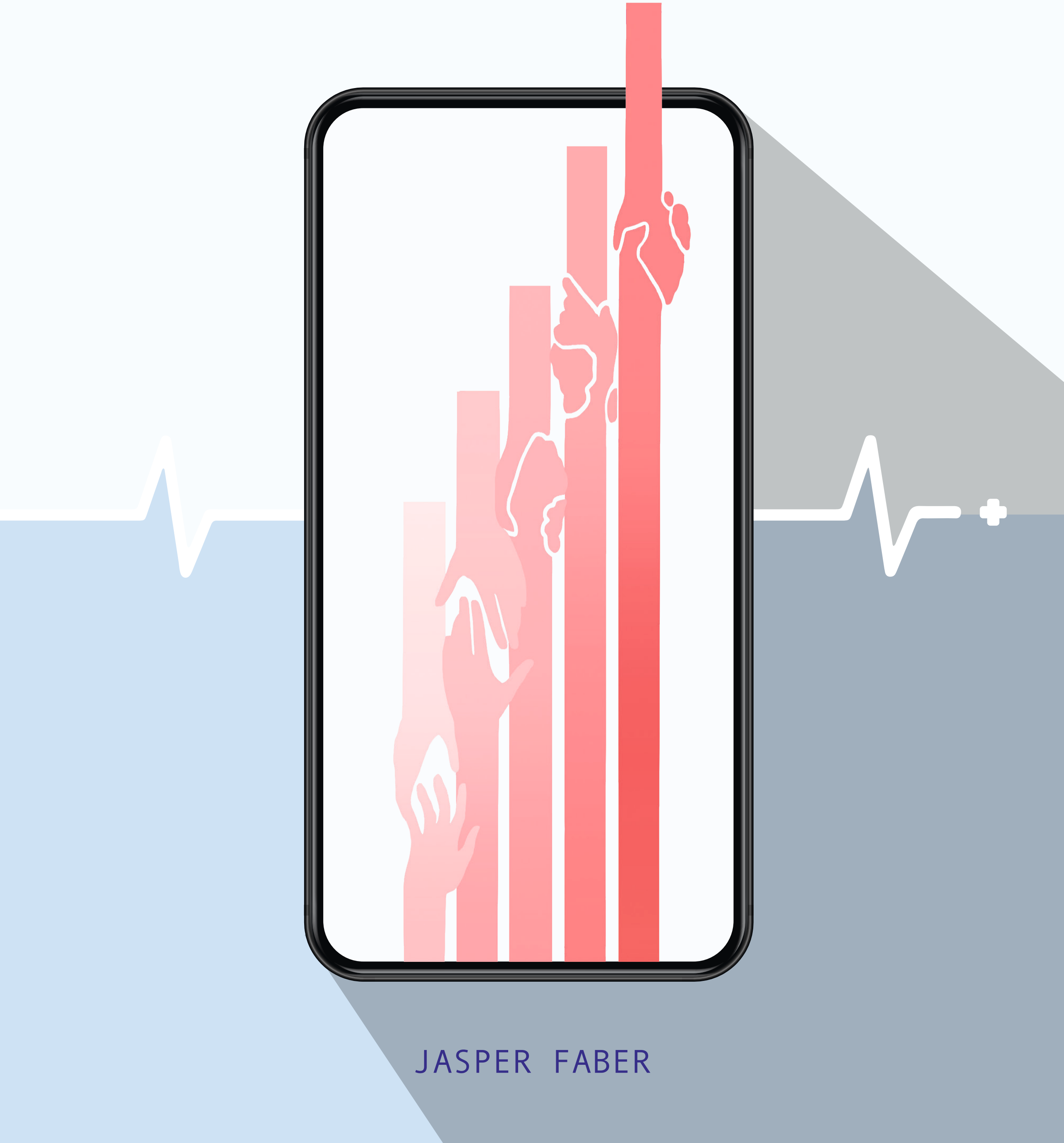
DESIGN FOR EHEALTH EQUITY

The development and application of design knowledge for the participatory design of eHealth interventions for people with a low socioeconomic position



JASPER FABER

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Dissertation

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by

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This dissertation has been approved by the promotors.

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Keywords: eHealth, behavior change, participatory design, low socioeconomic position, cardiac rehabilitation

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CHAPTER 1

Introduction

1.1 Background

Imagine a world in which you live nearly 30 years less in good health because of the socioeconomic circumstances in which you live. While this sounds like a dystopian scenario, it actually is a harsh reality. Currently, in the Netherlands, there is an average 7-year difference in lifespan between individuals with the highest and lowest levels of education (RIVM, 2017). This gap widens to 27 years when considering a person's health span, which refers to the years of good health they can enjoy (RIVM, 2017). People with lower levels of education tend to develop non-communicable chronic diseases (NCDs, e.g., cardiovascular disease, diabetes, and obesity) at an earlier age compared to their more highly educated counterparts (Mackenbach et al., 2008; Mackenbach et al., 2019; Stringhini et al., 2017). Similar disparities are observed across varying income (Jarvandi et al., 2012; Kaplan et al., 1996) and occupation levels (Ravesteijn et al., 2013; Volkers et al., 2007). Together, individuals with lower education, income, and occupational levels are referred to as those with a low socioeconomic position (SEP) (Braveman et al., 2005; Havranek et al., 2015). The 'health gap' between socioeconomic classes displays one of the most concerning examples of inequality within our current society. Moreover, the higher prevalence of NCDs among people with a low SEP leads to prolonged healthcare needs, a challenge that extends to both the individual and society (Adler & Stewart, 2010; Drewnowski et al., 2014; Latulipe et al., 2015; Mackenbach et al., 2008; Shishehbor et al., 2006).

