coders	How many data coders coded the data?	113
25.	Description of the coding tree	Did authors provide a description of the coding tree?	113
26.	Derivation of themes	Were themes identified in advance or derived from the data?	113
27.	Software	What software, if applicable, was used to manage the data?	112
28.	Participant checking	Did participants provide feedback on the findings?	112
Reporting			
29.	Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? E.g., participant number	115-21
30.	Data and findings consistent	Was there consistency between the data presented and the findings?	115-21
31.	Clarity of major themes	Were major themes clearly presented in the findings?	115-21
32.	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	App D

Appendix D

Other factors influencing implementation.

CFIR domain 1: Innovation

Table 1 describes all factors that proved relevant during the implementation, along with exemplary quotes from participants illustrating these factors. A facilitator was the comprehensive design of the programme and its development via co-creation with academia, healthcare providers, experts, and IT developers. The programme encompassed various lifestyle interventions and a rewards programme to incentivise health behaviours and adherence to make healthy living. These features were possible due to the availability of an extensive network of partners within the PPP, which stemmed mainly from the private company's considerable pre-existing network. Finally, another facilitator was the development of a sustainable business model which ensured hospitals could offer the programme without incurring financial losses, further facilitating large-scale programme implementation. Development of this business model was possible due to the private party focussing on finding a sustainable financing structure, and due to the expansive knowledge, expertise, and network of the PPP. However, programme complexity was a barrier, particularly regarding patient understanding of the PHA. According to several participants, the multi-layered connections and options within the PHA made it difficult for some patients to understand the main functions and use of the PHA, potentially hindering their ability to fully engage with and benefit from the programme. Finally, another barrier was the digital skills of a minority of patients included in the program. Patients' digital skills varied widely, with noticeable disparities between locations. Since all surveys for programme participation could only be completed digitally, this entailed additional support from healthcare providers and administrative staff.

Table 1. Factors of CFIR domain 1 Innovation influencing implementation.

Theme	Quotes
Facilitators	
• Design and source of the program	• "The programme provides a holistic approach to lifestyle modification, so depending on what someone needs, you can offer something. Because of the PPP, we have been able to connect so many partners in the ecosystem that you can refer patients to within the intervention. This enhances its appeal. Besides that, the owners also developed all kinds of things, such as the challenges in the portal." • "Due to the PPP, the BENEFIT programme is co-created with many healthcare providers, academic researchers, and business developers. We've engaged in extensive dialogue, gathering feedback regarding needs and desires, and then cross-referenced this input with literature to merge the necessary elements effectively."
• Sustainable business model	"The BENEFIT intervention, as developed now, does not incur losses for hospitals. It is feasible to offer the programme cost-effectively, for example through a third party, enabling hospitals to economise and subcontract the service provision."
Barriers	
• Programme complexity	"The programme's complexity lies in its multi-layered connections. We noticed that patients didn't understand the goal so quickly, so I thought the programme was highly complex. Of course, the main goal is to empower patients, to get them moving, feel supported, and be able to find resources to continue working with their behavioural change, but that got overshadowed by the complexity."
• Digital skills of some patients	"Surely, we sometimes overlook that many people still face challenges with online surveys. This varies by location, and it's evident, isn't it? In some locations, surveys are always completed, whilst in others, they are hardly ever."

CFIR domain 2: Outer setting

Table 2 presents the identified factors, along with exemplary quotes. A facilitator was the government's increasing focus on preventive measures, which became visible through significant policy changes. At the end of the BENEFIT implementation, preventive healthcare was included in healthcare insurance coverage, representing a significant advancement in officially recognising the importance of preventive healthcare. However, a barrier identified was the commitment to external deadlines, as the implementation had to proceed despite not being in an ideal state due to COVID-19. This led to higher-ups experiencing tension between project timelines and readiness of the intervention.

Table 2. Factors within CFIR domain 2 Outer setting influencing implementation.

Theme	Quotes
Facilitator	
• Focus on prevention in policies and law	"The government has intensified its focus on preventative measures. Whilst this didn't necessarily translate to aligned reimbursements, prevention has, for the first time, been prioritised on the agenda and is now uniquely covered by basic insurance. This advancement coincided with the BENEFIT programme implementation."
Barrier	
• Commitment to external deadlines	"There are immutable deadlines, and one must deliver eventually, ready or not. Despite suboptimal conditions or an imperfect product, action must be taken, otherwise, the project concludes, time expires, and nothing is accomplished."

CFIR domain 3: Inner setting

Table 3 describes all identified factors, along with exemplary quotes. Mission alignment was a facilitator; participants were enthusiastic about the programme already existing, so organisations did not need to create a new initiative, and the extension of a three-month CR programme by a coaching element was met with enthusiasm, as participants believed in the potential benefits of this approach. However, a key barrier was poor IT integration; participants reported significant challenges due to duplicate filing and the need to work across multiple systems, which led to increased workload and inefficiencies. Additionally, assimilating the programme into existing workflows was a barrier. The additional workload required to integrate the BENEFIT programme into existing workflows was highlighted as a considerable barrier, requiring substantial time and energy investment, particularly in the context of already busy work schedules.

Table 3. Factors within CFIR domain 3 Inner setting influencing implementation.

Theme	Quotes
Facilitator	
• Mission alignment	• "A distinct advantage for us was the pre-existence of the program, obviating the need for its creation from scratch, which was a considerable blessing." • "The idea of extending the three-month cardiac rehabilitation trajectory with an ongoing coaching element was immensely appealing to us, and we embraced it with enthusiasm."
Barrier	
• Integration of the programme into existing workflows and practice	"The programme supplements existing healthcare services, adding to an already demanding schedule. It required substantial energy and time, particularly as we navigated a suitable and effective working methodology within our organisation. And encountering and resolving unforeseen challenges was an energy-intensive process."

CFIR domain 4: Individuals

Table 4 describes all identified factors, along with exemplary quotes. A facilitator in specific organisations was strong dedication among employees, creating a supportive environment for its implementation. Employees across various roles recognised the positive intentions behind the program, which motivated them to invest their time and effort into making the programme implementation a success. This collective dedication also played a significant role in navigating the initial stages of the implementation, setting a positive tone for the continuation of the process. Furthermore, within these organisations, a facilitator was the presence of confidence among employees in using the BENEFIT program. This confidence, however, was not without its challenges, as it was tested during periods of adapting and updating the PHA. Nevertheless, commitment was evident, and it played a crucial role in maintaining a level of enthusiasm and willingness to participate in the process. Finally, a facilitator was local implementation project leaders who provided clear direction and coordination for the necessary tasks and activities. This role was crucial in ensuring that all preconditions were met and healthcare providers could focus on patient care whilst logistical and administrative aspects were handled effectively. These leaders were willing to go beyond their primary responsibilities, among others, by sharing their work time between different roles and responsibilities. This was crucial for overcoming (unforeseen) challenges and continuing implementation.

A barrier identified was workplace resistance. Some higher-ups felt they had to impose tasks on employees to keep the implementation on track. This involved making tough decisions about what to prioritise and set aside. Furthermore, in some organisations, a key barrier to implementation was top-down decision-making. Whilst there was commitment from higher-ups to sort issues out and progress with the implementation, a top-down approach led to a lack of confidence and motivation among employees. Being obligated to comply without much input affected overall morale and enthusiasm towards the implementation. Finally, a barrier was employee compliance over conviction. Especially among newer employees, for example within the role of implementation facilitator, there existed a tendency to go along with the suggested deadlines or implementation strategies of higher-ups despite having different personal views of what was necessary and possible within the given timeframe. Newer employees relied largely on existing in-house experience and knowledge, leading to a dynamic where suggested approaches and strategies by higher-ups or more experienced team members were not fully aligned with their beliefs, but nevertheless adopted without genuine engagement or confidence in their efficacy. It sometimes led to their pre-mature communication of deadlines to external stakeholders, based on upper management's directives, despite internal expectations that they were unrealistic and likely to be missed.

Table 4. Factors of CFIR domain 4 Individuals influencing implementation.

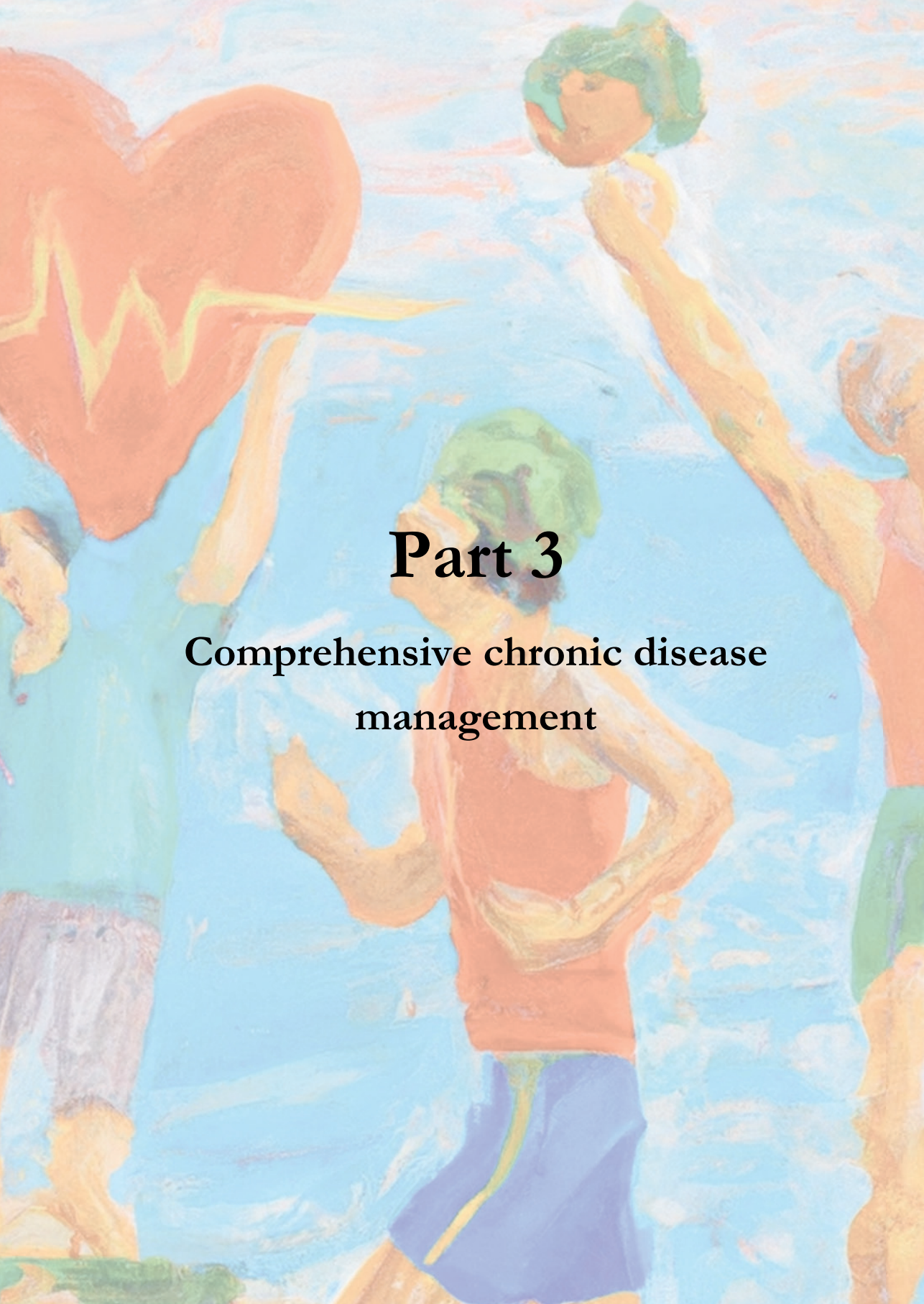
Theme	Quotes
Facilitators	
• Dedicated employees	"The programme's good intentions were apparent to all serving as a strong motivator. This encouraged a willingness to invest and participate, an effort we executed commendably, I believe."
• Confidence in using the program	"There was a consensus on the programme's utility. However, as it became apparent that further refinement was needed, there was a palpable decline in enthusiasm among nurses and physiotherapists, who faced repeated hindrances due to updates. Our collaborative efforts did enhance the platform, but each improvement phase came with a cost to satisfaction levels, impacting the healthcare provider's eagerness to utilise it."
• Having local implementation project leaders	• "My presence here is to ascertain which tasks need execution and who will undertake them, whilst also establishing the necessary preconditions. We have maintained extensive discussions with [L10] concerning the technical set-up, allowing healthcare providers to concentrate on the clinical aspects. My role is pivotal in ensuring that required actions are methodically executed, not all at once, but in a sequenced manner: identifying who is responsible for each task." • "In collaboration with [P2], we gave presentations. We proposed that [P2] joined to offer insights from the research perspective, which was essential and beneficial. They were receptive to this idea, and our interactions were invariably productive. This synergy was crucial, as our mutual dependence was evident."
Barriers	
• Workplace resistance	"When obstacles arise, my role is to guide decision-making: determining what will be done and what won't. At times, this involves asserting that certain actions are non-negotiable, overcoming resistance because these steps are necessary."
• Top-down decision making	"Decisions made by the board are definitive, and their commitment to resolving issues and progressing with the initiative was evident. However, this sometimes conflicted with personal confidence and motivation. Nonetheless, the decision was to forge ahead."
• Employee compliance over conviction	"Having not been part of the organisation for long, I tend to align with the existing expertise within the team. They opt for a particular course of action, believing it will achieve the desired outcomes, despite my colleague and I expressing reservations. Ultimately, one defers to the judgment and experience of those in senior positions."

CFIR domain 5: Implementation process

Table 5 describes all identified facilitators, along with exemplary quotes. A facilitator was conducting regular check-ins with external sites. This strategy was key for gathering information and maintaining proactive communication. Participants highlighted the critical role of being engaged and consistently checking in to identify and address potential issues early on, ensuring the process did not stagnate. Additionally, initiating the implementation with face-to-face introduction sessions was a facilitator, creating a foundation of trust and mutual understanding among team members, which facilitated smoother interactions and cooperation throughout the process.

Table 5. Factors of CFIR domain 5 Implementation process influencing implementation.

Theme	Quotes
Facilitators	
• Regular check-ins with external sites	"Engaging with individuals and providing clear instructions is crucial. Equally important is the ongoing dialogue to check in on progress, identify challenges, and ensure proactive problem-solving. Experience has taught us that processes invariably encounter stagnation; anticipating where and why, however, remains unpredictable."
• Face-to-face introduction sessions	"Initiating interactions with face-to-face introduction sessions is immensely beneficial. It establishes an understanding of the individuals you are working with, their motivations, and interests, which is fundamental to building mutual trust."



Part 3

Comprehensive chronic disease management

Chapter 6

Internet-based cognitive behavioural therapy among psychologists in a medical setting: a survey on implementation

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Abstract

Background: Internet-based Cognitive Behavioural Therapy (iCBT) is an effective treatment for patients with a chronic somatic illness to improve self-management skills and to learn to adjust to their chronic disease and its impact on daily life. However, the implementation of iCBT in clinical practice is challenging.

Objective: This study aimed to examine the current degree of implementation of iCBT among psychologists in a medical setting and discover determinants influencing the implementation of iCBT among nonusers.

Methods: A Web-based survey, based on the Unified Theory of Acceptance and Use of Technology (UTAUT), was distributed among psychologists in a medical setting. The survey included questions regarding the current use of iCBT, intention to use iCBT in the future, and operationalised concepts of the UTAUT constructs, that is, performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC).

Results: In total, 107 (24.8%) psychologists completed the survey. Of them, 16.8% have access to iCBT, 15.9% currently use iCBT, and 21.5% are expected to use iCBT within the next year. The constructs PE, EE, and FC together significantly influenced behavioural intention (BI; mean 3.9 [SD=.8]) among nonusers (R^2=.490; $F_{4.85}$=20.405; P<.001).

Conclusions: Despite an average to high BI, the current implementation of iCBT is rather low among psychologists in a medical setting. Further research should focus on reducing the gap between intention to use and actual use by focusing on influencing the predictive UTAUT constructs.

Introduction

Patients with a chronic somatic illness often struggle with a complex interaction of physical, psychological, and social demands related to their disease. These demands significantly influence their disease perception and quality of life (1–3). Supporting patients in increasing their disease self-management can effectively increase illness adjustment and adherence to treatment, and decrease problems related to illness behaviours and comorbid mental illnesses such as depression and anxiety (4–6). Psychologists can offer this support as part of outpatient treatment in a hospital clinic. In the Netherlands, these psychologists are called medical psychologists, and patients are referred to them by their medical specialist. Regarding the content of this support, cognitive behavioural therapy (CBT)-based techniques are regularly used. However, CBT is generally only available to a small number of patients in this setting because it is expensive, time consuming (7,8), and sometimes inaccessible because of attendance barriers (9,10).

Internet-based Cognitive Behavioural Therapy

With the development of internet-based treatment (11), CBT has become much more accessible to a wide range of patients (4). In the Netherlands, internet-based CBT (iCBT) is usually offered as a guided programme, containing modules regarding goal setting, psychoeducation, (behavioural) assignments, relaxation exercises, and diary registrations, which are supported by asynchronous contact with a therapist through messages in a secured email box (12). The iCBT service can be used in several ways, depending on the severity of the problems of the patient and the patient preferences. It can be provided as a stand-alone service, in which it is a replacement of a regular therapy, or it can be used as an addition to regular treatment, in which iCBT is used blended, combined with face-to-face sessions. In all scenarios, patients use the Web portal from their home environment. Use of iCBT potentially produces similar overall effects compared with face-to-face CBT (13–15) and is significantly efficacious in improving disease-specific symptoms, disease control (9,16–18), and disease-related physical outcomes (13). Moreover, treatment by traditional forms of psychological therapy can be associated with stigmatising beliefs about mental illness and negative prejudices about therapists (19), whereas iCBT is usually experienced as easy to access and the most private way to seek help (20). Moreover, iCBT provides patients the ability to administer treatment and access treatment-related material at any time and any place (16). Finally, regarding economical perspectives, offering iCBT enables a potential reduction in healthcare costs (21), the number of needed contact hours, waiting lists, and traveling time for patients (22).

Current implementation of internet-based Cognitive Behavioural Therapy

However, implementation of iCBT in clinical practice remains a challenge (23,24), and different healthcare settings show different usages of iCBT. Results of a naturalistic study among therapists of a Dutch mental health centre showed that after training, over a period of 3 years, only 3.6% of the patients were offered the possibility to participate in iCBT, initiated by 18% of the therapists qualified to provide iCBT (25). On the contrary, a study among Dutch primary care psychologists (PCPs) and mental health councillors (MHCs) in general practitioner practices showed more optimistic numbers, with 29% of the PCPs and 60% of the MHCs having used Web-based psychological self-management interventions (based on CBT) in their treatments (26). Regarding iCBT in the hospital setting, research is lacking. Therefore, the aim of this study was to gain insight into use, barriers, and facilitators regarding implementation of iCBT among psychologists in medical settings.

Research into possible factors influencing the degree of implementation of iCBT and iCBT-related interventions among psychologists is relatively young. Dissemination and implementation of digital health interventions often face many barriers on differing levels, for example, related to perceived effectiveness, expected usability, usefulness in the patient population, facilitating conditions (FC) at work, and personal productivity (26,27). A suitable model to measure acceptance of technology and its associated influences on those multiple levels is the Unified Theory of Acceptance and Use of Technology (UTAUT) (28). Based on this model, determinants influencing behavioural intention (BI) of iCBT are mapped, related to future users' performance expectancy (PE), effort expectancy (EE), social influence (SI), and available FC (28).

Use of the Unified Theory of Acceptance and Use of Technology

According to the UTAUT model, four constructs are crucial in explaining the use of technology, namely PE, EE, SI, and FC. PE indicates "the degree to which an individual believes that using the system will help him or her to attain gains in job performance" (28). For psychologists in medical settings, this would mean that the use of iCBT may or may not contribute to their quality of work in a positive manner, for instance, the use of iCBT reduces time that is required to fulfil major responsibilities (e.g., providing help to patients). EE can be defined as "the degree of ease associated with the use of the system" (28). In practice, this would mean that the use of iCBT may or may not be clear, understandable, and easy to learn for psychologists. SI indicates "the degree to which an individual perceives that important others believe he or she should use the new system" (28). In practice, this would mean that psychologists may or may not believe that colleagues and management at the workplace think they should use iCBT and support their use of iCBT. FC indicates "the degree to which an individual believes that an organisational and technical infrastructure exists to support the

use of the system" (28). For psychologists in medical settings, this would indicate that the use of iCBT may or may not be stimulated by the organisation or manager. Moreover, the construct BI is a crucial determinant for use behaviour and can be defined as "a person's subjective probability to perform a specified behaviour" (29). In practice, this would mean the likelihood of use of iCBT among psychologists in medical settings.