A major reason for the higher prevalence of NCDs in groups with a low SEP is the greater prevalence of an unhealthy lifestyle compared to groups with a high SEP. Studies have shown that people with a low SEP are more likely to display lower levels of leisure-time physical activity (Beenackers et al., 2012; Gidlow et al., 2016), increased television viewing time (Clark et al., 2010; King et al., 2010), poorer diet (Darmon & Drewnowski, 2008), and more smoking behavior (Hiscock et al., 2012) compared to people with a high SEP. A multitude of interconnected factors, including stress, low literacy, poor living conditions, poor parenting, lack of social support, and low self-efficacy, contribute to this unfavorable health behavior (Marmot, 2005; Pampel et al., 2010). The complexity of these interconnected factors makes it challenging to address the underlying causes of an unhealthy lifestyle.

Lifestyle interventions have shown promising outcomes in areas such as physical activity, diet, and quitting smoking in the general population. Interventions focusing on diet and exercise have led to significant changes in body weight and physical activity (Greaves et al., 2011). In addition, behavioral approaches have proven to generally reduce tobacco usage (Stead et al., 2016). The rise of eHealth technologies has further transformed the approach to lifestyle interventions in recent years. Through digital platforms, mobile applications, and wearable devices, eHealth interventions can potentially make health behavior more engaging and accessible, particularly when they are based on theoretical frameworks and behavior change techniques (Webb et al., 2010). While traditional interventions have been shown to improve health behavior, several studies also emphasize that eHealth interventions can improve physical activity, diet, and sedentary behavior (Schoeppe et al., 2016) and lead to smoking cessation (Taylor et al., 2017; Whittaker et al., 2016). While traditional and eHealth interventions hold substantial promise for improving health behavior in the general population, evidence suggests that their success could be more evident in low socioeconomic populations (Reiners et al., 2019; Yamin et al., 2011).

1.2 Problem statement and knowledge gaps

Traditional lifestyle interventions have been largely unsuccessful in changing the behavior and improving the health of people with a low SEP (Bull et al., 2015; White et al., 2009). This can be attributed to several constraints related explicitly to low-SEP groups, such as stressful life situations (Marmot, 2005), accessibility issues (Coupe et al., 2018), inadequate social support (Moroshko et al., 2011), experienced stigma and distrust in healthcare (Armstrong et al., 2007), and low health literacy (Paasche-Orlow & Wolf, 2007). Another potential reason is that some individuals within the target group are less willing to engage in health-promoting behavior (Hardcastle et al., 2015). After all, it is worth questioning whether academics' views on health genuinely resonate with the values, beliefs, and priorities of those we aim to help. We might be operating from a standpoint that equates health with longevity and quality of life. At the same time, some individuals in the target group might prefer living a fulfilling life, even if it means that it may be shorter or less "healthy" by our standards (Heutink et al., 2010; Wardle & Steptoe, 2003). This dissonance could lead to a lack of willingness from the target group to engage with "our" interventions.

eHealth interventions possess inherent qualities that could mitigate some barriers regarding lifestyle interventions for low-SEP groups. eHealth platforms are often customizable, allowing for adaptations that better suit the problematic life situations frequently encountered by low-SEP groups. They can provide information in accessible multi-media formats, aligning with the needs of those with low (health) literacy levels (Michie et al., 2009). Moreover, the virtual nature of eHealth makes it more accessible than traditional interventions, as it can be accessed from any location with an internet connection, thereby partially bypassing accessibility issues (Hill & Powell, 2009). However, despite these advantages, current eHealth interventions seem to need to catch up to their potential in low-SEP populations. Several studies have indicated that eHealth interventions remain largely ineffective for people with a low SEP (Veinot et al., 2018). Multiple key factors must be in place for an eHealth intervention to be effective. First, accessibility is crucial; the intervention should reach its intended audience and be supported by the necessary technological infrastructure and device availability. Second, the target group must find the intervention acceptable, indicating willingness and ability to use it. Finally, adherence is essential; the target group should consistently engage with the intervention throughout its intended duration. Currently, eHealth interventions need to catch up in reaching and retaining adherence among individuals with a low SEP (Reiners et al., 2019; Yamin et al., 2011). Additional barriers that could account for this include inadequate digital (health) literacy (Cashen et al., 2004; Estacio et al., 2019), skeptical or less confident attitudes toward technology (Choi & Dinitto, 2013) and lack of resources (Cashen et al., 2004).