The purpose of this study was to examine the fit and current degree of implementation of iCBT among psychologists in a medical setting and explore the extent to which the determinants of the UTAUT model influence the degree of implementation among nonusers. This was done using a nationally spread survey in the Netherlands to gain broad and generalisable insights into barriers and facilitators regarding implementation of iCBT in hospitals.

Methods

Recruitment

Respondents were recruited by (personal) email in March 2017. Dissemination of the survey was done by the Dutch Association of Medical Psychologists, and email addresses were collected by systematically searching hospitals per province (using Zorgkaart Nederland and Google), after which these hospitals were approached. In case no information on the names or email addresses of psychologists was found on the website, the secretariat of the hospital was contacted by phone to ask whether they would agree to share their psychologists' contact information. This resulted in a total initial spreading among 432 addresses. However, a snowball effect might have occurred because psychologists were asked to forward our invitation to colleagues to whom it might be relevant as well.

The email included an information letter and a link to the Web-based survey in Qualtrics (2015 Qualtrics, LLC). The information letter explained the purpose of the study and its voluntary nature, use and anonymisation of the data, estimated time needed to participate (10 min), and the reward for participating in the study (5 gift certificates of €50 were raffled among the respondents). All email addresses were stored separately and were only used for the raffle. The Web-based survey started with an informed consent form. Not responding to the survey or opting out of the informed consent form was considered as choosing not to participate in the study. Psychologists who were employed at multiple hospitals were asked to choose 1 hospital and fill in the survey based on their chosen hospital. If the survey was not fully completed, data were not included in further statistical analysis. Furthermore, 1 and 2 weeks after sending the invitation emails, reminder emails were sent to all email addresses. The study was approved by the Psychology Research Ethics Committee of Leiden University.

Survey

The survey consisted of 3 parts, namely i) background information about the psychologist and the hospital, ii) general and work-related use of the internet of the respondent, and iii) an operationalisation of the UTAUT constructs. The background information included gender, age, professional background, number of working hours per week, and years of employment. Background information about the hospital included number of colleagues working as a psychologist, number of newly referred patients per month, reasons for referral of patients, consult duration per visit, number of contacts per patient per treatment trajectory, and type of primarily offered help to patients. In part 2, general and work-related use of the internet was measured using questions about quantity of internet use in general, self-perceived skills to use the internet, use of internet for work-related activities, and current available Web-based applications in the hospital.

To operationalise the UTAUT, subscales were created for each construct in the model (PE, EE, SI, FC, and BI). Regarding BI, respondents first answered whether using iCBT was part of their current work activities, after which they had to answer whether they had the intention to start using iCBT in case they currently did not use it. By measuring actual use of iCBT, a distinction between users and nonusers was possible. Subscales of the UTAUT constructs were measured with 3 to 8 items formulated as statements, for instance, "I expect/experience that guided iCBT is effective for my patient population" (PE), "I expect/experience that guided iCBT is time intensive to use" (EE), "I expect/experience that iCBT is seen as a positive development among my colleagues" (SI), "I expect/experience that iCBT fits within the technological circumstances of my practice" (FC), and "I want to use/continue to use guided iCBT" (BI). Respondents answered statements on a 5-point Likert scale, ranging from completely disagree (1) to completely agree (5). A complete overview of the survey is provided in **Appendix A**.

Statistical analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (IBM SPSS Statistics 24). Descriptive statistics were used to describe the study sample, their internet experience, and their scores on the UTAUT constructs. Scale scores and Cronbach alphas were calculated for each UTAUT construct to check internal reliability. In the sample of nonusers, Pearson correlations were calculated to determine the relationship between the UTAUT variables PE, EE, SI, and FC and the dependent variable BI. Based on the statistical significance of these relations, multiple regression analysis was carried out to examine the further nature of these relations.

Results

Respondents

A total of 127 psychologists in medical settings filled in the survey. Among them, 107 completed the survey, whereas 20 stopped early. These data were not used for analyses and contained 11.8% of the data. Among the respondents, 58 (58/107, 54.2%) stated that they are members of the Dutch Association of Medical Psychologists, whereas 49 (49/107, 45.8%) stated that they are not members. The estimated response rate is 24.8%, as 432 people were contacted for participation via their email addresses. However, because of the method of data collection, it is not possible to calculate an exact response rate.

Table 1 provides an overview of the respondents' characteristics. Most respondents were female (92/107, 86.0%), with a mean age of 40.9 years (SD=11.3). A large part of the respondents had a professional background as a health care psychologist (45/107, 42.1%) or clinical psychologist (27/107, 25.2%; these are both protected titles in the Netherlands, based on postmaster educational tracks). On average, respondents have been active as psychologists in a medical setting for 10.0 (SD=8.1) years and received up to 20 (69/107, 64.5%) new patients each month (data not shown in Table 1). Regarding consultations, most patients were seen for 5 to 10 times (60/107, 56.1%), and therapy sessions lasted an average of 53 min per session. Regarding characteristics of the care provided, respondents most often reported treating problems with dealing with chronic physical complaints and limitations (93/107, 86.9%), anxiety- and/or mood-related problems (68/107, 63.6%), and pain (39/107, 36.4%). Finally, the type of care primarily provided consisted of interventions aimed at improving mental functioning (93/107, 86.9%), problem clarification and diagnostics (90/107, 84.1%), psychoeducation (80/107, 75.7%), and guiding and supporting self-management (65/107, 60.7%).

Internet experience

Most respondents used the internet daily (102/107, 95.3%) and rated their internet skills as (very) good (92/107, 86%). Concerning work functionalities, respondents mainly used the internet to search for medical information (103/107, 96.3%) or have contact with clients through email (71/107, 66.4%). Regarding availability of Web-based health applications in the hospital, respondents primarily reported availability of electronic medical records (104/107, 97.2%), a website with patient information (73/107, 68.2%), and a Web portal with patient records (46/107, 43%). Electronic or Web-based screening (21/107, 19.6%), Web-based self-management modules (18/107, 16.8%), and use of teleconsultation (10/107, 9.3%) were less common.

Table 1. Background information of the respondents and their hospital (N=107).

Characteristics	
Gender, n (%)	
Men	15 (14.0)
Women	92 (86.0)
Age (years), mean (SD)	40.5 (11.5)
Professional background, n (%)	
Psychologist, MSc	13 (12.1)
Health care psychologist	45 (43.1)
Clinical psychologist	27 (25.2)
Clinical neuropsychologist	2 (1.9)
Other (e.g., in training to become health care psychologist)	20 (18.7)
Number of consultations during 1 complete treatment, n (%)	
<5	39 (36.4)
5-10	60 (56.1)
>10	8 (18.7)
Average number of minutes spent per therapy session, mean (SD)	53.9 (29.2)

Use of guided internet-based Cognitive Behavioural Therapy

Regarding the type of problems for which the respondents considered iCBT as an appropriate treatment, anxiety- and/or mood-related problems were most often reported (81/107, 75.7%), followed by problems dealing with chronic physical complaints and limitations (78/107, 72.9%), sleep problems (72/107, 67.3%), and fatigue problems (70/107, 65.4%).

Table 2 shows that 15.9% (17/107) of the respondents used guided iCBT at the time of filling in the survey. More than half of the respondents (68/107, 63.6%) had seen guided iCBT programmes before. Among this subgroup, almost three-fourths (49/68, 72.1%) considered iCBT a suitable treatment for problems related to dealing with chronic physical complaints and limitations, and more than three-fourths (54/68, 79.4%) considered iCBT a suitable treatment for anxiety- and/or mood-related problems. In addition, almost one-third of the respondents (31/107, 29%) had received training in the use of guided iCBT, and more than a quarter used it as a part of their work activities in the past (31/107, 29%). Within these subgroups, more than half of the respondents (18/31, 58.1% in both subgroups) considered iCBT a suitable treatment for problems related to dealing with chronic physical complaints and limitations, and more than three-fourths (26/31, 83.9% and 25/31, 80.6%, respectively) considered iCBT a suitable treatment for anxiety- and/or mood-related problems. Finally, of the (former) users, a majority (20/31, 64.5%) had used guided iCBT in less than 10 treatments. Regarding future use of iCBT, more than one-fourth of all nonusers (23/90, 25.6%) expected to use guided iCBT within the next year, and more than half (57/90, 63.3%) expected to use guided iCBT within 2 to 5 years.

Table 2. Use of guided internet-based cognitive behavioural therapy (N=107).

Question	
Current use of guided iCBT[a]	17 (15.9)
Previous experience with guided iCBT	
Has seen a programme of guided iCBT	68 (63.6)
Has received a training in the use of guided iCBT	31 (29.0)
Has applied guided iCBT in previous treatments	31 (29.0)
Completed guided iCBT treatment programmes by (former) users (n=31)	
<10 treatments	20 (64.6)
10-20 treatments	4 (12.9)
>20 treatments	7 (22.6)
Expected time frame of iCBT usage in the future among nonusers (n=90)	
Within the next year	23 (25.6)
Within 2-5 years	57 (63.3)
Not within the next 5 years	9 (10.0)
Never	1 (1.1)

[a]iCBT: internet-based cognitive behavioural therapy.

Facilitators and barriers

Distribution of the scores on the UTAUT constructs was normal. Internal consistency was acceptable to excellent (see **Table 3**). On average, responses varied between the answer categories neutral and partly agree.

Influence of Unified Theory of Acceptance and Use of Technology constructs on Behavioural Intention among nonusers

Pearson correlations showed statistically significant moderate to high positive associations between the UTAUT constructs PE, EE, SI, and FC and the dependent variable of BI, respectively (PE r=.656; EE r=.479; SI r=0.251; and FC r=.443; P<.001 for PE, EE, and FC, and P=.02 for SI). **Table 4** shows the results of the multiple regression analysis using the enter method. The multiple regression model with the dependent variable BI explained 49% of variance in BI (R2=.490; F4.85=20.405; P<.001). The constructs PE, EE, and FC had a significant positive effect on BI regarding use of iCBT, whereas SI did not.

Table 3. Scores on the Unified Theory of Acceptance and Use of Technology constructs (total N=107; users N=17; nonusers N=90).

Construct	Cronbach alpha	Statistics, mean (SD)[a]
Behavioral intention	.90	3.9 (.8)
Users	—[b]	4.5 (.7)
Nonusers	—	3.8 (.8)
Performance expectancy	.80	3.7 (.4)
Users	—	3.7 (.3)
Nonusers	—	3.7 (.4)
Effort expectancy	.71	3.5 (.4)
Users	—	3.5 (.3)
Nonusers	—	3.5 (.4)
Social influence	.78	3.0 (.7)
Users	—	3.2 (.7)
Nonusers	—	2.9 (.6)
Facilitating conditions	.68	3.4 (.6)
Users	—	3.5 (.6)
Nonusers	—	3.3 (.6)

[a]Responses answered all statements of all constructs by a 5-point Likert scale, namely 1: completely disagree, 2: partly disagree, 3: neutral, 4: partly agree, and 5: completely agree.

[b]—: not applicable.

Table 4. Results multiple regression analysis of Unified Theory of Acceptance and Use of Technology constructs on behavioral intention (N=90).

Model	B[a]	Beta[b]	SE	P value
Constant	-1.823	—[c]	.669	.01
Performance expectancy	.803	.438	.176	<.001
Effort expectancy	.625	.288	.187	.001
Social influence	-.222	-.174	.139	.11
Facilitating conditions	.355	.270	.154	.02

[a]B: partial regression coefficient.

[b]Beta: standardized regression coefficient.

[c]—: not applicable.

Discussion

Principal findings

Guided iCBT is a suitable and effective treatment for patients with a chronic somatic illness. However, its implementation in clinical practice remains challenging. The main purpose of this study was to examine the fit and the current degree of implementation of iCBT among psychologists in medical settings and determine its facilitators and barriers among nonusers. Most respondents in our sample were female (92/107, 86.0%) and had an official registration as psychologist, which is representative for the Dutch situation (30).

The results of the study showed that the use of technology is highly integrated among psychologists, both on a personal level and work-related level. Moreover, respondents generally considered iCBT as an appropriate treatment for the type of problems they treat their patients for, regardless of their (previous) experience with iCBT. The actual current use of iCBT, however, was limited. Our results show that only 16% (17/107) of the respondents is currently using iCBT. In addition, 29% (31/107) had received training in the use of guided iCBT, and 29% (31/107) had used it as a part of their work activities in the past. This raises the question why only such a small portion of psychologists use these Web-based treatment tools nowadays and what happened when they stopped using them. Presumable reasons for ending the use of iCBT could be that people have changed organisations and were not satisfied with the Web-based programmes they used or, for instance, a change of policy from their management.

Our results concerning outcomes on the UTAUT model provide some insight into these questions and into what is further needed to increase implementation success. BI regarding the use of iCBT was found to be high among nonusers, with 98.9% (89/90) planning to use it within the upcoming 5 years; therefore, there is a high willingness to use Web-based tools in treatment. We also found that PE, EE, and FC appear to be significant predictors for this BI. These results indicate that aspects such as effectiveness for the client population, easiness of use, and managerial focus impact psychologists' choice in the use of iCBT. These outcomes are in line with recent research on iCBT use in primary and routine care (26,27). Still, the answers on most constructs had a small dispersion (spreading of the answers; responses were located around the answer categories partly agree or neutral), indicating that the respondents did not have very outspoken expectations on these determinants. This might indicate an implementation barrier because the needs and beliefs about iCBT might not be strong enough to actually create behavioural change. To create actual change, it seems of major importance that the availability of Web-based self-management tools increases in hospital settings because, currently, only 17% (18/107) have access to iCBT. As a result, a larger part of psychologists in these settings will be able to use iCBT when willing to.

In the Netherlands, there is quite a large number of commercially provided iCBT portals, in which hosting and updating is outsourced. Psychologists can make use of these programmes using a paid license. Although we now know that practicing psychologists would be intended to use these iCBT services, the actual access is probably often depending on the willingness of their management to invest in iCBT services. Future implementation efforts should therefore initially focus on these types of stakeholders, using implementation models that take a broad range of stakeholders into account. An example of such a model is the Consolidated Framework for Implementation Research (31), addressing five domains to

include in implementation research. These are intervention characteristics (e.g., adaptability and relative advantage), the setting within the organisation (e.g., culture, leadership engagement, and communication), the environment outside the organisation (e.g., external policies and incentives, peer pressure, needs, and resources), characteristics of the individuals involved (e.g., self-efficacy, personal attributes, and individual stages of change), and the process of implementation (e.g., planning, execution, and internal implementation leaders).

Future directions

Based on our results using the UTAUT model, we can further reflect on what follow-up steps in improving implementation success seem essential, partly on an individual level. Concerning PE and EE, this study showed that fewer than one-third of the respondents have received a training in the use of iCBT. Therefore, expectations about whether iCBT asks a lot of new skills, affects work productivity, and increases the quality-of-care provision appear to affect the implementation process of iCBT. Moreover, these findings are consistent with previous research stating that lack of knowledge of the programme and expectations regarding effectiveness and fully mastering the required protocol influence acceptance of iCBT (8,27,32,33). Therefore, attention should be paid to providing employees more education in iCBT by offering knowledge regarding availability of existing iCBT programmes, their effectiveness, usefulness, and performance productivity and by offering them proper skills training (27,34). Regarding FC, stimulation of iCBT use from a management level is a key prerequisite for use in daily practice. Moreover, attention should be paid to the degree of customisation of iCBT to the daily workflow of psychologists.

Limitations

With this survey, we aimed to reach the most representative sample possible by trying to contact each psychologist in a medical setting in the Netherlands. The possibility exists that people interested in electronic health (eHealth) or actual eHealth users were more inclined to respond to the survey. This could result in fewer psychologists actually using iCBT in the complete population than the results from this survey show. In addition, social desirability may have influenced the provided answers of the respondents because the government encourages the use of eHealth among health professionals, which might have pressured our respondents toward positive answers. Furthermore, it is not possible to exactly estimate how many psychologists received our survey because invited psychologists were asked to forward our invitation to colleagues to whom it might be relevant as well. However, our estimated response rate of 24.8% is in line with the average response rate of large surveys (35). Moreover, by sending out 2 reminders each 7 days after the first invitation email and by making use of personalisation, appropriate measures were used to increase the response rate as much as possible (36). Delay between reminders was based on research stating no

significant difference in response rate for follow-up emails sent after 1 or 2 weeks and recommending time lags of 1 week (37).

Conclusion

Despite an average to high BI, current implementation of iCBT is low among psychologists in medical settings. Increasing the availability of iCBT and bringing change in other areas that could influence the gap between intention and actual use is needed. The UTAUT constructs PE, EE, and FC significantly affect BI regarding use of iCBT. Therefore, further research and implementation trajectories should focus on offering a wide range of iCBT programmes, education on iCBT facilities and required skills, and customisation of iCBT to the daily workflow of psychologists.

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Appendix A

English version of the survey as distributed among medical psychologists in the Netherlands.

You and your practice

	Question	Answer
1.	What is your age?	… years
2.	What is your sex?	☐ Male ☐ Female
3.	What is your professional background?	☐ Psychologist, MSc. ☐ Healthcare psychologist ☐ Clinical psychologist ☐ Clinical neuropsychologist ☐ Other ……
4.	Are you a member of the National Association of Medical Psychology?	☐ Yes ☐ No
5.	How many years do you work as a psychologist?	… years
6.	How many years do you work as a medical psychologist?	… years
7.	How many hours are you employed on a weekly basis?	… hours a week
8.	In which province is your hospital positioned?	☐ Groningen ☐ Friesland ☐ Drenthe ☐ Overijssel ☐ Gelderland ☐ Utrecht ☐ Flevoland ☐ Noord-Holland ☐ Zuid-Holland ☐ Noord-Brabant ☐ Zeeland
9.	What kind of hospital do you work for?	☐ General hospital ☐ Top clinical hospital ☐ Academic hospital
10.	How many inhabitants does the place in which the hospital is located count?	☐ < 10.000 inhabitants ☐ 10.000 – 50.000 inhabitants ☐ 50.000 – 150.000 inhabitants ☐ 150.000 – 300.000 inhabitants ☐ > 300.000 inhabitants

11.	How many medical psychologists work at your hospital?	… medical psychologists
12.	With what reason/referral indication do clients mostly come to you as a medical psychologist? (Max. 3 answers)	☐ Problems in dealing with the chronic psychical complaints and limitations ☐ Anxiety and/or mood complaints ☐ Social problems (e.g., relationships) ☐ Pain problems ☐ Sleep problems ☐ Fatigue complaints ☐ Sexuality problems ☐ Others, namely ……
13.	How many new clients do you see every month, on average?	… clients
14.	Per treatment programme, how many sessions do you have with a client, on average?	☐ 1 session ☐ 2 to 5 sessions ☐ 5 to 10 sessions ☐ More than 10 sessions
15.	How many minutes do you spend per client contact, on average?	… minutes
16.	What type of help do you mainly offer your clients? (Max. 3 answers)	☐ Problem clarification and diagnostics ☐ Psychoeducation ☐ Guidance/support with self-management ☐ Interventions aimed at improving physical functioning of the client ☐ Interventions aimed at improving psychological functioning of the client ☐ Relapse prevention ☐ Other, namely ……

You, your hospital, and technology

	Question	**Answer**
17.	How often do you use the internet? (In general, i.e., to send an e-mail, or to search for information)	☐ (Almost) every day ☐ Several times a week ☐ Approximately 1 day a week ☐ Less than 1 day a week ☐ (Almost) never
18.	How do you rate your internet skills?	☐ Very good ☐ Good ☐ Average ☐ Poor ☐ Very poor ☐ No, never

19.	Do you also use the internet for work? If so, please indicate the purpose. (You can select multiple answers)	☐ Yes, to search for medical information ☐ Yes, to communicate with clients via e-mail ☐ Yes, to search for information on insurances and reimbursements ☐ Other purpose, namely ……
20	Which technology is available in your hospital? (You can select multiple answers)	☐ Electronic medical records ☐ Web portal with client file ☐ Online appointment tool ☐ Online recipes tool ☐ Website for client information ☐ Electronic/online screening ☐ eConsult (secure client e-mail contact) ☐ Tele-medicine (e.g., video calling, remote care) ☐ Online self-management/treatment modules ☐ None of the above-mentioned possibilities ☐ Other, namely ……

You, your hospital, and guided eHealth programmes

Within hospital setting, eHealth programmes can be offered in the form of guided internet-based cognitive behavioural therapy (guided-iCBT), which makes it suitable for self-management support for patients with chronic somatic complaints, and treatment of co-morbid anxiety and mood problems.