Bottom-up, participatory approaches serve as a transformative lens to address the challenges, needs, skills, and preferences of the target group by actively involving them in the design process of eHealth interventions (van Gemert-Pijnen et al., 2011). Essentially, participatory approaches shift the paradigm from designing “for” to designing “with” the target group. This orientation is deeply rooted in human-centered design and design research, as it prioritizes the lived experiences, insights, and contextual nuances of the users (Sanders & Stappers, 2008; Spinuzzi, 2016). Given the complex interplay of factors contributing to low uptake and engagement of eHealth interventions in low-SEP groups, tailored participatory approaches are recommended above top-down, one-size-fits-all strategies (Braveman et al., 2005). Indeed, participatory approaches have shown success in ensuring the intervention is aligned with the specific challenges, skills, and needs of the target group and may facilitate the uptake of the developed interventions (Lee et al., 2022; Neuhauser, 2017). Therefore, integrating participatory design in developing eHealth lifestyle interventions for low-SEP groups could be a crucial strategy to reach equitable eHealth interventions.

However, these approaches can be challenging when working with hard-to-reach groups, such as those with a low SEP. eHealth professionals (e.g., designers, developers, researchers, and care providers) often face practical challenges in reaching these groups for participatory design, including low health literacy, distrust toward the research team, cultural differences, and stigmatization (Bonevski et al., 2014; Stowell et al., 2018). These barriers can be time-consuming and challenging to overcome, especially under tight budgets and timelines. While the body of scientific knowledge on addressing the barriers related to the participatory design for and with groups with a low SEP is growing (Bonevski et al., 2014; Stowell et al., 2018), there has been limited effort to translate this knowledge into practical guides that specifically aid in the design of eHealth interventions for and with low-SEP groups. Practical guides are essential because they act as roadmaps for eHealth professionals, condensing complex research findings into actionable steps that can be easily implemented, particularly when resources are constrained (Graham et al., 2006). Indeed, there are existing practical guides for eHealth development (van Gemert-Pijnen et al., 2011) and for participatory design more broadly (Sanders et al., 2010; Spinuzzi, 2016), but none of these resources focus on the complexities of engaging specifically with low-SEP groups in such a process. Some guides do target low-SEP groups specifically, yet they often limit their scope by focusing primarily on addressing literacy-related barriers. This involves addressing digital literacy by designing more user-friendly and understandable interfaces and addressing traditional literacy by ensuring that the information provided is easily comprehensible (Choi & Dinitto, 2013). However, successful behavior change goes beyond these surface-level factors; it also requires tackling the more fundamental elements that underpin motivation—such as contextual (e.g., accessibility, social support, and influences), psychological (e.g., self-efficacy, perceived barriers), and emotional (e.g., stressful life situations) factors.

1.3 Aim of dissertation

The equity challenges currently experienced during the design of eHealth interventions result in these interventions often being designed as a one-size-fits-all solution, which unintentionally favors those with high health literacy, motivation, and willingness to engage with the intervention and access to technology and the internet. However, this approach leaves out those who may need eHealth interventions the most: people with a low SEP. This leads to the possibility that eHealth interventions are not helping to address health disparities but instead exacerbate them. Therefore, there is a pressing need for a comprehensive and practical tool that integrates the known barriers and facilitators regarding inclusive eHealth design to inform the design of eHealth interventions aligned with the needs of low-SEP groups.

The main aim of this dissertation was to develop a practically applicable knowledge tool that aligns with the needs of professionals and helps to facilitate the designing of eHealth interventions tailored to people with a low SEP. To accomplish this aim, this thesis consists of several studies that relate to each other based on the knowledge-to-action (KTA) framework (Graham et al., 2006). This framework is often used in healthcare research to move knowledge into actionable strategies. It involves the three dynamically interacting concepts of knowledge inquiry, the development of a knowledge tool, and action cycles (Figure 1.1). To facilitate the main aim of developing the knowledge tool, we address two additional aims. First, we engaged in knowledge inquiry by addressing critical knowledge gaps about the attitudes of individuals with a low SEP toward health, healthcare, and eHealth and how participatory design can better engage these groups in research and design processes. Second, we engaged in an action cycle representing a design process of an eHealth intervention in the specific context of cardiac rehabilitation (CR). This involves adapting and applying the knowledge tool in a real-world setting to assess the applicability of the knowledge and evaluate the outcomes of the resulting intervention. These outcomes serve to refine and improve the knowledge tool's applicability in specific settings, acting as an initial step in the iterative refinement needed to sustain knowledge use in future studies to develop eHealth interventions for low-SEP populations.

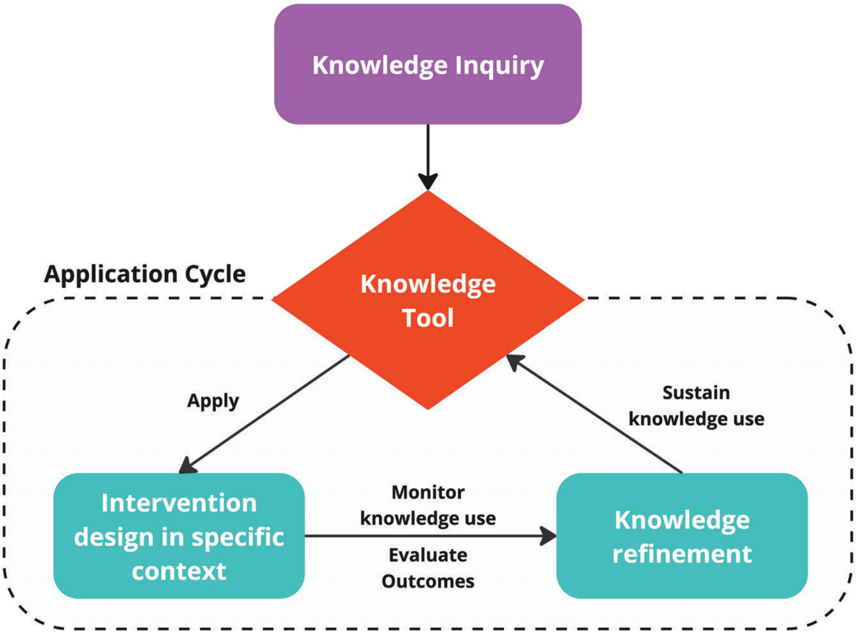

Figure 1.1 Visualization of the thesis approach modified from KTA framework presented in Field et al. (2014).

1.4 Project background

This project was a collaborative effort funded by the Medical Delta as part of the theme "eHealth and self-management for a healthy society" and Capri Cardiac Rehabilitation. It involved multiple institutions, including Delft University of Technology, Erasmus University Medical Center, Leiden University, Leiden University Medical Center, and Capri Cardiac Rehabilitation. The project's primary objective was to develop and evaluate a knowledge tool designed to support professionals developing eHealth interventions together with and for low-SEP populations. Two PhD projects contributed to this goal. The project that was carried out at Leiden University and Leiden University Medical Center was performed by Isra Al-Dhahir. She adopted a broad, top-down approach and explored barriers and facilitators in eHealth design for low-SEP groups, primarily through a literature review and consultation with professionals. She later evaluated the acceptance of the knowledge tool's content among professionals.

The PhD project that constitutes this thesis was carried out at the Delft University of Technology, Erasmus University Medical Center, and Capri Cardiac Rehabilitation. The approach adopted a bottom-up perspective, in contrast to Isra Al-Dhahir's approach, by concentrating on participatory design with the target group in specific contexts. Although each PhD candidate largely worked independently, developing the knowledge tool was a collaborative effort. It aimed to integrate the top-down (professionals) and bottom-up (target group) perspectives.

1.5 Thesis outline

In line with the three aims presented in section 1.3, this thesis is divided into three parts that address knowledge inquiry, development of the knowledge tool, and the application cycle (Figure 1.2).

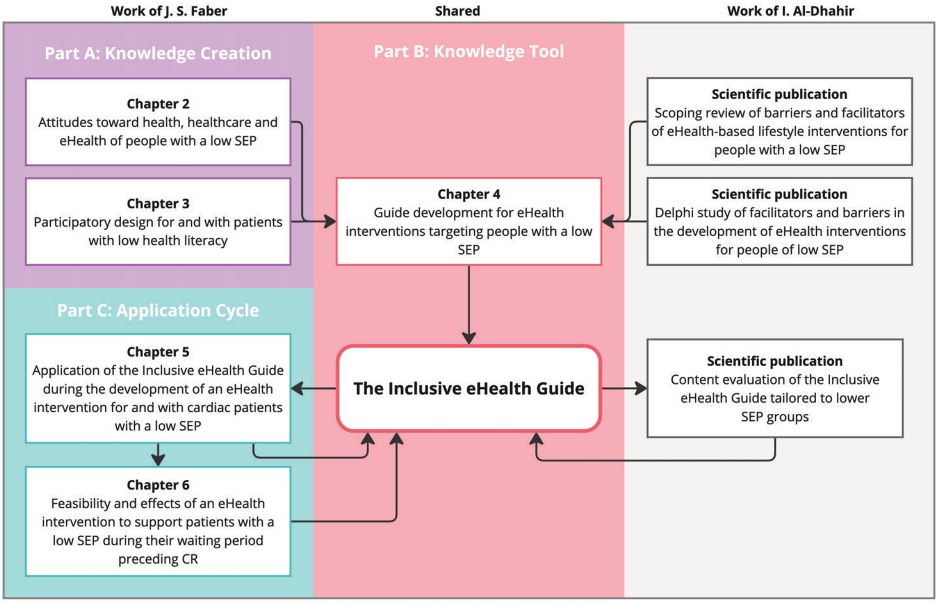

Figure 1.2 Thesis outline schematic and chapter division. SEP: socioeconomic position; CR: cardiac rehabilitation.

Part A: Knowledge inquiry: Attitudes and participatory design

In the research described in Chapter 2, we investigated whether people with a low SEP are willing to improve their health through technology by exploring their attitudes toward health, healthcare, and eHealth through a community-based participatory research approach. Nine individual attitude profiles and two general attitudes regarding health, healthcare, and eHealth are described.

In Chapter 3, we describe a participatory design process within a case study aimed to develop an eHealth intervention to improve medication adherence of asthma patients with low health literacy. We demonstrate the challenges of performing participatory design with hard-to-reach groups and propose three participatory design strategies that could facilitate such a participatory process.