	Question	**Answer**
21.	Have you ever seen a programme for guided eHealth?	☐ Yes ☐ No ☐ I don't know
22.	Have you ever been trained to use a programme for guided eHealth?	☐ Yes ☐ No ☐ I don't know
23.a.	Have you ever used a programme for guided eHealth within treatment?	☐ Yes ☐ No ☐ I don't know
23.b.	If so, how many guided eHealth treatment programmes did you go through, approximately?	☐ Zero treatments / I don't know ☐ Less than 10 treatments ☐ Between 10 and 20 treatments ☐ More than 20 treatments

24.	For which type of complaints do you think guided eHealth programmes are suitable/did you use guided eHealth programmes? (You can select multiple answers)	☐ Problems in dealing with the chronic psychical complaints and limitations ☐ Anxiety and/or mood complaints ☐ Social problems (e.g., relationships) ☐ Pain problems ☐ Sleep problems ☐ Fatigue complaints ☐ Sexuality problems ☐ Others, namely ……

25. "I expect/perceive that guided eHealth programmes…"[1]

		Statement	Answer				
			Totally disagree	**Partly disagree**	**Neutral**	**Partly agree**	**Totally agree**
a.	[PE]	… be effective for my client population.	☐	☐	☐	☐	☐
b.	[EE]	… be easy to use.	☐	☐	☐	☐	☐
c.	[PE]	… be useful for my client population.	☐	☐	☐	☐	☐
d.	[PE]	… increase the quality of my care provision.	☐	☐	☐	☐	☐
e.	[SI]	… advised by important people or colleagues in my immediate area	☐	☐	☐	☐	☐
f.	[EE]	… ask a lot of practice and schooling.	☐	☐	☐	☐	☐
g.	[PE]	… increase the diversity of my care provision.	☐	☐	☐	☐	☐
h.	[FC]	… fit within the financial structures of my practice.	☐	☐	☐	☐	☐
i.	[EE]	… are time consuming to use.	☐	☐	☐	☐	☐
j.	[FC]	… fit within the current technological state of things in my practice.	☐	☐	☐	☐	☐
k.	[PE]	… increase the productivity of my practice.	☐	☐	☐	☐	☐
l.	[SI]	… be seen as a positive development among my colleagues.	☐	☐	☐	☐	☐
m.	[PE]	… increase the interaction or communication with my clients.	☐	☐	☐	☐	☐
n.	[FC]	… be stimulated by my organisation or manager.	☐	☐	☐	☐	☐
o.	[EE]	… be fun to use.	☐	☐	☐	☐	☐

p.	[SI]	… used by colleagues with a lot of respect in my hospital.	☐	☐	☐	☐	☐
q.	[PE]	… decrease the interaction or communication with my clients.	☐	☐	☐	☐	☐
r.	[PE]	… increase the tailoring of care among my clients.	☐	☐	☐	☐	☐
s.	[EE]	… ask a lot of new skills from me.	☐	☐	☐	☐	☐
t.	[EE]	… are easy to gain skills in.	☐	☐	☐	☐	☐
u.	[SI]	… be actively used by my colleagues.	☐	☐	☐	☐	☐
v.	[EE]	… be interesting to use.	☐	☐	☐	☐	☐
w.	[FC]	… fit within my way of working.	☐	☐	☐	☐	☐
x.	[SI]	… be seen as a positive development by my organisation or manager.	☐	☐	☐	☐	☐
y.	[FC]	… fit with the goals of (the management of) my organisation.	☐	☐	☐	☐	☐
z.	[SI]	… cause an increase in respect and admiration to colleagues who use his.	☐	☐	☐	☐	☐
aa.	[FC]	… fit with the possibilities I receive for schooling and education.	☐	☐	☐	☐	☐

[1][PE] = Performance Expectancy; [EE] = Effort Expectancy; [SI] = Social Influence; [FC] = Facilitating Conditions.

			Answer				
		Statement	**Totally disagree**	**Partly disagree**	**Neutral**	**Partly agree**	**Totally agree**
26.	[BI][1]	I would like to use/keep using guided eHealth programmes.	☐	☐	☐	☐	☐
27.	[BI]	I intend to use/keep using guided eHealth programmes.	☐	☐	☐	☐	☐
28.	[BI]	I expect to use/keep using guided eHealth programmes in the future.	☐	☐	☐	☐	☐
29.		It is/remains my own choice to continue using guided eHealth programmes.	☐	☐	☐	☐	☐
30.		My management will put pressure on me to continue using guided eHealth programmes.	☐	☐	☐	☐	☐

[1][BI] = Behavioral Intention.

		Question	Answer
31.	[BI][1]	Within which time frame do you expect to use guided eHealth programmes?	☐ I currently use them already ☐ Within the next six months ☐ Within the next year ☐ Within two to five years ☐ Not within the next five years ☐ Never
32.		Are you interested in receiving (more) information about guided eHealth programmes?	☐ Yes ☐ No
33.		Are you interested in a training course in the use guided eHealth programmes?	☐ Yes ☐ No
34.		If so, what kind of information or training would you like to receive?	

[1][BI] = Behavioral Intention.



Bringing it all together

Chapter 7

General discussion

One year after her second heart attack, Eva looks back on a period that began in uncertainty and slowly turned into adjustment.

The lifestyle changes she once found overwhelming, such as morning breathing exercises, forty-minute walks, and nicotine-free evenings, have become almost second nature; what felt impossible now structures her days.

Setbacks still occur, yet she anticipates them: a missed walk turns into a short yoga session, and a craving for cigarettes triggers a call with her digital coach. She no longer feels like a patient but a participant in her own life, confident in her ability to manage her health and trust her body again.

Whilst she knows relapses remain possible, experience, support, and a renewed sense of agency leave her better equipped to respond more effectively.

GENERAL DISCUSSION

Globally, cardiovascular disease (CVD) is the primary contributor to both morbidity and mortality (1). This highlights the necessity for integrated strategies, including multifaceted eHealth tools, that move beyond clinical treatment to tackle the lifestyle and psychological determinants driving the condition's advancement (2–4). Although medical treatments and procedures have significantly improved patient outcomes, lasting improvements in cardiovascular health often require sustained changes in behaviour, such as smoking cessation and increased physical activity. Nevertheless, sustaining habit changes can be difficult (5), particularly as patients are forced to reconcile the psychological aftermath of a cardiac event with the rigorous schedule of rehabilitation and their daily obligations (6,7). This underscores the need for multifaceted interventions that extend beyond traditional medical treatment.

This thesis has three aims:

1. Advance knowledge on the initiation and maintenance of sustainable health behaviour change in patients with CVD.
2. Identify and address the multifaceted barriers and facilitators to implementing complex eHealth interventions in clinical practice, particularly within public-private partnerships (PPPs).
3. Integrate behavioural change and complex eHealth interventions into a holistic approach for chronic disease management, including psychosocial challenges faced by patients with CVD.

Aim 1 focuses on understanding how patients initiate and sustain behaviour change, whereas Aim 2 concerns the effective integration of complex eHealth interventions into clinical care to support this process. Aim 3 connects these insights into an integrated approach for chronic disease management. As sustainable change often relies on ongoing support and monitoring, insight into both patient-level mechanisms and system-level implementation is essential for real-world impact.

In line with these aims, this thesis first examined mechanisms that motivate the initiation and maintenance of lifestyle changes in patients with CVD (**Chapter 2** and **Chapter 3**). Specifically, it was investigated how brief lifestyle advice and the integration of life and health goals can foster intention-to-change-lifestyle in patients with CVD (**Aim 1**). Second, barriers and facilitators to implementing complex eHealth interventions, particularly in the context of PPPs, within routine clinical care were explored (**Chapter 4** and **Chapter 5**), thereby applying theory-informed implementation science to design and evaluate a practice-tailored

implementation strategy (**Aim 2**). Additionally, barriers to adopting eHealth among non-using psychologists in medical hospitals were assessed (**Chapter 6**), offering further insights into factors influencing the uptake of online therapy as part of a holistic approach for chronic disease management (**Aim 3**).

This concluding **Chapter 7** summarises the key findings from each study and places them in a broader context. The subsequent sections delve deeper into these findings based on each research objective, situating them within recent literature, and considering their implications for patient-centred cardiac care. Finally, the chapter offers recommendations for practice and policy, discusses the research's strengths and weaknesses, and suggests directions for future research.

Discussion of the main findings

In this section, we reflect on the main findings from each study and discuss how they relate to this thesis's overarching aims.

Aim 1: Advance knowledge on the initiation and maintenance of sustainable health behaviour change in patients with CVD

Aim 1 examined ways to strengthen CVD patients' intention to adopt and maintain healthy lifestyles (RQ 1). Two routes were tested: first, optimising brief lifestyle advice by varying the source (cardiologist versus physiotherapist) and the message framing (gain- versus loss-frame); second, linking goals by comparing stand-alone health goals with combined life- and health-goal setting. Chapter 2 reported the impact of source and framing on intention, whilst Chapter 3 identified life and health goals preferences and showed how linking life and health goals, and specific socio-demographic factors, influence their intention.

In **Chapter 2**, patients' intention-to-change-lifestyle was significantly higher when the advice came from a cardiologist compared to a physiotherapist. However, advice from physiotherapists also generally led to positive intentions. These findings relate to previous research emphasising that patients primarily see changing their lifestyle habits as their own responsibility, but that guidance from healthcare providers is essential in order for them to truly take control of their own health (8). Patients recognised that their health is "up to them", but also highlighted the importance of gaining knowledge, building self-efficacy, and receiving encouragement from trusted professionals to initiate and sustain change. Other recent findings indicated that cardiac patients respond most positively when advice is repeated throughout the care pathway and provided by a trusted professional (9,10). This

underscores the value of a dual approach in which both personal agency and professional guidance are actively used to foster sustainable behaviour change in patients (8).

The results of our study also showed that framing of the message, whether highlighting the benefits of a healthy lifestyle (gain-frame) or the risks of an unhealthy one (loss-frame), did not differentially affect intention. However, gain-framed messages were recalled far more frequently than loss-framed ones, suggesting a cognitive advantage for positive messaging. Whilst earlier studies report that gain-framed messages are more effective in preventive contexts, possibly, among the participating patients already diagnosed with CVD, baseline motivation may be high enough to reduce the impact of framing style. Nevertheless, only 9% of participants remembered risk-based messages after participating in the experiment, compared to 89% who recalled benefit-based communication. This complements current European Society of Cardiology (ESC) recommendations to communicate risk information, by highlighting the added value of positively framed messages to promote participation in lifestyle interventions (2). Moreover, whilst initial advice appears most effective when delivered by a cardiologist, continuity and reinforcement of motivation can be successfully maintained by physiotherapists or nurses, particularly when trained in motivational interviewing techniques (11,12).

In **Chapter 3**, linking life goals to health goals did not significantly influence CVD patients' intention-to-change-lifestyle. A possible explanation for this finding may be the high baseline level of meaning in life amongst the relatively older and highly educated sample, who may have already possessed strong intrinsic motivation and goal-orientation. Nevertheless, linking life goals to health goals proved particularly effective for participants with lower or medium education levels, indicating the importance of tailoring goal-setting interventions to educational background. This result may be explained by research on cognitive load and meaning-making. Individuals who face more daily stress and structural challenges may have limited mental bandwidth to process abstract health messages (13). For them, anchoring lifestyle advice in personally meaningful goals may reduce complexity and enhance motivation, providing a clearer path to action. Moreover, recent Dutch research supports this recommendation, emphasising the need to elicit patient preferences and tailor preventive counselling accordingly. Current findings further advise practitioners to prioritise the inclusion of patient preferences and ensure that dialogue remains accessible and free from medical jargon (14). However, findings do suggest that goal-directedness may not always be beneficial. A significant disparity between an individual's ambitions and their actual achievements, known as 'goal-striving stress', has been shown to elevate the risk of coronary heart disease, especially in women (15). This underscores the importance of helping

patients formulate meaningful and realistic goals tailored to their personal lives and their circumstances.

Our study also showed that patients who formulated a life goal were more likely to select stress management as a health goal. This reflects a psychological need in this population and aligns with growing evidence that stress is an important modifiable cardiovascular risk factor. Evidence from a systematic review confirms that interventions such as diaphragmatic breathing and muscle relaxation therapy can effectively lower blood pressure and psychological distress whilst enhancing overall cardiovascular health (16). Furthermore, recent data indicates that patients frequently identify stress as a critical threat to their heart health and are proactive in seeking professional assistance to manage it (14).

Finally, our findings contribute to a broader understanding of personalised goal setting in cardiac care. Evidence indicates that merging clinical health objectives with significant life obligations can bolster both motivation and compliance following a myocardial infarction (17). Similarly, meaningful goal-directed activities predict reduced hospital readmissions in heart failure patients (18). A recent study even showed that patients who adopted more health-related lifestyle changes subsequently experience an enhanced sense of life purpose (19). Consistent with these observations, longitudinal data point towards a reciprocal link (20,21), whereby a heightened sense of meaning fosters the intention to adopt healthier habits, which in turn reinforces the individual's perception of life's worth. This dynamic interplay may be key in fostering sustained behaviour change.

Together, these findings advance our understanding of the mechanisms required to trigger and sustain long-term lifestyle modifications in CVD populations. The findings suggest that successful change depends less on message delivery alone and more on establishing an environment of credible, positive communication, meaningful objectives, and robust psychological support. The success of these interventions is contingent upon their sensitivity to a patient's educational level, social environment, and psychological readiness. Patients are more likely to commit to healthier behaviours when these support their broader life goals and when lifestyle interventions reinforce their sense of purpose. Returning to the case of Eva, behavioural change is a means of regaining control over her life. Addressing cardiovascular health, therefore, requires a holistic approach that acknowledges the interplay between healthcare, motivation, and meaning. Whilst sustainable behaviour change is the primary goal, complex eHealth interventions are essential to support and sustain this process. Insights from Aim 1 on how patients initiate and maintain behavioural change can directly inform the design and implementation of these interventions (as explored in Aim 2), ensuring that they are not only technologically sound but also behaviourally intelligent.

Aim 2: Identify and address the multifaceted barriers and facilitators to implementing complex eHealth interventions in clinical practice, particularly within public-private partnerships (PPPs)

In Aim 2, the emphasis shifted from *what* to do to *how* to embed evidence-based complex eHealth interventions sustainably into routine practice. The BENEFIT programme served as a case study; an innovative PPP-based complex eHealth intervention offering personalised, digitally supported cardiac (after)care integrated with centre-based rehabilitation. This aim addressed RQ 2 and RQ 3 by exploring how implementation science can be applied to design an implementation strategy and understand the barriers and facilitators that influence its real-world use. Chapter 4 described the development of a practice-tailored implementation strategy for the BENEFIT programme using a structured, iterative, and theory-informed process. Chapter 5 presented the evaluation of implementation in routine care, applying the CFIR to identify key barriers and facilitators.

In **Chapter 4**, an implementation strategy was developed through a continuous feedback loop between theory and practical insights. Stakeholders were engaged throughout, allowing adaptations in response to clinical constraints, usability challenges, and organisational realities. Key barriers identified included the difficulty of integrating all programme features into existing workflows, an overwhelming initial strategy design, unclear role assignments, and insufficient staff involvement in decision-making. These challenges were addressed through participatory refinement, targeted training sessions, and clarification of responsibilities, ensuring that the strategy was both context-specific and adaptable to different clinical settings.

These results align with implementation science literature, which argues that effective eHealth integration depends less on technical maturity and more on fostering relationships, negotiating between stakeholders, and establishing shared meaning within shifting, unpredictable environments that defy top-down control (22). A systematic review on eHealth implementation for chronic illness echoes these points, identifying stakeholder engagement, training, and audit-feedback cycles as critical enablers, with internal and external facilitation emerging as key determinants of success (23). These insights affirm our strategy's emphasis on co-creation, adaptability, and context-aware refinement. Furthermore, research into hospital-based innovation emphasises the necessity of mitigating opposition to new practices and overcoming budgetary hurdles by employing forward-thinking change management and rigorous financial strategies (24). The results in Chapter 4 support these conclusions, particularly the risk of failure when implementation is imposed top-down without meaningful involvement from healthcare professionals.

Chapter 5 examined the real-world implementation of the BENEFIT programme across multiple CR sites using the CFIR framework. Key facilitators included the programme's adaptability, strong leadership, and the urgent need for digital solutions due to the COVID-19 pandemic. However, key barriers emerged, namely frequent personnel changes, unclear responsibilities within the PPP, and technological integration difficulties. These findings confirm that implementation is a complex undertaking influenced by the intervention, organisational context, and broader system dynamics and social processes. Recent literature supports this view. A systematic review has corroborated that implementation determinants for digital health services span all five CFIR domains, highlighting the necessity for multifaceted strategies that encompass the full spectrum of contextual influences (25). Critics have argued that the CFIR framework may provide an insufficient account of power dynamics and social friction. Hence, the Tensions in Innovation Implementation Processes (TIIPS) model has been introduced as a supplementary tool to identify and manage these underlying conflicts (26). In the BENEFIT programme, such tensions were evident in recurring role ambiguity, inconsistent engagement, and integration setbacks, which undermined collective commitment and hindered adoption.

Technological barriers were also salient during the implementation of the BENEFIT programme. A European scoping review on eHealth implementation (27) further substantiates the prominence of technical hurdles, specifically identifying gaps in interoperability and infrastructure constraints as persistent obstacles across various studies, stressing the need for dedicated strategies to enhance technological integration. These findings mirror the BENEFIT experience and underscore the importance of early alignment between technical and clinical stakeholders, sustained investment in interoperability, and ongoing technical support throughout implementation.

Finally, another barrier was the lack of shared understanding of implementation goals across sites. This mirrors findings from high-profile health technology implementation failures, such as the national electronic patient record in the UK, where fragmentation and misalignment between stakeholders led to termination (22). Such cases reinforce the necessity of clear, shared implementation objectives, iterative stakeholder alignment, and frameworks that address both the technical and social dimensions of eHealth integration.

In conclusion, the implementation of the BENEFIT programme illustrates that integrating complex eHealth interventions into routine care, particularly within PPPs, requires more than solving operational barriers. It demands an approach that embraces complexity rather than attempting to reduce it. Our findings show that implementation succeeds not by eliminating friction, but by making time for co-creation, negotiation, and continuous learning

across organisations. Particularly within PPPs, where a variety of motives and expectations intersect, effectiveness is determined by the successful synchronisation of clinical processes, technical systems, and stakeholder objectives within a shared, flexible framework. Frameworks such as CFIR offer structure but must be complemented by tools that address the political, relational, and shifting nature of innovation as it occurs in practice. Subsequently, sustainable use of complex eHealth interventions relies on implementation strategies that are technically fitting, context-aware, and tailored to the shifting realities and tensions of collaborative healthcare delivery. Building on these implementation insights, Aim 3 explores how complex eHealth interventions can be embedded not just in clinical workflows, but also in the psychosocial realities of patients' lives, a critical step for achieving truly holistic cardiovascular care.

Aim 3: Integrate behavioural change and complex eHealth interventions into a holistic approach for chronic disease management, including psychosocial challenges faced by patients with CVD

With Aim 3, it was researched how implementation science can be applied to integrate behavioural change and complex eHealth interventions into a holistic approach for chronic disease management, addressing psychosocial challenges faced by patients with CVD (RQ 4). Comprehensive management for patients with CVD must prioritise both physiological requirements and the psychological factors that impact treatment compliance, self-regulation, and general wellbeing (4,28). Complex eHealth interventions, such as internet-based cognitive behavioural therapy (iCBT), offer promising ways to meet these needs, but remain underutilised in routine care (29).

Chapter 6 examined the adoption of iCBT among psychologists in medical settings. Despite robust evidence for iCBT's effectiveness in supporting mental well-being and chronic disease self-management, uptake was limited: only 16.8% had access to iCBT, and 21.5% intended to use it in the coming year. Key barriers included limited platform access, inadequate training, and lack of integration into clinical workflows. For non-users, intention to adopt iCBT was primarily influenced by perceived effectiveness, ease of use, and facilitating conditions. These findings highlight that adoption requires more than awareness or evidence. Implementation efforts must focus on improving access, embedding training in professional development, and ensuring digital tools align with daily clinical routines. Organisational support via leadership endorsement, funding, and policy alignment is essential to enable structural integration.

These conclusions are supported by broader eHealth literature. Persistent adoption barriers include negative clinician attitudes, technical difficulties, and lack of training, all of which hinder integration into practice (30). Moreover, many healthcare professionals often highlight fragmentation between digital interventions and established health systems, which hinders seamless referral processes and consistent patient oversight (31). Another key concern is the generic nature of many programmes, which limits their suitability for tailored psychological care. Moreover, evidence consistently shows that a professional's readiness to utilise digital solutions is contingent upon their perceived utility and the degree to which they align with daily clinical routines (32,33). Nevertheless, the transition of medical innovations from the research phase to standard practice is frequently protracted, often taking well over a decade to achieve routine implementation (34). This underscores that passive diffusion is insufficient; structured, multilevel implementation strategies are essential to move beyond pilot phases and embed digital interventions in standard care.