Part B: Development of the knowledge tool: The Inclusive eHealth Guide

In Chapter 4 we describe the development of the knowledge tool: The Inclusive eHealth Guide. We describe how the research of part A and the work performed by Isra Al-Dhahir is synthesized into a practical guide to support the development of eHealth interventions for people with a low SEP. We describe how we developed the guide with professionals working with eHealth and people with a low SEP through participatory design to ensure the guide matches their practical needs. We identified 16 requirements the guide needed to comply with and developed the guide accordingly. The result is an open-ended website with recommendations, user portraits, practical knowledge, examples, and references.

Part C: Application cycle: Applying the Inclusive eHealth Guide during the design of an eHealth intervention for CR patients with a low SEP.

In Chapter 5 we demonstrate how the Inclusive eHealth Guide was applied in a participatory design process of an eHealth intervention for patients with a low SEP through a specific case study within the context of CR. This case study allowed us to explore specific use cases and challenges that provided insight into the application of the guide. CR provided a valuable setting for this study as it often focuses on lifestyle changes and involves a range of interventions that could be delivered effectively through eHealth.

In Chapter 6, we evaluate the feasibility of the resulting intervention using a mixed-method randomized controlled feasibility study. This chapter sheds light on the potential value of the guide while developing eHealth interventions tailored toward people with a low SEP.

General Discussion

Finally, in Chapter 7, we reflect on the findings from the three parts of this dissertation and their implications for the design of equitable eHealth. It also provides a discussion on the strengths and limitations and future directions.

PART A:
KNOWLEDGE INQUIRY

Attitudes and participatory design

CHAPTER 2

Attitudes toward health, healthcare, and eHealth of people with a low socioeconomic position

Building on the foundation in the introduction, this chapter delves into the first question of why eHealth interventions may be less successful for individuals with a low socioeconomic position (SEP). A limitation in existing research is its oversight of the target group's perspectives. To address this, our study adopted a community-based participatory research approach, emphasizing the direct involvement of those with a low SEP. Through this, we aimed to understand the target group's attitudes toward their health, healthcare, and eHealth. We present nine distinct profiles reflecting varied attitudes toward these areas, ultimately distilling them into two overarching attitudes: the "Optimistically Engaged" and "Doubtfully Disadvantaged". Our findings suggest that the assumption of a uniform unwillingness among people with a low SEP to engage with healthy behavior and eHealth interventions may not be entirely accurate. Our research indicates that there is diversity in attitudes within the low-SEP group and that the majority exhibits a willingness to engage in health-promoting behaviors. This suggests that the issue could stem more from the design of interventions, which might not adequately address the diverse needs of the group, than an unwillingness to participate in eHealth and healthy behaviors.

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All research data and code supporting the findings described in this chapter are available in 4TU. Centre for Research Data at 10.4121/7a2ca4e2-acca-4585-9d08-85d9f8139896

Abstract

Background | Low socioeconomic position (SEP) is associated with a higher prevalence of unhealthy lifestyles compared to a high SEP. Health interventions that promote a healthy lifestyle, like eHealth solutions, face limited adoption in low-SEP groups. To improve the adoption of eHealth interventions, their alignment with the target group's attitudes is crucial.

Objective | This study investigated the attitudes of people with a low SEP toward health, healthcare, and eHealth.

Methods | We adopted a mixed-method community-based participatory research approach with 23 members of a community center in a low-SEP neighborhood in the city of Rotterdam, the Netherlands. We conducted a first set of interviews and analyzed these using a grounded theory approach resulting in a group of themes. These basic themes' representative value was validated and refined by an online questionnaire involving a different sample of 43 participants from multiple community centers in the same neighborhood. We executed three focus groups to validate and contextualize the results.

Results | We identified two general attitudes based on nine profiles toward health, healthcare, and eHealth. The first general attitude, Optimistically Engaged, embodied approximately half our sample and involved light-heartedness toward health, loyalty toward healthcare, and eagerness to adopt eHealth. The second general attitude, Doubtfully Disadvantaged, represented roughly a quarter of our sample and was related to feeling encumbered toward health, feeling disadvantaged within healthcare, and hesitance toward eHealth adoption.

Conclusions | The resulting attitudes strengthen the knowledge of the motivation and behavior of people with a low SEP regarding their health. Our results indicate that negative health attitudes are not as evident as often claimed. Nevertheless, intervention developers should still be mindful of differentiating life situations, motivations, healthcare needs, and eHealth expectations. Based on our findings, we recommend eHealth should fit into the person's daily life, ensure personal communication, be perceived usable and useful, adapt its communication to literacy level and life situation, allow for meaningful self-monitoring and embody self-efficacy enhancing strategies.

2.1 Introduction

Low socioeconomic position (SEP) is associated with a higher prevalence of unhealthy lifestyles compared to a high SEP (Stringhini et al., 2010). Consequently, people with a low SEP are at increased risk of chronic diseases (e.g., cardiovascular disease, diabetes, and obesity) (Drewnowski et al., 2014; Mackenbach et al., 2008; Shishehbor et al., 2006). eHealth interventions such as monitoring devices, online communication platforms, and serious games have been proven effective in changing behavior and promoting a healthy lifestyle in various domains. However, these interventions are less successful in changing the behavior of people with a low SEP due to low reach, less adherence during the intervention or less effectiveness of the interventions (Bull et al., 2015; Busch & van der Lucht, 2012; Busch & Schrijvers, 2010; Michie et al., 2009; Reiners et al., 2019).