Taken together, the findings emphasise that integrating complex eHealth interventions into chronic care is not only a question of technological availability or professional intention; it is about embedding these tools meaningfully into the routines, relationships, and realities of routine healthcare practice. Achieving this necessitates a transition towards interdisciplinary cooperation where psychological needs are viewed as fundamental to managing illness. For patients such as Eva, who navigate both clinical and emotional challenges, this shift may determine the difference between short-term compliance and enduring engagement. As such, sustainable complex eHealth implementation within chronic care does not start with the tool itself, but with the ecosystem around it: one that acknowledges lived experience, invests in professional self-efficacy, and aligns innovation with the complexity of real-world practice.

Implications for practice and policy

This thesis underscores the necessity of structured, evidence-based approaches for integrating lifestyle change and complex eHealth interventions into cardiovascular care. Its findings have different practical and policy implications, summarised through six lessons.

Lesson 1: Brief, positively framed lifestyle advice from trusted sources drives behaviour change

At the level of individual consultations, Chapter 2 demonstrated that the effectiveness of brief lifestyle advice in patients with CVD is a matter of credibility and framing. As a highly trusted source, advice delivered by a cardiologist was associated with significantly higher intention-to-change-lifestyle behaviours than advice from another professional. Moreover, messages that were gain-framed, emphasising the benefits of behaviour change rather than

the risks of inaction, were much more memorable, with 89% of participants recalling gain-framed messages versus just 9% for loss-framed content. To translate these insights into practice, we developed two tools: a Very Brief Advice (VBA) protocol (35) and a Brief Advice (BA) protocol containing motivational interviewing techniques, both co-designed with healthcare professionals across disciplines. Updated versions of the protocols are provided in **Appendix A**.

The utility of these instruments, however, is contingent upon adapting the guidance to the patient's receptivity, psychological readiness, and capacity for change (36). Employing an identical approach for all patients can result in the sub-optimal use of a practitioner's time and resources. A tiered approach is therefore essential: certain patients will respond well to minimal intervention, whereas others may need an immediate referral to specialist services, and for some, it may be prudent to defer the conversation entirely. In clinical practice, clinicians are encouraged to evaluate in advance which patients are likely to benefit from (V)BA and which require more robust support from the start. Aligning the timing of the intervention with the patient's motivation and their specific life constraints can substantially enhance the probability of achieving meaningful behaviour change.

In short, these tools support the delivery of structured, practical lifestyle advice and enable quick referral to more specialised lifestyle care if needed. When integrated into a comprehensive care pathway, brief advice protocols assist professionals in offering support as part of a seamless continuum of care, ultimately enhancing both clinical efficiency and patient outcomes.

Lesson 2: Timing and personalisation matter, as one size does not fit all

Beyond whom delivers lifestyle advice, behavioural interventions are most effective when timed appropriately and tailored to the patient's context. The studies in Chapter 2 (brief lifestyle advice) and Chapter 3 (goal setting) illustrate that a significant event, such as an acute cardiac event or a new diagnosis, can act as a 'teachable moment' that increases readiness to change (9,10), as intention-to-change-lifestyle was above average to high among participants. However, motivation alone does not guarantee success, as the 'invisible work' required to manage a chronic condition, comprising emotional, cognitive, and practical tasks, is estimated to consume up to two hours of a patient's time every day (6). This substantial burden is frequently underestimated or entirely overlooked by healthcare practitioners (37). Moreover, external stressors and socioeconomic disadvantages can severely hinder a patient's ability to take action, even when they are highly motivated (10).

The study on goal setting revealed that linking life goals to health goals significantly enhanced intention among lower- and medium-educated patients. This is supported by research indicating that persistent financial strain and social hardship deplete 'cognitive bandwidth', thereby limiting the executive functions necessary for complex decision-making and future-oriented planning (13,38–40). Consequently, health guidance that is framed within the context of a patient's broader life goals achieves greater relevance and emotional impact (41). Moreover, when patients align their health objectives with personal life values, they are notably more inclined to prioritise stress management, an often-neglected cardiovascular risk factor. Evidence confirms that specific relaxation methods, such as diaphragmatic breathing, can significantly enhance both quality of life and clinical cardiovascular outcomes (16).

Nevertheless, even with motivation and appropriate timing, not all patients are equally able to act. The capacity to translate intention into action is essential here, which is influenced by self-regulation, executive functioning, and stress levels. These mechanisms are widely recognised in academic research and also highlighted by Dutch institutions working on health equity, including Pharos and the Scientific Council for Government Policy (38,42–45). Specifically, individuals in socioeconomically disadvantaged situations may possess strong intentions but lack the mental energy to execute them consistently. Furthermore, patients with limited health literacy are prone to assuming a passive role during consultations and often struggle to recall clinical instructions (46,47). They may feel less confident and be reluctant to ask questions (48). At the same time, healthcare providers frequently overestimate the clarity of their own communication and the patient's level of understanding (49,50). Techniques such as 'teach-back', where patients are asked to repeat information in their own words, can bridge this gap and ensure understanding (51). When combined with personalised goal setting, this kind of proportional support helps ensure that intention can actually lead to sustained behavioural change (52,53).

These insights highlight a necessary shift in policy and practice: from expecting equal action from all patients to offering proportional support tailored to individual capacity. For some, this may involve simplified, essential-only dialogue, whilst others may require extended consultations or rapid referral to integrated services to avoid an overwhelming treatment burden. The key is to match the type and intensity of support to the patient's cognitive, emotional, and social resources.

Lesson 3: Structural inequality should be addressed to avoid widening health gaps

At the system level, equity in health communication and intervention design is often overlooked, yet the findings from Chapter 3 show that whilst patients with lower or intermediate educational backgrounds gain the most from bespoke interventions, they are the demographic least likely to be offered them. Research shows that only 32.2% of patients receive lifestyle advice during healthcare visits, with a clear bias towards younger, male, and more highly educated patients (54). Healthcare professionals tend to focus on patients who are already motivated or articulate, which risks leaving behind those with lower health literacy or a lack of capacity to translate intention into action. Conversely, when guidance is actually extended to these neglected groups, 39.2% report tangible lifestyle adjustments, a trend particularly evident among older patients and those with less formal education (54). Failure to adapt tools and communication styles can thus exacerbate rather than reduce health inequality. Consequently, policy can include routine implementation of plain language, teach-back techniques, motivational interviewing, and the collaborative setting of personal goals. Systems should proactively identify underserved populations and allocate resources proportionally to reduce the equity gap.

These insights necessitate a shift from uniform care delivery towards differentiated support strategies that pinpoint underserved groups at an early stage and adapt to their specific circumstances. Rather than offering identical care to every individual, healthcare systems should provide proportionate resources, matching the level of intervention with the complexity of a patient's needs, to prevent the further expansion of current health disparities.

Lesson 4: Implementation succeeds with adaptability, stakeholder co-design, and role clarity

Chapters 4 and 5 explored the implementation of the BENEFIT programme using implementation science frameworks such as CFIR and RE-AIM. A key takeaway is that the implementation of complex eHealth innovations requires more than a one-off strategy; it demands iterative development, stakeholder involvement, and continuous adaptation. More fundamentally, successful implementation depends less on rigid strategies and more on the ability to learn from context by continuously involving frontline healthcare professionals in reshaping delivery as barriers emerge.

Based on the insights from Chapter 4 and Chapter 5 and aligned with broader literature identifying common eHealth challenges needs (22), several strategies for the implementation of complex eHealth interventions within practice can be advised:

- *Design for adaptability in implementation:* accept that not all components of a complex eHealth innovation will fit every healthcare setting. Therefore, it is advised to build modularity into the implementation plan and use feedback loops (such as regular check-ins and co-design sessions) to iteratively refine the strategy based on real-world experiences (Chapter 4).
- *Support implementers with ready-to-use tools:* it is recommended to provide context-sensitive implementation tools (such as implementation checklists and onboarding protocols) that assist local teams in translating a general implementation strategy into specific, feasible implementation actions (Chapter 4).
- *Ensure that frontline healthcare professionals are engaged throughout the process:* implementation cannot primarily be a top-down process. It is advisable to view stakeholders not just as users but as co-designers. Regular participatory reflection moments, such as periodic evaluation sessions and user feedback loops, are essential to realising this in practice (Chapters 4 and 5).
- *Establish a suitable governance structure:* to maintain implementation momentum, it is recommended to formally integrate co-design principles into leadership and operations. For instance, utilise a structured working group comprising clinical, scientific, private sector, and technical stakeholders to encompass all perspectives and streamline all processes (Chapter 5).
- *Prioritise role clarity from the start:* it is recommended to clearly define and document roles, tasks, and responsibilities across all involved organisations and professionals. This prevents confusion, duplication of effort, and delays in decision-making. Early agreements on accountability also support trust between partners and provide a foundation for efficient collaboration throughout the implementation process (Chapter 5).

The BENEFIT programme addressed implementation issues through, among others, co-creation sessions (participatory refinement). To translate all our insights into practice, we developed an implementation methodology (55) that includes three tools: an implementation plan tailored to healthcare settings, practical checklists, and an overview of key lessons learned during each step in the implementation process (see **Appendix B**). This evidence-based yet pragmatic and co-created approach serves as a blueprint for future large-scale implementations.

Lesson 5: Public-private partnerships (PPPs) offer essential opportunities but demand specific governance and implementation skills

Chapters 4 and 5 demonstrated that PPPs foster complex eHealth interventions through a combination of resources, expertise, and shared objectives. The BENEFIT programme, created by a consortium of academic, private, and healthcare stakeholders, showcases how PPPs can accelerate cardiovascular care innovation. Nonetheless, aligning private sector objectives with public health targets can lead to tensions that must be managed with care.

The interviews from Chapter 5 highlighted recurring issues such as unclear programme objectives, ambiguous role assignments, and resource strain, particularly in staffing and financial accountability. These challenges stem from the changing dynamics of PPPs, similar to creating an organisation from the ground up. Nevertheless, strong PPP leadership, structured meetings, and adaptability in implementation were key facilitators. Stakeholders with multiple roles, such as clinical leaders, project managers, and scientific contributors, served as vital connections between sectors, underscoring the need for transdisciplinary skills and strategic coordination. Recent literature echoes these findings, underscoring that PPPs in digital health succeed when they foster mutual trust, define clear governance structures, and build shared ownership (22,23,27). Moreover, power dynamics and competing stakeholder interests can disrupt progress unless made explicit and managed via participatory negotiation models such as the TIIPS model (26). Integrating models such as TIIPS alongside CFIR allows for a clearer visualisation and resolution of the social and structural tensions that emerge during collaborative projects.

Thus, the implications for future practice appear twofold. First, it may be helpful for PPPs to operate within formalised governance frameworks and to include facilitation roles that help navigate power dynamics, communication gaps, and operational responsibilities. Second, future PPPs could benefit from investment in coordination roles with hybrid expertise, professionals who can translate between clinical, managerial, and technical domains, and exploration of how conflict-resolution mechanisms might support the implementation infrastructure. Joint investments by public and private stakeholders in implementation capacity, such as staffing, IT integration, and operational flexibility, may also support sustainable adoption.

Lesson 6: Innovations such as complex eHealth interventions and online therapy must be embedded in workflows and supported by training

Despite evidence supporting the effectiveness of internet-based cognitive behavioural therapy (iCBT) and other digital tools in chronic disease management, their clinical uptake remains underwhelming. Data from Chapter 6 indicate a significant implementation gap, with 16.8% of psychologists having access to iCBT, and only 21.5% expressing an intention to utilise it. The gap between intention and usage largely stems from usability issues, lack of condition-specific content, poor integration into clinical workflows, and insufficient training. Recent studies highlight that digital self-management platforms often falter because of insufficient evidence regarding their usability and a failure to embed them within electronic health records (56). Research on eHealth adoption challenges in cardiovascular care highlights factors impacting healthcare professionals (HCPs), such as the need to integrate eHealth with existing workflows to reduce workload and resistance. HCPs also require structured training to enhance digital competency and implement eHealth effectively. Without proper training, digital solution adoption suffers. Many professionals face technical difficulties, inadequate integration, and a lack of dedicated support as major barriers to effective technology use (57).

To address these challenges, findings from this thesis suggest certain areas that could benefit from further attention. First, integrating digital health education into medical curricula and ongoing professional development could help reduce barriers to adoption. Based on existing literature and findings from Chapter 6, relevant training content may include technical proficiency for effective use and interpretation of digital health tools (57), behavioural change techniques, including motivational interviewing and (V)BA, to enhance patient engagement in eHealth interventions (58,59), and interdisciplinary collaboration among healthcare professionals and digital health experts (60). Without dedicated training, barriers to eHealth implementation will persist, limiting self-management and health outcomes for patients with chronic conditions. Furthermore, digital literacy is both a professional and patient-centred issue. Healthcare professionals should enhance digital inclusion by providing tailored guidance, simplifying interfaces, and integrating human support with digital tools (57).

Synthesising across behavioural, organisational, and systemic layers

This thesis has examined the implementation of health behavioural change (Aim 1) and complex eHealth interventions (Aim 2), and their integration into a broader, holistic approach for chronic disease management (Aim 3). Whilst each aim addressed distinct challenges, our findings underscore that these domains are dynamically interconnected.

Individual motivation for lifestyle change is more likely to translate into sustained behaviour when supported by context-sensitive implementation strategies and embedded within a health system that reinforces such changes. Likewise, organisational readiness for implementing complex eHealth interventions depends not only on technical feasibility but also on alignment with clinical workflows, patient needs, and equity considerations. Finally, the potential of online therapy, such as iCBT, to enhance chronic care and self-management can only be realised if its adoption is backed by cross-sectoral collaboration, systemic investment, and trust in its effectiveness. Taken together, these insights highlight the necessity of multi-level strategies that align personal, organisational, and societal drivers of health, advancing an integrated and sustainable vision of cardiovascular care.

Strengths and limitations

The studies in this thesis highlight several strengths in advancing knowledge on the implementation of complex eHealth interventions and lifestyle changes in routine cardiac care. One of the strengths is the mixed-method approach used to study the implementation of lifestyle changes and complex eHealth interventions. We employed a combination of experimental, observational, and qualitative methodologies, providing a comprehensive perspective on the potential and challenges of implementing complex eHealth interventions and lifestyle changes. Studies ranged from controlled experiments on behavioural intention (Chapters 2 and 3), to real-world implementation within a PPP (Chapters 4 and 5), and a survey-based study giving insights into online therapy adoption (Chapter 6). By researching in different real-world environments, such as various CR centres, a PPP deploying a complex eHealth intervention, and medical psychology practices within hospitals, ecological validity was enhanced, and it was ensured that the findings of this thesis are rooted in practical application.

Another strength is the application of multiple theoretical frameworks, ensuring a structured and evidence-based approach to studying the implementation of both behaviour change and complex eHealth interventions. The studies applied the Theory of Reasoned Action (Chapters 2 and 3), the Implementation model and RE-AIM (Chapter 4), CFIR (Chapters 4 and 5), and UTAUT (Chapter 6). This theoretical foundation strengthens the scientific validity of the findings.

A final strength of this thesis is its emphasis on a context-sensitive, implementation science-driven approach. The strategy developed for the BENEFIT programme (Chapter 4) followed an iterative and participatory process, incorporating stakeholder feedback at multiple stages. This co-creation with clinicians, implementation staff, and healthcare organisation managers ensured that implementation plans were flexible, feasible, and tailored

to diverse clinical environments. Such a dynamic, bottom-up approach enhances real-world applicability and supports long-term sustainability, making it a model for scaling complex eHealth interventions across healthcare systems.

Despite these strengths, several limitations must be acknowledged. First, although the methodological approach in this thesis provided comprehensive insights, the reliance on self-reported data in Chapters 2 and 3 and the lack of longitudinal behavioural assessments limit the robustness of our conclusions.

Second, online recruitment for the studies in Chapters 2 and 3 may have introduced selection bias, overrepresenting digitally literate, higher-educated, and health-engaged individuals. This limits generalisability to those with lower health literacy or fewer digital skills, precisely the populations often most at risk and most in need of support. Additionally, starting behaviour change is crucial, but maintaining it in the long run requires different psychological and contextual factors that extend beyond initial motivation. These include habit formation, which shields behaviours from lapses via automated, cue-driven repetition (61,62), shifts in self-identity which align behaviour with a new self-concept and reduce dissonance (63), and social reinforcement, which supports sustained behaviour through social support, modelling, and accountability (5,64).

Furthermore, both studies focused primarily on motivational factors, whilst environmental, biological, and structural determinants, such as the influence of the obesogenic environment, endocrine function, and genetic predispositions, were outside the scope of investigation. This is a relevant limitation, as endocrine mechanisms involving hormones such as leptin, ghrelin, and cortisol critically affect both eating behaviour and the long-term efficacy of behavioural interventions (65–67). Evidence also indicates that genetic variations can alter an individual's response to lifestyle modifications (68), whilst neurobiological mechanisms, including neural plasticity, are fundamental to adapting one's behaviour under stressful circumstances (69). As a result, the findings offer a partial perspective on why sustained lifestyle change is difficult, even when motivation is high.

Third, the clinical practice organisations involved in Chapters 4 and 5 were characterised by high levels of motivation and sufficient financial resources for implementation. Whilst this supported the BENEFIT programme's rollout, it may lead to an overestimation of feasibility in resource-constrained environments. Additionally, regarding the generalisability of the findings, the implementation insights in Chapters 4 and 5 were obtained from Dutch healthcare settings, which possess specific regulatory, financial, and policy frameworks.

Whilst these findings may hold relevance for European healthcare systems, they might not transfer directly to low-resource settings or non-European contexts.

Finally, Chapter 6 investigated the underutilisation of iCBT among psychologists in medical settings, aiming to identify barriers and facilitators influencing its adoption. Although performance expectancy, effort expectancy, and facilitating conditions collectively explained 49% of the variance in behavioural intention among non-users, over half of the variance remains unaccounted for. This gap may reflect additional psychological, organisational, and contextual influences, such as attitudes towards technology, institutional culture, professional identity, time constraints, or structural barriers such as reimbursement and policy support. Future research may benefit from integrating broader theoretical perspectives, such as the Technology Acceptance Model 3 (TAM3) (70) and the Theoretical Domains Framework (TDF) (71), to better capture the multifactorial nature of technology adoption in clinical practice. In addition, the CFIR (72) offers a comprehensive, multi-level lens for understanding the real-world complexity of implementing complex eHealth interventions such as iCBT in healthcare settings. Whereas UTAUT and TAM3 primarily model how clinicians' perceptions and beliefs shape behavioural intention and use, CFIR explicitly attends to determinants across organisational context, inner and outer setting, implementation processes, and wider system influences. By integrating the TDF, which offers a detailed account of individual capability, opportunity, and motivation, researchers can effectively situate personal behavioural drivers within the structural frameworks that facilitate or impede implementation. Accordingly, future research seeking to narrow the gap between intention and sustained use of iCBT may benefit from combining an individual-level behavioural framework with a multi-level implementation framework to address determinants across domains.

Future research

The studies in this thesis have demonstrated both the potential and challenges associated with the implementation of complex eHealth interventions and lifestyle change in routine cardiac care. Given the multifactorial nature of behaviour change and the dynamic context of healthcare settings and healthcare delivery, future research will help to ensure that promising innovations such as the BENEFIT programme result in long-term improvements in cardiovascular health. This section outlines five key areas for future research.

Behavioural maintenance and long-term impact

Chapters 2 and 3 examined factors influencing patients' intention to change their lifestyle, demonstrating that both credible lifestyle advice and personalised goal setting enhance intention-to-change-lifestyle. However, these studies relied on self-reported intention rather

than actual behaviour change. Moreover, current studies often focus on short-term improvements, but sustained adherence to lifestyle interventions requires in-depth follow-up to understand behavioural maintenance mechanisms. To bridge this gap, future research should prioritise longitudinal studies that assess the long-term sustainability of initial lifestyle changes. This can be achieved by integrating objective health metrics, such as data from wearable devices, which have shown promise in capturing lifestyle patterns over time and informing personalised care in cardiac patients (73,74). For example, randomised controlled trials (RCTs) with extended follow-up periods can help determine whether initial lifestyle changes are maintained over time and what factors contribute to long-term adherence.

Reducing health disparities through tailored design

Chapter 3 demonstrated that linking life goals to health goals is particularly effective for patients with lower and medium levels of education, yet most digital health solutions do not adequately address socio-economic disparities (75–77). Addressing socio-economic disparities in future intervention development is crucial. Beyond addressing individual-level factors, interventions must systematically integrate wider social determinants of health, including socio-economic standing, educational attainment, and equitable access to medical resources (52). Furthermore, identifying more effective methods to reach and involve socio-economically marginalised groups is essential for narrowing health disparities and avoiding unintended exclusion (22). Future research should therefore explore how complex eHealth interventions can be tailored to individuals with lower educational attainment or limited digital literacy (77). This may be possible by investigating tailored user-centred design approaches, multimodal interventions (e.g., combining face-to-face coaching with digital support), and strategies to enhance accessibility and engagement.

Embedding sustainability through health economics

Chapters 4 and 5 illustrated that successfully implementing complex eHealth interventions requires robust organisational support, stakeholder engagement, and integration into existing healthcare workflows. To further enhance and encourage broader implementation, especially given the current pressures on the healthcare field (78), future research could explore the cost-effectiveness of complex eHealth interventions and analyse the financial models that facilitate their adoption. This includes examining reimbursement structures, workforce training requirements, and scalability options for implementation. Health economic evaluations can be conducted to compare the costs of digital health interventions with standard care to assess not only cost savings but also contextual factors that influence economic outcomes. Various studies have demonstrated that such interventions are frequently cost-effective across different areas, ranging from chronic disease management (79) to medication safety (80) and paediatric care (81). Although initial investments may be

substantial, several studies report return on investment within three to four years (80). A comprehensive economic perspective that considers both direct and indirect costs, reimbursement, and long-term sustainability is recommended when shaping digital health policy and financing strategies. Therefore, using implementation science frameworks like CFIR to evaluate interventions can help determine how contextual factors, such as resource availability, leadership engagement, or workflow alignment, influence their cost-effectiveness and scalability. This approach highlights that economic outcomes are shaped not just by the intervention content but also by the conditions under which they are adopted, implemented, and maintained.

Optimising implementation in diverse healthcare contexts

Moreover, even though the studies in this thesis were conducted in relatively well-resourced environments, Chapter 5 highlighted challenges in implementing eHealth interventions across various cardiac rehabilitation sites. To realise wide adoption, future research can focus on exploring adaptive implementation models for low-resource settings, with a particular focus on digital literacy, infrastructural constraints, and the pursuit of equitable access to digital health services. Furthermore, the findings from Chapters 4 and 5 demonstrate the importance of PPPs in implementing complex eHealth interventions. However, challenges related to unclear role definitions and frequent personnel changes may show a need for further research into optimising governance structures, regulatory frameworks, and best practices for collaboration in digital health adoption.

Beyond individual responsibility: A call for systemic reform of our environment

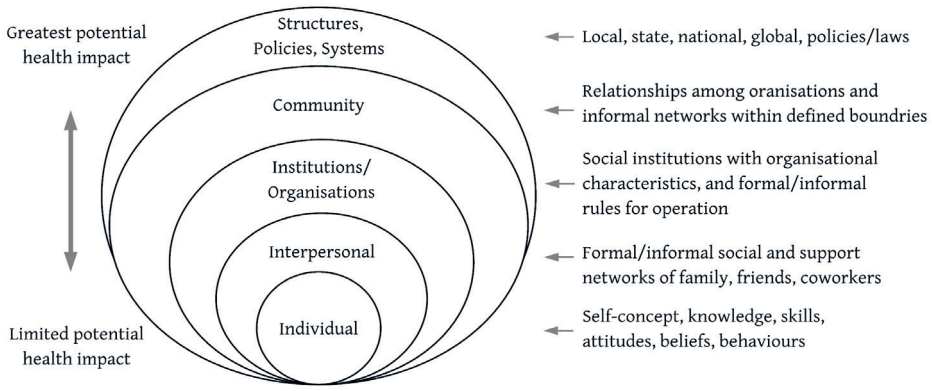
This thesis has underscored the significance of tailored cardiovascular care through complex eHealth interventions and lifestyle change. However, these strategies cannot independently resolve the systemic origins of CVD. Even the most rigorous and well-designed eHealth and lifestyle interventions cannot compete with an environment dominated by aggressive marketing of unhealthy food, economic barriers to nutritious options, and promotion of limited physical activity (82). Therefore, I would like to argue for urgent systemic and policy change.

A key societal issue is the persistent promotion of unhealthy behaviours via environmental cues that drive obesity, a chronic, progressive disease associated with over 200 comorbidities, including CVD, type 2 diabetes, 13 types of cancers, sleep apnoea, and osteoarthritis (83,84). Long-term elevated BMI facilitates metabolism and immune dysfunction, often termed 'metaflammation', contributing to early-onset cancer and heart disease (85,86). Metabolic syndrome (MetS), which now affects approximately 31% of the global adult population (87), exemplifies how chronic disease is driven by systemic exposure to energy-dense, ultra-

processed dietary products (88,89). In the Netherlands, this is reflected in retail practices, where 70% of supermarket promotional flyers feature unhealthy products, with 57% of these being classified as ultra-processed (90). These food products, including snack bars, chips, and ready-to-eat meals, trigger neural reward mechanisms and encourage overconsumption (91). Such dietary patterns contribute directly to an elevated risk of cardiovascular disease, obesity, type 2 diabetes, cancer, and overall mortality (88,92). Commercial entities frequently hinder public health initiatives: the food and beverage industry invests heavily in lobbying, often exceeding the combined expenditure of the tobacco and alcohol sectors, to obstruct regulation and discredit scientific findings (93). Furthermore, marketing aimed at children plays a pivotal role, with estimates suggesting that a significant portion of childhood obesity cases could be prevented in the absence of food advertisements (94,95). These factors represent a systemic imbalance that cannot be resolved through individual-level interventions alone.

The difficulty of challenging powerful corporate interests, combined with the modest impact of individual-focused interventions in the absence of structural reform, is extensively documented. The Social Ecological Model (SEM) (96) shows that health behaviours are shaped not just by individual willpower but by structural factors across personal, relational, institutional, and policy levels. As visualised in **Figure 1** (97), the greatest potential impact lies not in individual willpower but in transforming environments that shape choices through healthy policies, social norms, infrastructure, and support systems. This perspective aligns with evidence that Dutch health promotion has historically trained practitioners within a behavioural paradigm that over-emphasises individual responsibility. Consequently, even when systemic drivers are recognised, the field continues to focus on personal behaviour change rather than addressing the structural causes of health inequality (98).

Figure 1. The Social Ecological Model, derived and adapted from Ewald et al., 2023.



The burden of preventing and treating pathologies linked to obesity, such as cardiovascular disease, cancer, and hypertension, cannot be placed exclusively on the shoulders of individuals or clinical systems that are already operating at capacity (99). These systems are currently navigating significant workforce shortages that threaten the sustainability of care (100). Whilst personal responsibility affects health behaviours, assuming individuals can consistently make healthy choices in an environment promoting overconsumption is unrealistic and, in my opinion, ethically questionable. Research underscores this point by showing how core textbooks often portray unhealthy behaviour as a result of individual psychological 'shortcomings', such as limited cognitive capacity or negative intentions, whilst ignoring social and political factors. Such professional socialisation further reinforces the notion that individuals are the primary problem to be 'fixed', a perspective that conflicts with the ethical concerns raised here (98).

Structural reform is, therefore, needed to break this cycle, with evidence favouring population-level strategies that reconfigure the environment to facilitate healthier decision-making (101). Key priorities should include regulating the food industry's influence (102), creating healthier supermarkets (103), implementing a sugar tax (104,105), and reducing financial barriers to healthy food (106,107). Yet, research found that health promotion curricula in the Netherlands offer practitioners very few practical strategies to contest the influence of powerful corporate entities. Whilst industry influence is acknowledged, methods such as advocacy or lobbying are rarely taught in depth, leaving professionals ill-prepared to contribute to the very policy reforms that are most urgently needed (98). This gap underscores the importance of rethinking both policy and professional training if structural change is to become feasible.

In conclusion, whilst individual behaviour change is a cornerstone of CVD prevention, this thesis emphasises that even the best and most well-supported complex eHealth interventions are constrained by environments that actively promote poor health. Without systemic shifts achieved through robust food policies, health-oriented city design, taxation, and equitable access to resources, healthcare professionals remain stuck treating avoidable pathologies such as CVD without addressing their root causes. To move towards prevention-focused and supportive systems, future research could focus on:

- *The real-world impact of policy-level interventions:* research could evaluate how measures such as sugar-sweetened-beverage taxes, restrictions on child-directed food advertising, or rewards for buying healthy foods affect cardiovascular health outcomes. In addition to measuring health effects, studies could assess how these policies are implemented, accepted by communities, and maintained over time.

Implementation science approaches have proven useful for evaluating such public health interventions in real-world settings (108,109).

- *Understanding how our everyday surroundings influence everyday choices:* by combining qualitative methods such as in-depth interviews with objective data from supermarket sales or location tracking, it is possible to help uncover how commercial factors, including product placement, pricing, and promotional tactics, interact with cognitive load and ingrained habits (110,111). These insights are valuable for designing complex eHealth interventions that respond to the real-world environments people navigate every day, particularly those in socio-economically vulnerable positions. Implementation science could further explore how to embed these interventions into local systems such as schools, health care organisations, or community organisations, to align them with users' lived experiences. This supports the consistent usage of interventions over time.
- *Fostering system transformation via transdisciplinary collaboration:* future research can explore how cities, businesses, health services, and academic organisations can collaborate to establish environments that promote healthy living. Theoretical frameworks such as the CFIR and SEM can help examine how such collaborations emerge, evolve, and succeed. Integrating public health expertise with urban planning and economics is a proven necessity for shifting the systemic drivers of unhealthy lifestyle patterns observed globally (112).
- *Addressing structural resistance to preventive health policies:* to enable large-scale societal change, it is important to understand why promising policies fail or stall, as has been done regarding alcohol, food, and tobacco policies in other countries (113–115). Research could investigate the political, institutional, and commercial barriers to implementing health-promoting regulation. This includes examining corporate lobbying strategies, the exploitation of regulatory gaps, and the specific conditions under which policy innovation can succeed despite industrial pushback.
- *Simulating and comparing policy strategies across populations:* health-economic models can predict which combinations of strategies offer the best value concerning health outcomes and impact the most people over time (116). These models should be equity-sensitive and reflect real-world data on who participates, who benefits, and under what conditions (117). Adaptive strategies, including participatory action research (118) and ripple effect mapping (119), help ensure that public health initiatives remain aligned with community needs and evolving local dynamics.
- *Examining paradigms in health promotion practice:* future studies should critically examine how curricula, professional training, and dominant behavioural models shape the field's capacity to address health inequalities. Such inquiry could help reorient prevention research towards systemic, equity-driven strategies (98).

Conclusion

This thesis demonstrates how expertise in implementing complex eHealth interventions and promoting lifestyle change can *heartwire* both patients and the healthcare system, embedding lasting change. This heartwire, connecting individuals, clinical practice, and policy, points the way towards future-proof, patient-centred cardiovascular care.

Sustainable lifestyle changes and the successful implementation of complex eHealth interventions in cardiovascular care require a holistic, multidimensional approach. Addressing CVD effectively necessitates a combination of behavioural interventions, digital health solutions, and interdisciplinary collaboration. Findings related to behaviour change (Aim 1) highlight that credible healthcare professionals and gain-framed messages improve patients' intention to adopt a healthier lifestyle. Linking life goals to health goals enhances motivation, particularly among individuals with lower and medium education levels, reinforcing the need for tailored interventions that align with patients' socio-demographic backgrounds. However, motivation alone does not ensure sustained behaviour change, as broader socioeconomic and structural determinants influence patients' capacity to act. In relation to the implementation of complex eHealth interventions (Aim 2), findings indicate that technological feasibility alone is insufficient. Clear role definitions, structured implementation strategies, and sustained stakeholder engagement are critical for successful adoption. The iterative development of an evidence-based implementation strategy for the BENEFIT programme underscores the importance of context-driven co-creation to ensure long-term implementation into clinical practice. Finally, the integration of behavioural change and complex eHealth innovations into chronic disease management (Aim 3) highlights the potential of online therapy solutions, such as iCBT, to support self-management in CVD patients. However, barriers related to uptake, such as limited training, low digital literacy, and workflow misalignment impede implementation, necessitating targeted capacity-building efforts, financial incentives, and digital inclusion strategies.

Ultimately, achieving meaningful improvements in cardiovascular health necessitates an ecosystem that bridges technology, behaviour change, and holistic, integrated care models to deliver patient-centred and scalable solutions, combined with a living environment that stimulates and facilitates the long-term execution of healthy behaviours.

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Appendix A

Very Brief Advice: rapid referral to a Combined Lifestyle Intervention (GLI) for overweight and obesity

Step 1: Ask

'Would it be alright if we spent a couple of minutes talking about your weight and health today?'
If no: 'Of course, we don't have to. If you ever want to revisit it, just let me know.'
If yes: go to Step 2.

Step 2: Advise

'For many people, even a small amount of weight loss can improve energy, fitness and overall health. The most effective approach is usually structured support, rather than trying to do it alone.'

Step 3: Act

'Would you be interested in a referral to a local***** Combined Lifestyle Intervention (GLI)****** programme? It's covered by your health insurer'

If interested: 'Great. You will be contacted to arrange an appointment. Here's a leaflet.'
If unsure: 'That's fine. You can take the leaflet and read it at home. If you'd like, we can pick it up at your next appointment.'
If not interested: 'No problem. If you ever want to revisit it, just let me know.'

Advice for healthcare professionals on how to discuss someone's weight with patients, see:

- https://www.partnerschapovergewicht.nl/wp-content/uploads/2022/04/Praten-over-gewicht-advies-voor-zorgprofessionals.pdf

*** For an overview of GLI providers by municipality, see:**

- https://www.loketgezondleven.nl/gezondheidsthema/overgewicht/gecombineerde-leefstijlinterventie/erkende-gli-basisverzekering/tabel-gli-aanbieders and
- https://www.loketgezondleven.nl/gezondheidsthema/overgewicht/gecombineerde-leefstijlinterventie/kaartje-aanbod-GLI

**** For an overview of all types of GLI programmes, see:**

- https://www.loketgezondleven.nl/gezondheidsthema/overgewicht/gecombineerde-leefstijlinterventie

Brief Advice: extended referral to a Combined Lifestyle Intervention (GLI) for overweight and obesity

Step 1: Ask

'Would it be alright if we spent a couple of minutes talking about your weight and health today?'
If no: 'Of course, we don't have to. If you ever want to revisit it, just let me know.'
If yes: go to Step 2.

Step 2A: Advise

'For many people, even a small amount of weight loss can improve energy, fitness and overall health. The most effective approach is usually structured support, rather than trying to do it alone.'

Step 2A: Motivational interviewing*

'Would you like some support with that, for example, to improve your health, fitness or energy levels?'

If interested:

Opening question options

A. 'What would be an inspiring goal for you, for example, in terms of energy, fitness, or day-to-day functioning?'
B. 'What would you like to work towards, so you feel healthier or more comfortable day to day?'

Follow-up question options

A. 'What do you think you'll gain if you achieve that goal?'
B. 'Imagine it's a year from now and things have gone as you'd hoped, what's different in your day-to-day life?'

If unsure:

Opening question options

A. 'If you decided to make a change, what do you think it might help with?'
B. 'What do you see as the pros and cons of making a change to your health or lifestyle?'

Follow-up question options

A. 'What would you do differently, or notice, in day-to-day life if it worked out?'
B. *Briefly reflect on the pros and cons mentioned:* 'So you can see [pro], and you're also concerned about [con]. How do those weigh up for you?'

Step 3: Act

Bridge:

If interested/clear goal: 'Given what you've said about wanting to [patient's goal], there's a structured programme that can support you with that.'
If unsure/ambivalent: 'It sounds like part of you can see benefits, and part of you has some understandable concerns. A structured programme can offer support at your pace.'

Act question (short, autonomy-supportive, specific):

'Would you like me to refer you to a local** Combined Lifestyle Intervention (GLI)*** programme? It's tailored, and it's covered by your health insurer.'

If interested: 'Great, they will contact you soon to arrange an appointment. Here's a leaflet with more information.'
If unsure: 'That's absolutely fine. You can take the leaflet and think it over at home. Would you like us to book a follow-up to talk it through?'

Optional, one extra sentence:

'You can also discuss it with the practice nurse/[other healthcare provider within the organisation] if you prefer.'

If not interested: 'No problem. If you'd like, you can take the leaflet so you know what options exist. If you change your mind later, we can revisit it.'

*** Motivational interviewing** aims to gently draw out a patient's *change talk*. The clinician supports the conversation in a respectful, non-judgemental way, so that the patient can reflect on whether there is something they would like to change and why. The patient then puts into their own words what matters to them, what might motivate them, and how confident they feel about making a change. This *change talk* can increase the likelihood of meaningful, sustained lifestyle change. See the last page of this tool for an **example dialogue**.

Advice for healthcare professionals on how to discuss someone's weight with patients, see:

- https://www.partnerschapovergewicht.nl/wp-content/uploads/2022/04/Praten-over-gewicht-advies-voor-zorgprofessionals.pdf

**** For an overview of GLI providers by municipality, see:**

- https://www.loketgezondleven.nl/gezondheidsthema/overgewicht/gecombineerde-leefstijlinterventie/erkende-gli-basisverzekering/tabel-gli-aanbieders and
- https://www.loketgezondleven.nl/gezondheidsthema/overgewicht/gecombineerde-leefstijlinterventie/kaartje-aanbod-GLI

***** For an overview of all types of GLI programmes, see:**

- https://www.loketgezondleven.nl/gezondheidsthema/overgewicht/gecombineerde-leefstijlinterventie

Example dialogue motivational interviewing

Clinician: 'What would be an inspiring goal for you, for example, in terms of energy, fitness, or day-to-day functioning?'
Patient: 'I'd like to have more energy and feel more comfortable at work, especially in my work clothes.'

Clinician: 'What do you think you'll gain if that happens?'
Patient: 'I wouldn't dread getting dressed. I'd feel more confident, and I'd probably enjoy work more.'

Clinician: 'So feeling comfortable in your clothes and more confident at work really matters to you.' (reflect)
Patient: 'Yes, exactly.'

Clinician: 'Imagine it's a year from now and things have gone as you'd hoped. What would be different in your day-to-day life?'
Patient: 'I'd get ready without stress, I'd feel lighter on my feet, and I'd be less self-conscious when I have to speak to people.'

Clinician: 'That sounds like a real quality-of-life improvement. Less stress, more confidence, and feeling fitter day to day. Have I got that right?' (summary + check)
Patient: 'Yes.'

Clinician: 'Given what you've said about wanting to feel more confident and comfortable day to day, there's a structured programme that can support you with that. Would you like me to refer you to such a local Combined Lifestyle Intervention (GLI) programme? It's tailored, and it's covered by your health insurer.'

If interested:
Patient: 'I think so, yes.'
Clinician: 'Great. They will contact you soon to arrange an appointment. Here's a leaflet with more information.'

If unsure:
Patient: 'I don't know…'
Clinician: 'That makes sense. It sounds like part of you can see the benefits, and part of you has some understandable concerns. You can take the leaflet and think it over. Would you like us to book a follow-up to talk it through?'
Optional: 'That's absolutely fine. We can leave it there for today.'

If not interested:

Patient: 'For now? No, not really.'

Clinician: 'That's absolutely fine. It's completely your choice. If you'd like, you can take this leaflet so you know what options exist. And if you ever want to revisit it later, just let me know.'

Appendix B

Implementation plan

Complex healthcare innovations within (routine) care

7

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BENEFIT for all-project
for the National network: Healthy living in a healthy environment

February 23, 2023

1. Theoretical underpinning of the implementation plan

Aim

The present implementation plan supports the implementation of complex healthcare innovations across diverse (routine) care settings, including hospitals, rehabilitation centres and general practices. Complex healthcare innovations, such as eHealth interventions, are characterised using multiple interacting functions and/or user groups, embedded within a continuously changing system.

Implementing complex healthcare innovations entails many challenges. This is partly due to the various behavioural, technological, and organisational components that interact in unclear, non-linear ways and therefore must be coordinated at multiple levels to be effective. Other challenges may include poor planning, high costs, limited fit with the intended organisations where the innovation must be implemented, and inadequate stakeholder collaboration during the dissemination and implementation of the healthcare innovation.

To address the many challenges during the implementation of complex healthcare innovations, the developed implementation plan consists of a stepwise process whose concrete content can be adapted based on new findings and insights gained during the different phases of implementation. The implementation plan, therefore, serves as a blueprint that can be tailored to each individual healthcare organisation.