A crucial factor in facilitating the adoption, and therefore success, of eHealth interventions, is the alignment with a person's attitude toward using this technology (Garavand et al., 2016; Venkatesh et al., 2003). Moreover, successfully achieving a lifestyle change, a primary goal of such interventions, requires the person to have a positive attitude toward their health and health services (Ajzen, 1991). eHealth is designed to expect its intended users to have a positive and pro-active health attitude. However, considering the growth of current health inequalities, such interventions would have a bigger impact when they can support groups not sharing these attitudes.

A multitude of studies point out that people with a low SEP have unfavorable attitudes toward their health, healthcare, and eHealth. For instance, Wardle and Steptoe (2003) found that health attitudes within the low-SEP groups are specifically characterized by a lower consciousness about health and less often thinking about the future. Other studies have identified more passive attitudes toward healthcare (Schröder et al., 2018) and less confident attitudes toward digital health interventions (Choi & Dinitto, 2013) within low-SEP groups. Nevertheless, there is insufficient evidence to inform researchers and designers about these attitudes. The complexity of studying health values within contrasting sociodemographic environments poses various emotional and ethical challenges such as perceived harms, feelings of stigmatization, and anxiety toward research and the research team (Birks et al., 2007; Bonevski et al., 2014; Stuber et al., 2020). As a result, hard-to-reach groups are minimally included in research efforts. Moreover, existing evidence is difficult to generalize toward other contexts. Measurements of attitudes are highly context-dependent and are expected to differ by country, setting, and time (Eagly & Chaiken, 2007). Financial wellbeing and accessibility of health sources, for example, will not have a profound impact within countries that have unemployment funds, state-funded healthcare, and relatively good public transportation. Consequently, we have a lack of evidence to support the research and design of eHealth interventions that align with the attitudes of people with a low SEP.

The rise of eHealth in current healthcare systems opens up exciting new possibilities to improve healthcare quality and efficiency. However, with the increased use of technical innovations and digital systems come unintended, unpredictable, and adverse consequences for individuals. Due to the underrepresentation of these specific societal groups, interventions are minimally aligned toward their attitudes. Consequently, these interventions face the risk of not being adopted and therefore unintentionally contribute to rising health inequalities. Researchers and designers should carry the responsibility to harness the potential of eHealth to create benefit for all groups in society, not merely for those that are motivated to perform a healthy lifestyle (Viswanath & Kreuter, 2007).

To engage the target group in the research process, an approach is needed that is comprehensive, culturally sensitive, and builds upon a relationship-based personal approach (Stuber et al., 2020). Community-based participatory research (CBPR), a socio-culturally sensitive approach, which creates a trustful and long-lasting relationship between researcher and participant, has been effectively applied in culturally contrasting contexts (Israel, 2013; Unertl et al., 2016). For example, Henderson et al. (2013) successfully implemented a CBPR approach to develop a tailored web-based diabetes self-management tool in a low-resource setting in the United States. Such an approach can engage hard-to-reach groups in the research process yet has not been applied in the context of attitudes in low-SEP groups. In addition, focusing on a community instead of a person's individual characteristics is increasingly being recognized as a valuable approach. Studies that focus on these characteristics imply that these are the cause of poor health outcomes, which carries the risk of increasing stigma (Auerswald et al., 2017). It is becoming increasingly known that contextual community factors, such as the availability of healthy food, experiences of discrimination, and neighborhood poverty, also have a significant relation to poor health outcomes (Schüz, 2017; Winkleby & Cubbin, 2003).

The resulting knowledge could improve the alignment of health services toward attitudes of low-SEP populations, thereby facilitating their adoption. Currently, eHealth interventions aimed at these populations have only been minimally tailored, for example, by simplifying text and including images and videos (Kock et al., 2019). However, there is currently limited evidence reporting how interventions could be tailored toward psychological characteristics, such as attitudes with regard to eHealth. Although some studies report on the relationship between attitudes and interventions (Bukman et al., 2014; Coupe et al., 2018), the resulting knowledge is difficult to apply in the design of interventions directly. Forms of practical knowledge, such as data-driven patient-profiles, have been used in the past to tailor content, context, and delivery of care toward individual preferences (Dekkers & Hertroijs, 2018). Yet, such a form of knowledge has not been developed for attitudes of people with a low SEP toward their health, healthcare, and eHealth in general.

This study aims to achieve design-relevant knowledge about the attitudes of people with a low SEP toward their health, healthcare, and eHealth. To achieve this, we took a community-based participatory research approach to facilitate responsible engagement of the target group in the research process. The resulting knowledge can facilitate the design and alignment of health services toward the different attitudes of low-SEP populations. This will result narrowing current health disparities by developing interventions that are more acceptable, satisfactory, and user-friendly.

2.2 Methods

Our methodology revolved around the principles of CBPR. CBPR is a partnership approach to research that equitably involves community members, organizational representatives, and researchers in all aspects of the research process (Israel, 2013). Our CBPR approach consisted of three separate phases (Figure 2.1) in which the outcomes of each phase were used in the next.

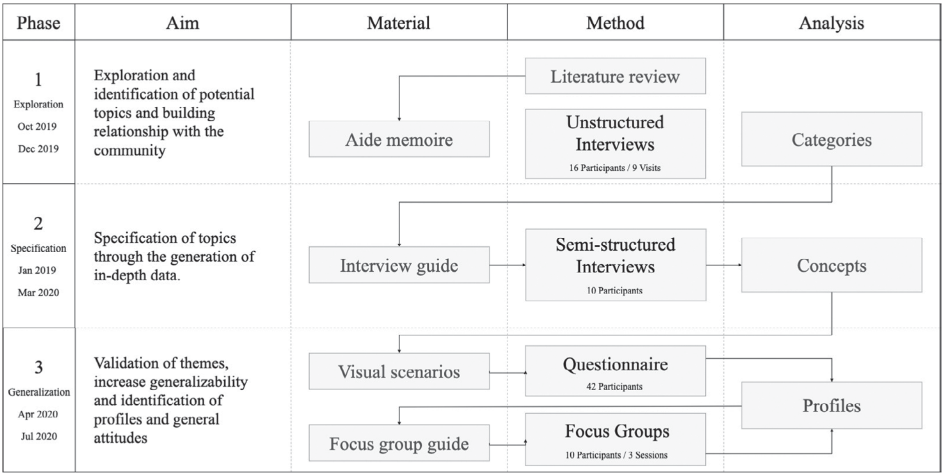


Figure 2.1 Overview of project phases and corresponding methods, materials, and analysis products.

2.2.1 Sampling and recruitment

We initiated our collaboration with a community center located in a neighborhood in Rotterdam, the Netherlands. The neighborhood was selected based on its neighborhood SEP, a combined measure of neighborhood income, education, and occupation (CBS, 2019). The neighborhood in which the community center is situated has been one of the lowest scoring neighborhoods on livability; a combined measure of its social, physical and safety index (Gemeente Rotterdam, 2020). The area therefore is on the agenda as one of the focus-neighborhoods of the municipality of Rotterdam. Sixty-eight percent of the inhabitants have a migration background, compared to 52% in Rotterdam. In addition, 59% of the households have a low income compared to 52% in Rotterdam. Finally, 34% of the inhabitants have a low education, compared to 32% in Rotterdam (de Graaf, 2018).

The participants were sampled based on their affiliation with the community center and their living area (neighborhood SEP). The community center situated in this neighborhood facilitates inhabitants that struggle with fundamental aspects of their life. They focus on poverty, occupation, living, social contacts, upbringing, and safety. We included participants living in the selected neighborhood with the following affiliations with the community center: (1) Visitors (Vi): Persons who visit the community center regularly and require support. (2) Volunteers (Vo): Unemployed persons who performed volunteering work in the community center in exchange for state funding. (3) Key persons (Kp): Social workers who have close relationships with the community members. In this study, Kp's were not considered as part of the target group as they are employed at the community center and are in the role of providing support. However, since they interact with Vi's and Vo's on a daily basis, we included them to learn about attitudes within the community from the Kp's perspective. In that light, we did not include Kp's in the second phase of the study as we were solely interested in acquiring a deeper understanding of the attitudes we observed in the first phase. Finally, it should be noted that Vo's could visit the community center as Vi's as well. For this study, we considered persons a Vo when they had at least one regular weekly shift at the community center.

In phase one, we sampled the participants conveniently and recruited them face-to-face at the community center. In the second phase, Vo's and Vi's were purposively sampled and recruited face-to-face. In phase three, we recruited participants for the questionnaire through an advertisement on the community center's Facebook page and WhatsApp group and through Kp's of various community centers within the same neighborhood. The participants for the focus groups were recruited through a question attached at the end of the digital questionnaire and by approaching them face-to-face at the community center. Because of the come-and-go nature of the community center, some participants frequently visiting the community center participated in each of the three phases, while others only participated in one.