Theoretical framework

To approach the implementation of complex healthcare innovations in a structured and systematic way, the development of the implementation plan drew on several theoretically grounded implementation models:

- The Implementation of Change Model (Grol and Wensing, 2011; a process model within implementation science that helps structure the implementation process), and
- The RE-AIM (Glasgow, Voght, & Boles, 1999; an evaluation framework within implementation science that supports the operationalisation of several components of the Implementation of Change Model, including Step 7: evaluation of the implementation process).

The Implementation of Change Model describes the seven steps that are followed during the implementation of a healthcare innovation (see **Figure 1**). The RE-AIM framework describes five dimensions to consider during the implementation of a healthcare innovation and when evaluating its implementation (see **Figure 2**).

Figure 1. Implementation of Change Model (Grol & Wensing, 2011).

Step 1	Develop proposal for change
Step 2	Analyse actual care; define concrete improvement goals
Step 3	Problem analysis: target group and setting
Step 4	Develop and select interventions/strategies
Step 5	Develop, test and execute the implementation plan
Step 6	Integrate into routines
Step 7	(Continuous) evaluation and (if needed) adjustment of the plan

Figure 2. RE-AIM (Glasgow, Voght, & Boles, 1999).

Reach	- Build relationships with the community and targetpopulation - Involve the target population in the development of documents and ideas for improving the healthcare innovation offered - Determine the most appropriate recruitment materials - Visit the community and target population to distribute recruitment materials
Effectiveness	- Use evidence-based programmes - Involve partner organisations - Identify resources that are already available - Identify resources that are prerequisites for implementation - Develop and maintain effective documentation
Adoption	- Gain insight into the system in which the healthcare innovation will be implemented - Involve local decision-makers in the early stages of the development process of the healthcare innovation - Provide information demonstrating reach, effectiveness, and ease of delivery and use
Implementation	- Use an implementation procedure tailored to the needs, knowledge and skills of the individuals involved - Provide resources (e.g. manuals, protocols) to enable implementation of the healthcare innovation - Offer training and technical support in the initial phase of the implementation process
Maintenance (sustainability) of implementation	- *Individual level:* availability of provided resources, gradual ramp-up of the healthcare innovation, establishing local support groups - *Organisational level:* use of existing infrastructure, introducing periodic contact, integration into daily work processes

2. Implementation plan for complex healthcare innovations (such as eHealth interventions)

A. Steps 1 and 2: Proposal for change and analysis of actual care

Objectives

This chapter describes requirements for Steps 1 and 2 within the implementation plan:

- Development of a proposal for change
- Analysis of actual care and goals for improvement

Key questions

The following key questions are addressed through consultation with the local healthcare organisation:

- At present, what does current care look like, and who is involved and in what way?
- Why and how does the healthcare organisation want to change current care?

To be discussed with the local healthcare organisation

Eliciting current care

1. How is care for your patients currently organised?
2. What, in your view, could be improved?
3. Do you have concrete goals for change, and what are they?
4. What resources (time, money, people) are available to realise the project?
5. Do you use eHealth and/or self-management tools within your work?
6. How do you think healthcare innovation can be used effectively within your organisation?
7. Does your organisation evaluate the quality of care delivered, and in which domains?[1]
8. Are specific indicators used for this? For example: patient satisfaction, number of complications, number of available healthcare professionals
9. Does the organisation need to comply with certain legal standards? For example: MedMij

Mapping roles of healthcare professionals

Map the roles that healthcare professionals have within the organisation where implementation will take place; identify who within the organisation is ready for change; and identify which roles and needs participants/patients have.

1. Which colleagues are involved in the changes you want to introduce?
2. How are these colleagues involved (overview of support staff, timing of involvement: everyone immediately/phased approach, internal/external, frequency)?

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[1]Evaluation of care using: (1) structure indicators (e.g. available healthcare professionals, equipment, availability of diagnostics), (2) process indicators (e.g. communication with patients, referral policy), and (3) outcome indicators (e.g. health status, patient satisfaction, complications).

3. How do they view the changes you want to introduce?
4. How does your management view the changes you want to introduce?
5. Without whose approval can the change not be implemented (e.g. organisational board/council)? And how do they view the changes you want to introduce? Have they been involved from the start of the development process?
6. To what extent have your ideas for change been discussed with the target group (patients)?
7. What ideas does the target group have regarding these changes?

Checklist for proposal for change and analysis of actual care

Establish the presence of preconditions

- ☐ There is an inspired/enthusiastic champion (local lead)
- ☐ A guiding coalition is (or will be) formed to enthuse staff
- ☐ The project lead has sufficient expertise in the organisational process involved in implementing the healthcare innovation
- ☐ There is support from decision-makers (funding) and management (from the start + longer term)
- ☐ Organisational decision-makers are involved from the early stages of the development process
- ☐ The (need for) change is rolled out stepwise
- ☐ Staff themselves experience the need for change
- ☐ A safe learning environment is ensured
- ☐ A local working group has been formed that is enthusiastic about the healthcare innovation
- ☐ The vision of the healthcare innovation is communicated consistently to convince an increasing number of people

B. Step 3: Problem analysis, target group and setting

Aim

This chapter describes requirements for Step 3 within the implementation plan:

- Analysis of context and target group
- Analysis of influencing factors

Key questions

The following key questions are addressed through consultation with the local healthcare organisation:

- Which healthcare professionals want to use the healthcare innovation, in what way and why?
- What does the target population look like, and how will they use the healthcare innovation?
- Which barriers and facilitators relevant to change are present?

To be discussed with the local healthcare organisation

Eliciting intended use

1. What need or goal do you have regarding the use of the healthcare innovation?
2. How do you think the healthcare innovation can be used effectively within your organisation?
3. What level of structural (sustained) use of the healthcare innovation is being targeted?
4. On which and how many departments do you want to implement the use of the healthcare innovation in?
5. Do you want the healthcare innovation to be additional to existing services, or will it (partly) replace them? If replacement: what exactly will be replaced?
6. What does the implementation growth pathway look like: at which moments do you want to reach what level of replacement, and how many users, departments, etc.?[2]
7. Which ethical aspects are relevant, and how will we address them?

Mapping influencing factors (determinants)

1. Which agreements and processes are needed for the structural and consistent use of the healthcare innovation?
2. What does this mean for current work processes?
3. Which skills must all staff acquire (eHealth use, knowledge, confidence in use) and what support structure (e.g. intervision/peer consultation, supervision) is needed?
4. Which habits do you consider supportive, and which are obstructive?
5. How will we support adoption/unlearning to enable the structural use of the healthcare innovation?
6. How do you want to introduce the healthcare innovation to the target group (patients), and what guidance do they need?
7. Which skills (self-discipline, reading or writing ability) are required amongst the target group?
8. With whom within the organisation must collaboration occur (e.g., ICT, communications, privacy)?
9. What potential challenges do you foresee in the implementation process?
10. Is there interest in a cost analysis at the end of implementation?

Mapping the patient journey

Map under which circumstances the target group will use the healthcare innovation, and how the healthcare innovation will become part of the care pathway for the target group.

1. Which patient population will be offered the healthcare innovation?
2. What problems does this patient population experience?
3. At what point in time do these problems occur for each population?

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[2] With respect to reach of the intervention: monitoring (1) the ratio between the number of actual users of the intervention and the population to whom it is offered, and (2) characteristics of actual users compared with characteristics of the total population to whom it is offered.

4. To what extent have your ideas for change been discussed with the target group (patients)?
5. What ideas does the target group have about these changes? Are they open to them?
6. What care do you want to deliver to your patient population via the healthcare innovation?
7. At what point in the care pathway do you want to offer the healthcare innovation?
8. In what setting will the healthcare innovation be offered?
9. Based on the topics discussed so far, do you foresee specific challenges or obstacles involved in realising the project?

Checklists for problem analysis, target group and setting

Schematic overview of involved target group(s) and external parties

- ☐ A visualised overview of patient groups, individuals and organisations: (jointly) create an overview in which the patient groups, individuals and organisations that have a role or interest in the implementation of the healthcare innovation are mapped
  - » Send the template to the organisation prior to the consultation
- ☐ A general worked-out version of the healthcare innovation patient journey, which is presented to the interested local healthcare organisation during or after mapping the patient journey, and adapted if needed based on their preferred way of working and problem definition

Establish the presence of involved staff, resources and budget

- ☐ There is a local coordinator (point of contact) for project-related matters
- ☐ There is an overview of the involved and support staff (internal/external, frequency)
- ☐ Clear expectations and internal agreement regarding compensation for additional staff work
- ☐ If of interest: define the design and requirements for a cost analysis at the end of implementation

Identification of factors influencing implementation

- ☐ Overview of all stakeholders within the implementation process (names and roles)
- ☐ Overview of facilitating and limiting factors, per change objective, per stakeholder
- ☐ Prioritisation of influencing factors within the implementation plan
- ☐ Measurement of actual care has been conducted, and a problem analysis has been made

Establish the presence of implementation objectives

- ☐ Description of what exactly is being implemented
- ☐ Description of target group(s) (e.g. local healthcare organisation and patients)
- ☐ Overview of key recommendations, goals and ambitions
- ☐ Overview of key recommendations and concrete goals for improvement
- ☐ Target groups (local healthcare organisation, patients) are involved in formulating goals

C. Step 4: Development and selection of interventions/strategies

Aim

This chapter describes requirements for Step 4 within the implementation plan:

- Development of dissemination strategies[3]
- Development of implementation strategies[4]

Key questions

The following key questions are addressed through consultation with the local healthcare organisation:

- Which strategies are needed for effective local dissemination of the healthcare innovation?
- What do healthcare professionals need to support the implementation of the healthcare innovation?

To be discussed with the local healthcare organisation

Eliciting dissemination needs

1. Has a plan been developed for the different phases of the change process?
2. Have all subgroups been informed, and are they interested?
3. If there is resistance, what is needed to remove/mitigate resistance?
4. What is needed to realise change within the current way of delivering care?

Eliciting implementation needs

In consultation with the local healthcare organisation, the following should be elicited:

1. Which preparations are desirable during dissemination and implementation?
2. Is there a need for a fixed group of trainers responsible for training staff?
3. Is there a need to organise informal meetings to exchange experiences?
4. Which supporting materials are desired during implementation?
5. Which methods will be used for data collection, analysis and feedback?
6. Which preparations are needed for the smooth implementation of the healthcare innovation?

Checklists for development and selection of interventions/strategies

Required local support during dissemination and implementation

- ☐ Involve the target population in developing documents and ideas for improvement
- ☐ Tailor the implementation plan to the needs, knowledge and skills within the organisation
- ☐ Provide resources (e.g. manuals, protocols) to enable implementation of the healthcare innovation

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[3] *Dissemination:* increasing interest in and knowledge about the healthcare innovation, promoting a positive attitude towards the healthcare innovation, and willingness to adjust existing working practices for the healthcare innovation.

[4] *Implementation:* promoting use of the healthcare innovation in practice, whereby the new way of working becomes an integral part of daily routines.

- ☐ Offer training and technical support during the implementation process
- ☐ Align implementation strategies based on needs at two levels:
  - ☐ Individual level: availability of provided resources, gradual ramp-up of the healthcare innovation, and forming local support groups
  - ☐ Organisational level: use of existing infrastructure, introducing periodic contact, integration into daily work processes, protocolised implementation across multiple organisational levels

Materials required for an implementation support toolbox

- ☐ Tools for healthcare professionals (e.g. patient journey, protocols and manuals)
- ☐ Tools for participants/patients (e.g. leaflets, videos, manuals)
- ☐ Optional: tools for the organisation (e.g. collaboration model, overview of relevant care pathways)

Overview of methods for data collection, analysis and feedback

- ☐ Overview of planned appointments (meetings, onboarding/training days, evaluations), including locations
- ☐ Overview of questionnaires to evaluate (indicator) data (e.g. job satisfaction amongst healthcare professionals; patients' health, wellbeing, quality of life, and satisfaction)
- ☐ Overview of data to be fed back (with attention to communicating local quick wins)
- ☐ Overview of preparatory activities for informing, motivating and persuading subgroups

Establish the presence of local organisational preconditions for implementation

- ☐ Overview of the chronological rollout of the healthcare innovation
- ☐ Description of channels used to share information within the healthcare organisation
- ☐ Overview of those responsible for dissemination of healthcare-innovation-related matters
- ☐ There are guidelines on the availability of internal documentation relating to the healthcare innovation

D. Step 5: Development, testing and execution of the implementation plan

Objectives

This chapter describes requirements for Step 5 within the implementation plan:

- Attention to smooth realisation of dissemination and implementation
- Successful execution of an appropriate implementation plan

Key questions

The following key questions are addressed through consultation with the local healthcare organisation:

- To what extent is the planned dissemination approach being applied?
- Which changes are needed to improve the dissemination process?

- To what extent is the planned implementation approach being applied?
- Which changes are needed to improve the implementation process?

To be discussed with the local healthcare organisation

Eliciting dissemination progress

1. To what extent is there a guiding coalition of staff to enthuse the other stakeholders? What challenges are encountered?
2. To what extent do stakeholders adhere to the planned schedule? What challenges are encountered?
3. To what extent are internal media used to disseminate knowledge and experiences?
4. To what extent are all subgroups informed, and to what extent are they interested?
5. If there is resistance: how is resistance being addressed?

Eliciting experiences from the implementation pilot

1. *Product evaluation:* Is the healthcare innovation user-friendly, stable, fast, written in understandable language, and does it add value for users in daily practice?
2. *Process evaluation:* Does what we designed work?
    a. How does the patient/client experience the quality of care delivered?
    b. How does the staff member experience the feasibility of their work?
    c. What is needed to achieve (even) higher quality?
    d. Is the work process sufficiently adapted to daily practice?
    e. Is everyone sufficiently equipped in terms of knowledge and skills?
    f. Is everyone sufficiently informed and meaningfully involved?
    g. Have time and pace sufficiently taken users into account?
    h. Have the set goals and ambitions been achieved?

Eliciting implementation progress

1. Are the supporting materials being used? What is needed?
2. Is training and technical support being used in the initial phase? Are there challenges?
3. Which additional supporting materials are desired during implementation?
4. Which methods are used for the collection, analysis and feedback of (indicator) data?
5. Discuss which local organisational conditions are desirable to enable the smooth implementation of the healthcare innovation.

Checklists for development, testing and execution of the implementation plan

Evaluation of dissemination and implementation

- ☐ Evaluation of the pre-planned dissemination approach
- ☐ Evaluation of the pre-planned implementation approach
- ☐ Evaluation of job satisfaction amongst healthcare professionals
- ☐ Evaluation of patients' health, well-being, quality of life and satisfaction

Internal action plan: follow-up based on pilot evaluation results

- ☐ Overview of pilot experience results and pilot evaluation
- ☐ If needed, adjust the implementation plan based on evaluation
- ☐ Feedback findings to the local healthcare organisation based on evaluation results
- ☐ Provide the adjusted project implementation plan to the local healthcare organisation
- ☐ Internal overview of lessons learned to improve the implementation plan
- ☐ Develop/adjust measures that safeguard the working method after implementation

E. Step 6: Integration into routines

Objectives

This chapter describes requirements for Step 6 within the implementation plan:

- Creating a routinisation of the use of the healthcare innovation within the organisation
- Developing a systematic approach for evaluating intended goals

Key questions

The following key questions are addressed through consultation with the local healthcare organisation:

- What goals does the local healthcare organisation have for the short and long term?
- How can influencing factors be actively monitored and managed during integration into work processes?
- Which measures safeguard the structural continuity of the healthcare innovation?
- How can work processes best be standardised?

To be discussed with the local healthcare organisation

Aligning agreements for structural continuation of the implementation programme

In consultation with the local healthcare organisation, the following should be discussed:

1. Define short-term and long-term goals
2. Monitor behaviour/actions continuously as part of data collection by scheduling meetings, progress consultations, retraining healthcare professionals, etc., and continuously testing actions

Aligning standardisation of the work process

1. Is it clear what the standard work process for the healthcare innovation is?
2. Has it been clearly communicated when deviations from the standard work process occur?
3. Has the new way of working been included in all communications?
4. When scaling up to other department(s), is it clear whether the output/methodology is reusable or requires adaptation?
5. Are users (clients and staff) involved again during recalibration?
6. Is it clear how work is progressing towards the broader use of the healthcare innovation?

Eliciting experiences of integration into routines

1. *Product evaluation:* Is the healthcare innovation user-friendly, stable, fast, written in understandable language, and does it add value for users in daily practice?
2. *Process evaluation:* Does what we designed work?
    a. How does the client experience the quality of care delivered?
    b. How does the staff member experience the feasibility of their work?
    c. What is needed to achieve (even) higher quality?
    d. Is the work process sufficiently adapted to daily practice?
    e. Is everyone sufficiently equipped in terms of knowledge and skills?
    f. Is everyone sufficiently informed and meaningfully involved?
    g. Have time and pace sufficiently taken users into account?
    h. Have the set goals and ambitions been achieved?

Eliciting influencing factors for structural integration
(for a relapse-prevention plan)

1. To what extent do the facilitating and limiting factors (identified during Step 3) appear to influence integration into routines in practice?
2. What challenges does the local healthcare organisation face in integrating into routines?
3. How are influencing factors identified locally? How is this acted upon?

Checklists for integration into routines

Systematic approach for integration into routines

- ☐ Specify the structural continuation of implementation, including concrete agreements regarding evaluation
- ☐ Evaluation moments have taken place as planned
- ☐ Development of requirements arising from the evaluation moments
- ☐ Relapse-prevention plan: implement measures that safeguard the working method after completion of the implementation process

Action plan: follow-up based on evaluation results

- ☐ Overview of evaluation results and adjustment of the implementation plan based on the evaluation
- ☐ Feedback findings to the local healthcare organisation following the evaluation(s)
- ☐ Provide the adjusted project implementation plan to the local healthcare organisation
- ☐ Internal overview of all lessons learned to improve the implementation plan
- ☐ Develop/adjust measures that safeguard the working method after implementation

F. Step 7: Continuous evaluation and adjustment of the plan

Objectives

This chapter describes requirements for Step 7 within the implementation plan:

- Evaluation of intended goals
- Improvement of the implementation of the healthcare innovation at the overarching and local levels

Key questions

The following key questions are addressed through consultation with the local healthcare organisation:

- To what extent are the goals, as defined in Step 6, achieved?
- How can implementation be improved? Which factors influence this?

To be discussed with the local healthcare organisation

Evaluation of defined goals

1. To what extent have the defined goals (short-term, intermediate and long-term) been achieved?
2. Which new goals have you set?

Evaluation of agreements for the structural continuation of use of the healthcare innovation

1. To what extent are the agreements made to continue the use of the healthcare innovation satisfactory structurally?
2. Who benefits (or does not benefit) from which agreements, and in what way?
3. Which challenges have been encountered that were not accounted for?
4. What can be improved (and how)?

Checklist for continuous evaluation and adjustment of the plan (if needed)

Evaluation of implementation

- ☐ Evaluation of job satisfaction amongst healthcare professionals
- ☐ Evaluation of patients' health, well-being, quality of life and satisfaction
- ☐ If agreed, perform a cost analysis
- ☐ If needed, adjust the implementation plan based on the evaluation
- ☐ Internal overview of lessons learned to improve the implementation plan
- ☐ Develop/adjust measures that safeguard the working method after implementation

3. References

Theoretical models

1. Figure 1: Implementation of Change Model (Grol & Wensing, 2011)
2. Figure 2: RE-AIM (Glasgow, Voght, & Boles, 1999)

Practice-oriented approaches

1. Step-by-step plan "Implementation of eHealth" (Zorg voor Innoveren, 2019)
2. Implementing innovations: examples of implementation strategies (Boendermaker & Regeer, 2016)

BENEFIT programme

1. Keesman, M., Janssen, V., Kemps, H., et al. (2019). BENEFIT for all: An ecosystem to facilitate sustained healthy living and reduce the burden of cardiovascular disease. *European Journal of Preventive Cardiology*, 26:606–8. doi: 10.1177/2047487318816388
2. Breeman, L.D., Keesman, M., Atsma, D.E., et al. (2021). A multi-stakeholder approach to eHealth development: Promoting sustained healthy living among cardiovascular patients. *International Journal of Medical Informatics*, 147:104364. doi: 10.1016/j.ijmedinf.2020.104364

Chapter 8

Summary and Samenvatting

SUMMARY

Heartwired for Change: Advancing the implementation of complex eHealth interventions and lifestyle change in routine cardiac care

Chapter 1 outlines the framework of this thesis by situating cardiovascular disease (CVD) within the rising global burden of chronic (non-communicable) diseases, largely driven by unhealthy lifestyle behaviours (e.g., tobacco use and physical inactivity). Sustainable health behaviour change is essential for prevention and long-term management. Yet, it is difficult to initiate and maintain due to interacting psychological, social, and contextual determinants, and the tendency for intervention effects to diminish over time. The first chapter introduces two key behavioural strategies central to this thesis, namely motivating the initiation of lifestyle change through brief lifestyle advice, and supporting it through structured goal setting. Additionally, complex eHealth interventions are presented as a promising approach to support behaviour change, by using personalisation, monitoring and feedback, coaching, and integration into daily routines. As their real-world impact depends on successful implementation within routine care, implementation science is introduced to bridge the research-to-practice gap, with key frameworks described to guide implementation planning, determinant assessment, and evaluation. Furthermore, the BENEFIT programme is introduced as a public-private partnership (PPP)-based case study of a complex eHealth intervention that supports sustained healthy living amongst cardiac patients. The chapter also emphasises psychosocial challenges in CVD, including depression and anxiety, and positions (internet-based) cognitive behavioural therapy (iCBT) as a promising, evidence-based component of holistic chronic disease management.

The main aims of this thesis are to: (i) advance knowledge on the initiation and maintenance of sustainable health behaviour change in patients with CVD, (ii) identify and address barriers and facilitators to implementing complex eHealth interventions in routine clinical care, particularly within PPPs, and (iii) integrate behavioural change and complex eHealth interventions into a holistic approach for chronic disease management, including psychosocial challenges in patients with CVD.

It presents four research questions: RQ1 How can brief lifestyle advice and the integration of life and health goals influence the intention to initiate and maintain lifestyle change in patients with CVD? (related to Aim 1), RQ2 How can implementation science be applied to design and implement a theory-based, practice-tailored implementation strategy for implementing complex eHealth interventions into routine clinical care? (related to Aim 2),

RQ3 How can implementation science be applied to identify barriers and facilitators influencing the implementation of complex eHealth interventions into routine clinical care? (related to Aim 2), and RQ4 How can implementation science be applied to integrate behavioural change and complex eHealth interventions into a holistic approach for chronic disease management, addressing psychosocial challenges faced by patients with CVD? (related to Aim 3).

Chapter 2 aims to advance knowledge on the initiation and maintenance of sustainable health behaviour change in patients with CVD (Aim 1). It explores how the source of the message (cardiologist vs physiotherapist) and the framing of the message (gain vs loss) of brief lifestyle advice may influence intention-to-change-lifestyle amongst patients with CVD. In an online experimental study with 636 patients with CVD, it was found that their intention-to-change-lifestyle was significantly higher when they received advice from the cardiologist. However, participants generally demonstrated a positive intention-to-change-lifestyle following the advice received from both the cardiologist and physiotherapist. The framing of the advice, whether it focused on the benefits of a healthy lifestyle (gain-frame) or the risks of an unhealthy one (loss-frame), appeared equally effective on their intention-to-change-lifestyle. Nevertheless, gain-framed messages were much better recalled by participants compared to loss-framed messages: only 9% of patients remembered the risks (loss), whilst 89% recalled the benefits (gain). Overall, these findings indicate that brief, positively framed lifestyle advice from a credible professional enhances motivation for health behaviour change. The next question is how this can be nurtured through personalised goal-setting strategies.

Chapter 3 also aims to advance knowledge on the initiation and maintenance of sustainable health behaviour change in patients with CVD (Aim 1). The study explores patients' preferences in health and life goals, examining how linking these goals affects their intention-to-change-lifestyle. Additionally, it investigated socio-demographic and health-related factors that may influence their intention-to-change-lifestyle. Conducted as a second online experimental study amongst 629 participants, patients with CVD were randomised into two conditions: the health-goal group (HG) or the life-and-health-goal group (LHG). The first condition, HG, set a health goal, whilst the second condition, LHG, established a life goal and then a health goal to support it. Then, intention-to-change-lifestyle was analysed along with secondary outcomes. Exercise-related health goals were most chosen in both goal-setting groups, but stress management goals were significantly more prevalent when life goals were linked to health goals. Linking life goals to health goals did not significantly influence CVD patients' intention-to-change-lifestyle. However, lower- and medium-educated participants showed a significantly higher intention-to-change-lifestyle when life goals were

linked to health goals. Moreover, experiencing meaning in life was shown to have a significant positive impact on intention-to-change-lifestyle. These findings underscore the importance of personalised goal setting within cardiac care practice, particularly for individuals with CVD with lower and medium education levels, and highlight the benefits of integrating life goals with health goals to enhance their motivation and adherence to lifestyle changes. Our results also emphasise the critical need to consider and anticipate socio-demographic factors when developing and enrolling interventions within healthcare.

Chapter 4 contributes towards the identification and addressing of the multifaceted barriers and facilitators to implementing complex eHealth interventions in clinical practice, particularly within PPPs (Aim 2). A detailed method for developing, evaluating, and refining an implementation strategy for complex eHealth interventions in routine practice is presented. The BENEFIT programme, a complex eHealth intervention developed by the BENEFIT consortium, a PPP to support healthy living in patients with CVD, serves as a case study to describe the development process of the strategy. Through six iterative phases alternating between theory and practice, an initial strategy was developed based on a process model and evaluation framework well-known within implementation science, namely the Implementation of Change Model and the RE-AIM framework. Input from key stakeholders was gathered to refine the strategy, followed by pilot-testing within clinical practice after some improvements were made. Key challenges hindering implementation were subsequently identified, such as the impracticality of implementing all programme features in certain organisations, overwhelming initial strategy presentation, unclear role assignments, and lack of employee involvement in decision-making. These barriers were subsequently mapped onto relevant domains and constructs of the Consolidated Framework for Implementation Research (CFIR). The purpose of this was to interpret the barriers as determinants of implementation success and, on that basis, to select and tailor targeted implementation strategies. These evidence-based recommendations were then used to strengthen the strategy. The result was an implementation strategy that was both scientifically grounded and practically feasible, aligning with stakeholders' needs and the context in which it was to be applied. This study highlights the importance of a multifaceted and adaptable implementation strategy approach, emphasising thorough communication, stakeholder involvement, and continuous refinement based on practical feedback. The findings provide a valuable blueprint for researchers and implementation experts aiming to implement complex eHealth interventions sustainably. It also underscores the need for evidence-based and practice-oriented strategies to ensure successful and long-term adoption in clinical settings. However, developing an implementation strategy is only the first step; its real-world usage depends on how organisations and stakeholders respond to the strategy in routine

clinical practice. Therefore, the next chapter evaluates the real-world implementation process that was executed.

Chapter 5 also contributes towards the identification and addressing of the multifaceted barriers and facilitators to implementing complex eHealth interventions in clinical practice, particularly within PPPs (Aim 2). It presents a comprehensive evaluation of the barriers and facilitators encountered whilst implementing the BENEFIT programme. Using the CFIR as a guiding framework, several key facilitators for successful implementation were identified. These included the adaptability of the programme, team communication and planning, digital healthcare needs, dedicated PPP leadership, and the PPP's meeting structure and ability to quickly adapt the implementation strategy. Barriers were specific PPP challenges, such as frequently changing roles, vague responsibilities, and staffing shortages, along with disruptions in the workplace, ineffective IT integration, and vague implementation objectives across cardiac rehabilitation (CR) sites. These findings highlight the challenges involved in implementing complex eHealth interventions within healthcare systems, and emphasise the necessity for a multifaceted and adaptable approach. Overall, the findings stress the importance of a tailored and coordinated implementation approach that aligns with the dynamic nature of PPPs and their healthcare environments. The insights may inform practical strategies for future PPP-led implementations, ultimately supporting more effective chronic disease care and better patient outcomes.

Chapter 6 focuses on the integration of behavioural change and complex eHealth interventions into a holistic approach for chronic disease management, including psychosocial challenges faced by patients with CVD (Aim 3). It explores the adoption of online therapy, specifically, internet-based Cognitive Behavioural Therapy (iCBT), amongst psychologists in medical hospitals, using the Unified Theory of Acceptance and Use of Technology (UTAUT) model. Although iCBT's potential to improve self-management and adaptation to chronic illnesses is acknowledged, its actual usage amongst psychologists remains limited. During the time of research, 15.9% of psychologists used iCBT in their practice, whilst 16.8% had access to it, and 21.5% intended to use it within the following year. Key determinants influencing behavioural intention towards iCBT usage included performance expectancy, effort expectancy, and facilitating conditions, collectively explaining 49% of the variance in behavioural intention amongst non-users. Social influence did not significantly impact behavioural intention. These findings highlight the gap between intention and actual use of iCBT, underscoring the need to enhance education and training on iCBT, increase its availability within practice, and improve its integration into the daily workflow of psychologists. Strengthening these factors may contribute to better management of chronic diseases and improved patient outcomes.

Finally, **Chapter 7** synthesises the findings of this thesis and situates them within the broader context of patient-centred cardiovascular care. It argues that meaningful reductions in CVD burden require a holistic, integrated approach that links sustainable lifestyle change, the successful implementation of complex eHealth interventions, and psychosocial support. Drawing on the findings, six lessons for practice and policy were formulated: (i) brief, positively framed lifestyle advice from trusted sources drives behavioural change, and gain-framed messages are particularly memorable, (ii) timing and personalisation matter, yet intention alone is insufficient and is constrained by the (often invisible) work of being a patient, including stress, competing responsibilities, and limited capacity to translate intention into action, (iii) structural inequality must be addressed to avoid widening health gaps, because without equity-sensitive communication and design (including plain language, teach-back techniques, motivational interviewing, and personalised goal setting), interventions may exacerbate rather than reduce health inequality, (iv) implementation succeeds with adaptability, stakeholder co-design, and role clarity, (v) PPPs offer essential opportunities for innovation but require formalised governance frameworks, shared ownership, and implementation skills to manage role ambiguity, power dynamics, and competing stakeholder interests, and (vi) innovations such as complex eHealth interventions and online therapy (e.g. iCBT) must be embedded in clinical workflows and supported by training, alongside efforts to strengthen digital inclusion.

It is advised that future research focusses on (i) behavioural maintenance and long-term impact, using longitudinal designs and objective metrics such as wearable-device data, (ii) reducing health disparities through tailored design, including user-centred approaches for socioeconomically vulnerable groups and by paying attention to the broader social determinants of health, (iii) embedding sustainability through health economic evaluations, including cost-effectiveness and reimbursement structures, (iv) optimising implementation in diverse healthcare contexts, including adaptive implementation models for low-resource settings and improved PPP governance, and (v) moving beyond individual responsibility by studying and implementing systemic and policy change to reform health-shaping environments.

Overall, the thesis concludes that 'heartwiring' change requires an ecosystem that aligns behaviour change mechanisms, implementation strategies and organisational conditions (including workflow integration and training), and psychosocial care with real-world contexts and equity considerations. It also recognises that even the best, well-supported individual-level interventions remain constrained without broader environmental and policy reform.

SAMENVATTING

Heartwired for Change: Het bevorderen van de implementatie van complexe eHealth-interventies en leefstijlverandering in de routine hartzorg

Hoofdstuk 1 beschrijft het kader van dit proefschrift. Het plaatst hart- en vaatziekten in de context van de wereldwijd groeiende last van chronische ziekten. Die groei komt voor een groot deel door ongezonde leefstijlgewoonten, zoals roken en te weinig bewegen. Een blijvende verandering van leefstijl en gezondheidsgedrag is belangrijk om hart- en vaatziekten te voorkomen en om mensen met hart- en vaatziekten langdurig goed te begeleiden. Toch is het moeilijk om zo'n verandering te starten en vol te houden. Dat komt doordat veel factoren tegelijk meespelen: psychologische factoren, sociale factoren en factoren in iemands omgeving. Bovendien neemt het effect van interventies vaak af na verloop van tijd. Dit hoofdstuk introduceert twee gedragsstrategieën die centraal staan in dit proefschrift: mensen motiveren om te beginnen met leefstijlverandering via kort leefstijladvies, en mensen helpen om veranderingen vol te houden door doelen op een gestructureerde manier te formuleren (goal setting). Ook worden complexe eHealth-interventies (digitale zorginterventies) gepresenteerd als een veelbelovende manier om gedragsverandering te ondersteunen, bijvoorbeeld door persoonlijke afstemming, het volgen van gedrag (monitoring) en het geven van feedback, coaching, en het inpassen in het dagelijks leven. Maar of zulke interventies echt effect hebben, hangt af van de vraag of ze goed worden ingevoerd in de dagelijkse zorg. Daarom wordt gebruik gemaakt van implementatiewetenschap. Dat is een vakgebied dat helpt om de stap te maken van onderzoek naar praktijk. Er worden belangrijke modellen en raamwerken beschreven die kunnen helpen bij planning, het in kaart brengen van belemmerende en helpende factoren, en evaluatie. Verder introduceert het hoofdstuk het BENEFIT-programma als voorbeeld: een complexe eHealth-interventie die is ontwikkeld binnen een publiek-private samenwerking (PPS) en die mensen met hart- en vaatziekten ondersteunt bij blijvend gezond leven. Het hoofdstuk laat zien dat PPS'en extra uitdagingen geven bij implementatie, zoals afspraken over bestuurlijke organisatie en goede afstemming tussen alle betrokken stakeholders. Tot slot benoemt het hoofdstuk psychosociale problemen die vaak voorkomen bij hart- en vaatziekten, zoals depressie en angst. Het plaatst internet gebaseerde cognitieve gedragstherapie (iCGT) als een veelbelovend en wetenschappelijk onderbouwd onderdeel van brede zorg bij chronische ziekten.

De belangrijkste doelen van dit proefschrift zijn: (i) meer kennis opbouwen over hoe mensen met hart- en vaatziekten kunnen beginnen met, en volhouden van, duurzame leefstijlverandering, (ii) belemmeringen en helpende factoren vinden en aanpakken bij het invoeren van complexe eHealth-interventies in de dagelijkse klinische zorg, vooral binnen PPS'en, en (iii) gedragsverandering en complexe eHealth-interventies opnemen in een brede aanpak van chronische zorg, waarin ook psychosociale problemen bij hart- en vaatziekten aandacht krijgen.

Hier horen vier onderzoeksvragen bij: OV1 Hoe kunnen korte leefstijladviezen en het verbinden van levensdoelen met gezondheidsdoelen de motivatie (intentie) beïnvloeden om bij patiënten met hart- en vaatziekten een leefstijlverandering te starten én vol te houden? (Doel 1), OV2 Hoe kan implementatiewetenschap worden gebruikt om een op theorie gebaseerde en op de praktijk afgestemde implementatiestrategie te ontwerpen én uit te voeren, zodat complexe eHealth-interventies kunnen worden ingevoerd in de routinematige (dagelijkse) klinische zorg? (Doel 2), OV3 Hoe kan implementatiewetenschap worden toegepast om te achterhalen welke belemmeringen en welke bevorderende factoren (succesfactoren) invloed hebben op het invoeren van complexe eHealth-interventies in de dagelijkse klinische praktijk? (Doel 2), en OV4 Hoe kan implementatiewetenschap helpen om gedragsverandering en complexe eHealth-interventies samen te brengen in één samenhangende, holistische aanpak voor de behandeling/begeleiding van chronische ziekten, waarbij ook psychosociale uitdagingen van patiënten met hart- en vaatziekten worden meegenomen? (Doel 3).

Hoofdstuk 2 onderzoekt hoe kort leefstijladvies de intentie om de leefstijl te veranderen kan beïnvloeden bij mensen met hart- en vaatziekten (Doel 1). Daarbij werd gekeken naar twee dingen: wie het advies geeft (cardioloog of fysiotherapeut) en hoe het advies is geformuleerd (met nadruk op winst of met nadruk op verlies). In een online experimentele studie met 636 mensen met hart- en vaatziekten bleek dat de intentie om leefstijl te veranderen hoger was wanneer het advies van de cardioloog kwam. Tegelijk hadden deelnemers na advies van zowel de cardioloog als de fysiotherapeut meestal een positieve intentie om te veranderen. Ook maakte het voor de intentie weinig uit of het advies vooral de voordelen van een gezonde leefstijl benadrukte (winstframe) of juist de risico's van een ongezonde leefstijl (verliesframe). Wel onthielden deelnemers winst geformuleerde boodschappen veel beter dan verlies geformuleerde boodschappen: slechts 9% van de patiënten herinnerde zich de risico's, terwijl 89% de voordelen noemde. Samen laten deze resultaten zien dat kort, positief geformuleerd leefstijladvies van een vertrouwde professional de motivatie voor gedragsverandering vergroot. De volgende vraag is hoe dit verder kan worden ondersteund met persoonlijke strategieën voor het stellen van doelen.

Hoofdstuk 3 draagt ook bij aan Doel 1. Deze studie onderzoekt welke gezondheidsdoelen en levensdoelen mensen met hart- en vaatziekten belangrijk vinden, en wat er gebeurt als je die doelen met elkaar verbindt. Ook wordt bekeken welke sociaal-demografische en gezondheidskenmerken samenhangen met de intentie om de leefstijl te veranderen. In deze tweede online experimentele studie met 629 deelnemers werden mensen met hart- en vaatziekten willekeurig ingedeeld in twee groepen: de gezondheidsdoelgroep en de levens- en gezondheidsdoelgroep. In de gezondheidsdoelgroep formuleerden deelnemers een gezondheidsdoel. In de levens- en gezondheidsdoelgroep formuleerden deelnemers eerst een levensdoel en daarna een gezondheidsdoel dat helpt om dat levensdoel te bereiken. Daarna werd de intentie om de leefstijl te veranderen onderzocht, samen met andere uitkomsten. In beide groepen kozen mensen het vaakst doelen die met bewegen te maken hadden. Stressmanagementdoelen kwamen duidelijk vaker voor wanneer levensdoelen aan gezondheidsdoelen werden gekoppeld. Het koppelen van levensdoelen aan gezondheidsdoelen had geen duidelijk effect op de intentie tot leefstijlverandering, maar deelnemers met een lage of middelbare opleiding hadden wel een significant hogere intentie om hun leefstijl te veranderen wanneer levensdoelen aan gezondheidsdoelen werden gekoppeld. Ook bleek dat het ervaren van betekenis in het leven een significante, positieve invloed had op de intentie om de leefstijl te veranderen. Deze bevindingen laten zien dat het stellen van gepersonaliseerde doelen belangrijk is in de hartzorg, vooral voor mensen met een lage of middelbare opleiding. Ze laten ook zien dat het koppelen van levensdoelen aan gezondheidsdoelen kan helpen om motivatie en therapietrouw, het volhouden van veranderingen, te versterken. Daarnaast tonen de resultaten dat het belangrijk is om rekening te houden met sociaal-demografische verschillen bij het ontwikkelen van interventies en het betrekken van mensen bij de zorg.

Hoofdstuk 4 onderzoekt belemmeringen en helpende factoren bij het invoeren van complexe eHealth-interventies in de klinische praktijk, vooral binnen PPS'en (Doel 2). Het hoofdstuk beschrijft stap voor stap hoe je een implementatiestrategie kunt ontwikkelen, testen, evalueren en verbeteren. Het BENEFIT-programma wordt hierbij als voorbeeld gebruikt. Dit programma is een complexe eHealth-interventie die is ontwikkeld door het BENEFIT-consortium, een PPS die gezond leven bij mensen met hart- en vaatziekten wil ondersteunen. De stappen omvatten zes rondes, waarin theorie en praktijk een balans vormden. Als eerste werd een strategie ontwikkeld waarbij een procesmodel en een evaluatiekader werden gebruikt die bekend zijn in de implementatiewetenschap: het Implementation of Change Model en het RE-AIM framework. Daarna werd feedback opgehaald bij belangrijke betrokkenen, en werd de strategie aangepast. Vervolgens werd de strategie in de praktijk getest, nadat er verbeteringen waren doorgevoerd. Hier kwamen belangrijke belemmeringen naar voren die de implementatie in de weg stonden. Voorbeelden

waren: niet alle onderdelen van het programma waren in elke organisatie haalbaar, de eerste uitleg van de strategie was te veel en te ingewikkeld, rollen waren niet duidelijk verdeeld, en medewerkers werden te weinig betrokken bij beslissingen. Deze belemmeringen werden vervolgens gekoppeld aan passende onderdelen uit het Consolidated Framework of Implementation Research (CFIR). Het doel hiervan was om de belemmeringen te duiden als determinanten van implementatiesucces en op basis daarvan gerichte implementatie-strategieën te kunnen selecteren en aanpassen. Die wetenschappelijk onderbouwde aanbevelingen werden gebruikt om de strategie te verbeteren. Het eindresultaat was een implementatiestrategie die zowel wetenschappelijk onderbouwd als praktisch toepasbaar was, en die aansloot bij de behoeften en context van betrokkenen. Deze studie laat zien dat een brede en aanpasbare implementatiestrategie nodig is, met goede communicatie, betrokkenheid van stakeholders en steeds bijsturen op basis van ervaringen uit de praktijk. De bevindingen geven een bruikbaar voorbeeld voor onderzoekers en implementatie-experts die complexe eHealth-interventies duurzaam willen invoeren. Het hoofdstuk laat ook zien dat wetenschappelijk onderbouwde en praktijkgerichte strategieën belangrijk zijn voor succesvolle en langdurige toepassing in klinische settings. Tegelijk is het maken van een strategie pas de eerste stap. Of de strategie echt gebruikt wordt, hangt af van hoe organisaties en betrokkenen ermee omgaan in de dagelijkse zorg. Daarom kijkt het volgende hoofdstuk naar het implementatieproces dat in de praktijk is uitgevoerd.

Hoofdstuk 5 draagt ook bij aan Doel 2. Dit hoofdstuk evalueert welke belemmeringen en helpende factoren werden ervaren tijdens de implementatie van het BENEFIT-programma. Het CFIR wordt gebruikt als leidend raamwerk. Er werden verschillende belangrijke factoren gevonden die de implementatie hielpen. Voorbeelden waren: het programma kon worden aangepast aan de lokale situatie, teams communiceerden en planden goed, er was behoefte aan digitale zorg, er was betrokken leiderschap binnen de PPP, en de PPP-structuur (zoals vergaderingen) maakte het mogelijk om de implementatiestrategie snel aan te passen. Er werden ook belemmeringen gevonden. Dit waren uitdagingen die vaak spelen in PPS'en, zoals rollen die vaak wisselden, onduidelijkheid over verantwoordelijkheden en personeels-tekorten. Andere belemmeringen waren organisatorische onrust op de werkvloer, slechte IT-koppelingen en onduidelijke doelen voor implementatie tussen locaties voor hartrevalidatie. Deze resultaten laten zien dat het invoeren van complexe eHealth-interventies in zorgsystemen uitdagend is en dat je daarom een brede en flexibele aanpak nodig hebt. De bevindingen benadrukken ook dat implementatie op maat en goede afstemming belangrijk zijn, juist omdat PPS'en en zorgorganisaties in de praktijk vaak veranderen. Deze inzichten kunnen helpen bij praktische aanpakken voor toekomstige implementaties die door PPS'en worden geleid, en kunnen zo bijdragen aan betere chronische zorg en betere uitkomsten voor patiënten.

Hoofdstuk 6 richt zich op het opnemen van gedragsverandering en complexe eHealth-interventies in een brede aanpak van chronische zorg, met aandacht voor psychosociale problemen bij mensen met hart- en vaatziekten (Doel 3). Het hoofdstuk onderzoekt het gebruik van internet gebaseerde cognitieve gedragstherapie (iCGT) onder psychologen in ziekenhuizen. Daarbij wordt het UTAUT-model gebruikt. In de onderzoeksperiode gebruikte 15,9% van de psychologen iCGT in de praktijk. 16,8% had er toegang toe, en 21,5% was van plan het in het volgende jaar te gaan gebruiken. Belangrijke factoren die samenhingen met de intentie om iCGT te gebruiken waren: de verwachting dat het helpt (prestatieverwachting), hoe makkelijk het lijkt (inspanning/gebruiksgemak) en of de juiste voorwaarden aanwezig zijn (faciliterende voorwaarden). Samen verklaarden deze factoren 49% van de verschillen in intentie bij psychologen die iCGT nog niet gebruikten. Sociale invloed had geen significant effect op de intentie. De resultaten laten zien dat er een gat zit tussen online therapie willen gebruiken en het daadwerkelijk gebruiken. Ze laten ook zien dat het belangrijk is om scholing en training over iCGT te verbeteren, iCGT vaker beschikbaar te maken en iCGT beter in te passen in het dagelijkse werk van psychologen. Dat kan bijdragen aan betere zorg bij chronische ziekten en betere uitkomsten voor patiënten.

Tot slot brengt **Hoofdstuk 7** de bevindingen van dit proefschrift samen en plaatst ze in de bredere context van patiëntgerichte hartzorg. Het hoofdstuk stelt dat een echte vermindering van de ziektelast door hart- en vaatziekten een brede, geïntegreerde aanpak vraagt. Die aanpak moet duurzame leefstijlverandering, succesvolle implementatie van complexe eHealth-interventies en psychosociale ondersteuning met elkaar verbinden.

Op basis van de resultaten zijn zes lessen voor praktijk en beleid opgesteld: (i) kort, positief geformuleerd leefstijladvies van een vertrouwde bron helpt bij gedragsverandering, en boodschappen met nadruk op winst zijn extra goed te onthouden, (ii) timing en persoonlijke afstemming zijn belangrijk, maar intentie alleen is niet genoeg, en wordt beperkt door de (vaak onzichtbare) dagelijkse belasting van leven met een chronische aandoening, zoals stress, conflicterende verantwoordelijkheden en beperkte kracht en ruimte om plannen om te zetten in actie, (iii) structurele ongelijkheid moet worden aangepakt om te voorkomen dat gezondheidsverschillen groter worden. Zonder communicatie en ontwerp die rekening houden met gelijkheid (zoals duidelijke taal, teach-back, motiverende gespreksvoering en persoonlijke doelstelling) kunnen interventies ongelijkheid vergroten in plaats van verkleinen, (iv) implementatie lukt beter als het programma kan worden aangepast, als betrokkenen meedenken en als rollen duidelijk zijn, (v) PPS'en bieden belangrijke kansen voor innovatie, maar vragen om duidelijke afspraken over bestuurlijke organisatie, gedeeld eigenaarschap en implementatievaardigheden om onduidelijke rollen, machtsverhoudingen

en verschillende belangen goed te kunnen hanteren, en (vi) innovaties zoals complexe eHealth-interventies en online therapie moeten onderdeel worden van de dagelijkse werkprocessen, en professionals hebben training nodig, samen met inspanningen om digitale inclusie te verbeteren.

Voor toekomstig onderzoek wordt geadviseerd om te focussen op: (i) het volhouden van gedragsverandering en effecten op lange termijn, met langdurig onderzoek en objectieve metingen zoals data van wearables, (ii) het verkleinen van gezondheidsverschillen door ontwerp op maat, met gebruikersgerichte aanpakken voor mensen in een kwetsbare sociaaleconomische positie, en met aandacht voor bredere sociale determinanten van gezondheid, (iii) het borgen van duurzaamheid met gezondheid economische evaluaties, zoals kosteneffectiviteit en vergoedingsstructuren, (iv) het verbeteren van implementatie in verschillende zorgcontexten, met aanpasbare implementatiemodellen voor omgevingen met weinig middelen en met betere bestuurlijke organisatie binnen PPS'en, en (v) verder kijken dan individuele verantwoordelijkheid door systeem- en beleidsverandering te onderzoeken en toe te passen om omgevingen die gezondheid beïnvloeden te verbeteren.

Overkoepelend laat dit proefschrift zien dat 'heartwiring' van verandering een samenhangend geheel vereist waarin mechanismen voor gedragsverandering, implementatie-strategieën en organisatorische randvoorwaarden (zoals inpassing in werkprocessen en training), en psychosociale zorg goed aansluiten bij de dagelijkse praktijk en oog hebben voor rechtvaardige toegang. Het proefschrift maakt ook duidelijk dat zelfs de best ontworpen en goed ondersteunde interventies op individueel niveau hun grenzen hebben zolang bredere veranderingen in de omgeving en het beleid uitblijven.



Appendices

AUTHOR CONTRIBUTIONS

Chapter 1
General introduction

Concept and design	R.V.H. IJzerman
Data collection	Not applicable
Statistical analysis	Not applicable
Interpretation of the data	Not applicable
Drafting the manuscript	R.V.H. IJzerman
Critical revisions	V.R. Janssen, R. van der Vaart, A.W.M. Evers, W.J.M. Scholte op Reimer

Chapter 2
Brief lifestyle advice in cardiac care: an experimental study on message source and framing.

Concept and design	R.V.H. IJzerman, V.R. Janssen, R. van der Vaart, A.W.M. Evers, W.J.M. Scholte op Reimer
Data collection	R.V.H. IJzerman
Statistical analysis	R.V.H. IJzerman, R. van der Vaart, V.R. Janssen
Interpretation of the data	R.V.H. IJzerman, V.R. Janssen, R. van der Vaart, A.W.M. Evers, W.J.M. Scholte op Reimer
Drafting the manuscript	R.V.H. IJzerman, V.R. Janssen, R. van der Vaart
Critical revision	All authors

Chapter 3
What matters to cardiac patients? The impact of linking life goals to health goals in patient's intention-to-change-lifestyle: an online experiment.

Concept and design	R.V.H. IJzerman, R. van der Vaart, L.D. Breeman, T. Reijnders, A.W.M. Evers, W.J.M. Scholte op Reimer, V.R. Janssen
Data collection	R.V.H. IJzerman
Statistical analysis	R.V.H. IJzerman, R. van der Vaart, L.D. Breeman, E. Dusseldorp, A.W.M. Evers, W.J.M. Scholte op Reimer, V.R. Janssen
Interpretation of the data	R.V.H. IJzerman, R. van der Vaart, L.D. Breeman, E. Dusseldorp, A.W.M. Evers, W.J.M. Scholte op Reimer, V.R. Janssen
Drafting the manuscript	R.V.H. IJzerman, R. van der Vaart, V.R. Janssen, E. Dusseldorp
Critical revision	All authors

Chapter 4

An iterative approach to developing a multifaceted implementation strategy for a complex eHealth intervention within clinical practice.

Concept and design	R.V.H. IJzerman, R. van der Vaart, R.A. Kraaijenhagen, A.W.M. Evers, W.J.M. Scholte op Reimer, V.R. Janssen
Data collection	R.V.H. IJzerman, V.R. Janssen, R.A. Kraaijenhagen
Statistical analysis	R.V.H. IJzerman, R. van der Vaart, V.R. Janssen
Interpretation of the data	R.V.H. IJzerman, R. van der Vaart, L.D. Breeman, A.W.M. Evers, W.J.M. Scholte op Reimer, V.R. Janssen
Drafting the manuscript	R.V.H. IJzerman, R. van der Vaart, V.R. Janssen
Critical revision	All authors

Chapter 5

Implementation of a complex eHealth intervention by a public-private partnership in clinical practice: a qualitative multicentre analysis using CFIR.

Concept and design	R.V.H. IJzerman, R. van der Vaart, R.A. Kraaijenhagen, A.W.M. Evers, W.J.M. Scholte op Reimer, V.R. Janssen
Data collection	R.V.H. IJzerman, R.A. Kraaijenhagen
Statistical analysis	R.V.H. IJzerman, R. van der Vaart, V.R. Janssen
Interpretation of the data	R.V.H. IJzerman, R. van der Vaart, L.D. Breeman, A.W.M. Evers, W.J.M. Scholte op Reimer, V.R. Janssen
Drafting the manuscript	R.V.H. IJzerman, R. van der Vaart, V.R. Janssen
Critical revision	All authors

Chapter 6

Internet-based cognitive behavioral therapy among psychologists in a medical setting: a survey on implementation.

Concept and design	R.V.H. IJzerman, R. van der Vaart
Data collection	R.V.H. IJzerman
Statistical analysis	R.V.H. IJzerman, R. van der Vaart
Interpretation of the data	R.V.H. IJzerman, R. van der Vaart
Drafting the manuscript	R.V.H. IJzerman, R. van der Vaart
Critical revision	All authors

Chapter 7
General discussion

Concept and design	R.V.H. IJzerman
Data collection	Not applicable
Statistical analysis	Not applicable
Interpretation of the data	Not applicable
Drafting the manuscript	R.V.H. IJzerman
Critical revision	V.R. Janssen, R. van der Vaart, A.W.M. Evers, W.J.M. Scholte op Reimer

LIST OF PUBLICATIONS

Publications included in this thesis

IJzerman RVH, Van der Vaart R, Evers AWM. Internet-based cognitive behavioral therapy among psychologists in a medical setting: a survey on implementation. J Med Internet Res. 2019;21(8):e13432. doi: 10.2196/13432

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IJzerman RVH, van der Vaart R, Breeman LD, Kraaijenhagen RA, Evers AWM, Scholte op Reimer WJM, et al. Implementation of a complex eHealth intervention by a public-private partnership in clinical practice: a qualitative multicentre analysis using CFIR. Health Educ Res. 2025;40(2). doi: 10.1093/her/cyaf001

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Bente BE, Wentzel J, Groeneveld RG, **IJzerman RVH**, de Buisonjé DR, Breeman LD, et al. Values of importance to patients with cardiovascular disease as a foundation for eHealth design and evaluation: mixed methods study. JMIR Cardio. 2021;5(2):e33252. doi: 10.2196/33252

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Breeman LD, Janssen VR, Kraaijenhagen R, Al-Dhahir I, **IJzerman RVH,** Wolstencroft K, et al. Lifestyle behaviour change of patients following cardiac rehabilitation: the BENEFIT intervention study with one-year follow-up. Eur J Prev Cardiol. 2025;zwaf193. doi: 10.1093/eurjpc/zwaf193.

PhD PORTFOLIO

Name PhD candidate: Renée IJzerman
Name PhD supervisors: Prof. dr. W.J.M. Scholte op Reimer
Prof. dr. A.W.M. Evers
Name PhD co-supervisors: Dr. Veronica Janssen
Dr. Roos van der Vaart

PhD training	**Year**	**ECTS**
General courses		*6.7*
WMO Good Clinical Practice training	2020	1
AMC World of Science Day	2021	0.7
Entrepreneurship in Health and Life Sciences	2021	1.5
Presenting in English	2022	1
Talents in PhD	2022	0.2
Didactical Skills	2022	0.4
Qualitative Health Research	2022	1.9
Specific courses		*0.4*
Mind mapping	2020	0.1
Ted talk training, debat.nl	2022	0.3
Seminars, workshops, and masterclasses		*1.3*
Leerbijeenkomst van Expertise Netwerk Implementatie: "Netwerken: hoe helpt het de implementatie?", Utrecht	2019	0.2
eMEN seminar: "Let's make it work! De implementatie van e-mental health", Amsterdam	2019	0.3
Workshop "Visueel denken & Zakelijk tekenen", Leiden	2021	0.2
PhD Skills lab: "Present like a boss", Amsterdam	2021	0.2
Leerbijeenkomst van Expertise Netwerk Implementatie: "Wat is impact in het complexe veld met vele perspectieven?", online	2022 2023	0.2 0.2

	Year	ECTS
Oral presentations		*8.5*
Data Science for health and prevention spring event, Leiden	2018	0.5
Congres Samenwerkende Gezondheidsfondsen, Utrecht	2019	0.5
Mini symposium Vital10 BENEFIT, Amsterdam	2019	0.5
Amsterdam UMC Cardiologie HEART research meeting, Amsterdam	2020	0.5
Consortium bijeenkomst BENEFIT for all, online	2020	0.5
Interdisciplinary lifestyle meeting Leiden University Medical Center, online	2020	0.5
Association for Researchers in Psychology and Health Conference, online	2021	0.5
Amsterdam UMC Cardiologie HEART research meeting, Amsterdam	2021	0.5
Amsterdam UMC Cardiologie HEART research meeting, Amsterdam	2021	0.5
Amsterdam UMC Cardiologie HEART research meeting, Amsterdam	2022	0.5
Consortium meeting BENEFIT for all, online	2022	0.5
Healthy Society Event, Leiden	2022	0.5
Association for Researchers in Psychology and Health conference, Enschede	2023	0.5
7th DCVA-NLHI Translational Cardiovascular Research Meeting, Utrecht	2023	0.5
Consortium bijeenkomst BENEFIT for all project, Leiden	2023	0.5
17th International Congress on Behavioral Medicine, Vancouver, Canada	2023	0.5
Association for Researchers in Psychology and Health conference, Maastricht	2024	0.5

Poster presentations		*3.5*
Association for Researchers in Psychology and Health conference, Tilburg	2018	0.5
Nederlands Congres Volksgezondheid, Utrecht	2018	0.5
Digital Society Conference, Amersfoort	2018	0.5
Preventieve Cardiologie en Hartrevalidatie conferentie, online	2020	0.5
International Congress on Behavioral Medicine (ICBM), online	2021	0.5
ESC Preventive Cardiology conference 2022, online	2022	0.5
36th Annual Conference of the European Health Psychology Society, Bratislava, Slowakije	2022	0.5

(Inter)national conferences		*1.25*
3rd Translational Cardiovascular Research Meeting, Netherlands Heart Institute, Utrecht	2019	0.25
Dutch Implementation Science conference, Utrecht	2019	0.25
Science of Interdisciplinary Research and Practice, Leiden	2019	0.25
"Digital Health: weerstand of motivatie?" symposium Amsterdam Center for Health Communication, Amsterdam	2020	0.25
"What Works When for Whom? Text Mining in Psychotherapy and eHealth Research" conference	2020	0.25

	Year	ECTS
Other		*11.2*
Monthly eHealth & self-management research meeting, LUMC & Leiden University, Leiden	2018	0.2
Key stakeholder meetings within practice regarding field implementation of the BENEFIT for all program	2018-2019	2
Biennial consortium meetings BENEFIT for all, Leiden	2018-2023	2
Weekly HEART research meeting, Amsterdam UMC Cardiologie and HvA research group, Amsterdam	2019-2025	2
Yearly writing retreat with writing club & weekly meetings	2021-2025	5

Teaching	**Year**	**ECTS**
Lecturing		*6*
Lecture Implementation & Evaluation, course Innovations in eHealth care (level 500), master Health and Medical Psychology, Leiden University	2022-2026	1
Workgroup, course Designing Interventions for Behaviour Change (level 500), master Health and Medical Psychology), Leiden University	2022	1
Workgroup, course Basic Therapeutic Skills (level 500), master Health and Medical Psychology, Leiden University	2022	1
Workgroup Determinants of health behaviour, course The Older Individual (level 500), master Health, Ageing & Society, Leiden University Medical Center	2022-2026	1
Workgroup, course Health and Medical Psychology (level 400), bachelor Psychology, Leiden University	2022	1
Workgroup, course Perspective on Career Orientation (level 200), bachelor Psychology, Leiden University	2022	1
Supervising		*5*
Maartje Smakman, master's internship	2019	1
Renée Tilli, master's internship	2019	0.5
Magali de Rooij, research assistant	2019-2022	0.5
Emma Boom, research assistant	2020-2022	0.5
Sascha Arema, research assistant	2021	0.5
Mitzi Vijverberg, research assistant	2021-2022	0.5
Mark Mulder, research assistant	2021	0.5
Fie Luijten, research assistant	2021-2022	0.5
Julia Lantzendörffer, research assistant	2022	0.5

CURRICULUM VITAE



Renée IJzerman was born on 2 December 1991 in Apeldoorn, the Netherlands. After completing her secondary education at the Christelijk Lyceum, she obtained a bachelor's degree in psychology and a master's degree in health and medical psychology at Leiden University. During her master's programme, she completed a clinical internship at Leiden University Medical Centre (LUMC), providing (internet-based) cognitive behavioural therapy to patients in the Cardiology and Rheumatology departments. She also undertook a research internship at LUMC, contributing to the development of a new eHealth care pathway for patients with cardiovascular disease (CVD), and supported the development of the Hartvaat Beweegcoach training programme for Harteraad.

In September 2018, Renée started her PhD at the Health, Medical and Neuropsychology unit of the Psychology department at Leiden University and the Cardiology department of Amsterdam UMC (location AMC), under the supervision of Prof. dr. Wilma Scholte op Reimer, Prof. dr. Andrea Evers, Dr. Veronica Janssen, and Dr. Roos van der Vaart. Within the BENEFIT project, her doctoral research focused on the sustainable implementation of a complex eHealth intervention for patients with CVD in routine care. She conducted both qualitative and quantitative research, supervised students, and coordinated nationwide patient recruitment and inclusion within the BENEFIT programme. Alongside her PhD, she gained teaching experience at Leiden University and LUMC, contributing to lectures and workgroups in the bachelor's programme Psychology and the master's programmes Health and Medical Psychology and Health, Ageing & Society.

Since March 2024, Renée has been a postdoctoral researcher in the Care for Obesity research group at the Department of Health Sciences, Vrije Universiteit Amsterdam. Her work focuses on implementation research, including support for the nationwide implementation of the Dutch multidisciplinary guideline for overweight and obesity, as well as integrated care for overweight and obesity. Alongside this role, she was seconded to JOGG from September 2024 to February 2025, where she studied the role of regional coordinators in implementing the Kind naar Gezonder Gewicht (KnGG) approach, the Dutch integrated care approach for children with overweight and obesity. In late 2025, she was again seconded to JOGG to support the development of an organisation-wide implementation plan for both the JOGG and KnGG approaches.

DANKWOORD

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"If I have seen further, it is by standing on the shoulders of giants." – Isaac Newton

Renée