2.2.2 Procedure and materials

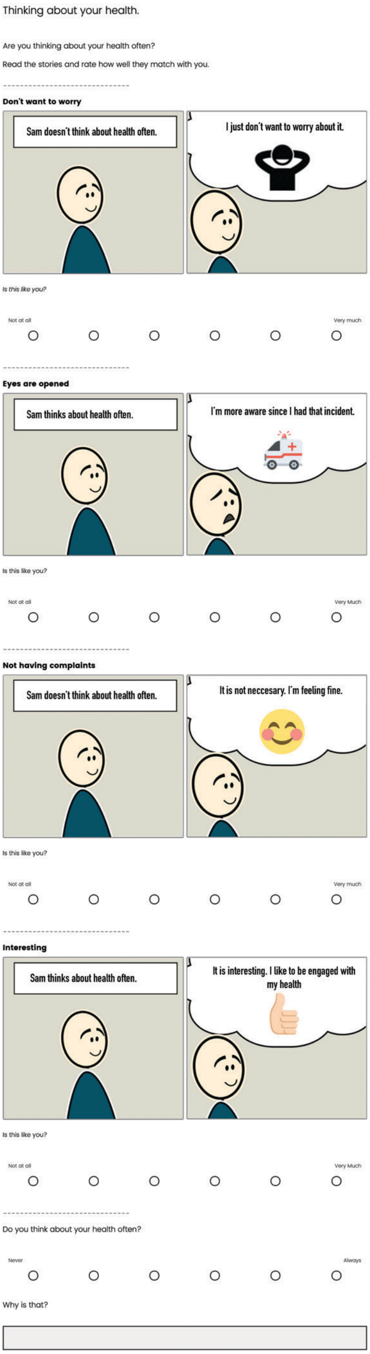
In phase one, we aimed to form a trustful research partnership with the community and narrow down the research scope by simultaneously exploring and identifying specific research directions. We initiated the partnership by attending community gatherings and organizing health-themed lunch events at the community center. Such immersive activities have been used and proven successful in creating a relationship in various other CBPR efforts (Israel, 2013). During these activities, we addressed the research scope by engaging in unstructured interviews with community members individually. Based on an initial literature review, a backlist of topics guided the interviews and helped to steer them toward our research questions (Wilson, 2014). We divided the topic questions into three overarching research themes: attitudes toward health, healthcare, and eHealth. For example, we explored the attitude toward health with questions such as “How important is it for you to live long?” Questions such as “What do you think of your doctor’s advice?” and “What do you think of a technology that could help you live healthier?” referred to the attitude toward healthcare and eHealth, respectively. Data was captured by taking quick field notes during the visits and elaborating on them into comprehensive reports directly afterward.

In phase two, we investigated the specific directions resulting from the first phase more extensively through semi-structured interviews. In contrast to unstructured interviews, these interviews are more formal and intimate, which comes conjointly with emotional challenges when discussing sensitive and stigma-inducing topics (Renzetti & Lee, 1993). Therefore, the pre-established trusting relationship between participants and the researcher was an essential facilitator. The interviews (N = 10) were conducted at the community center in a separate room with the participants individually and took approximately thirty minutes. We developed the interview guide structuring the interview based on the research directions from the first phase. For example, we explored how the participants perceived their health with the question: “What do you have to do to become 100% healthy?” The data was collected by audio-recording and transcribing the interviews. We progressed to the subsequent phase when we achieved theoretical saturation.

In the third phase, we validated and generalized the insights from phase two and discovered general attitudes through the data-driven profiles. Meanwhile, we had to consider the newly introduced COVID-19 regulations. Therefore, we developed a digital questionnaire which we distributed digitally to members of community centers. This questionnaire presented the resulting insights of the second phase and asked the participants to rate the extent to which they felt the insight reflected themselves. By distributing this online questionnaire, we reached a more extensive and diverse sample. In addition, we gathered quantitative data that we used to validate our preliminary results and develop data-driven attitude profiles. Questionnaires, frequently being long and textual, are at risk of being disengaged by their participants as they depend on reading comprehension. This risk holds especially true for participants with lower education attainment. The use of graphics in previous studies has successfully engaged low-literate participants with questionnaires (Maceviciute et al., 2019). Therefore, we synthesized our insights toward visual two-frame storyboards. We executed several pilot sessions to reduce the chance that participant understandings would not match the story's original implication and adjusted any inaccuracies accordingly. A 6-point Likert scale accompanied the stories in the questionnaire. The stories were grouped under their representative category. Each group concluded with an open-ended question regarding the corresponding category. See Figure 2.2 for an example of the consciousness page in the questionnaire. In addition, we asked participants to report their age, gender, educational attainment, and neighborhood. The online questionnaire was designed and distributed using Qualtrics. Finally, we performed focus groups to validate and contextualize the profiles that resulted from the questionnaire. Each focus group meeting consisted of three to four participants, lasted for approximately one hour, and was audio-recorded. The focus groups took place in a large and ventilated room at the community center that allowed maintaining 1,5-meter distance between the participants according to the COVID-19 regulations.

2.2.3 Data analysis

In phases one and two, we transcribed the audio recordings verbatim and analyzed them together with the field reports and qualitative questionnaire data using the software package ATLAS.ti. Throughout the qualitative analysis, we followed the grounded-theory approach outlined by Corbin and Strauss (1990), as it is specifically useful in discovering social processes focused on social change and improvement (de Boer, 2011). We continuously broke down the data and collected it under similar content in the form of concepts using open coding techniques. For example, we created the concept perceived barriers to refer to quotes where participants mentioned barriers that decreased their motivation to perform healthy behavior. Subsequently, we grouped related concepts toward overarching categories based on attitude theory constructs such as Beliefs, Feelings, Motivation, and Opportunity (Eagly & Chaiken, 2007; Fazio & Towles-Schwen, 1999). Two independent researchers (JF and IA) developed the concepts together to improve the reliability of the results.



Thinking about your health.

Are you thinking about your health often?

Read the stories and rate how well they match with you.

Don't want to worry

Sam doesn't think about health often.

I just don't want to worry about it.

Is this like you?

Not at all ○ ○ ○ ○ ○ ○ Very much

Eyes are opened

Sam thinks about health often.

I'm more aware since I had that incident.

Is this like you?

Not at all ○ ○ ○ ○ ○ ○ Very Much

Not having complaints

Sam doesn't think about health often.

It is not neccesary. I'm feeling fine.

Is this like you?

Not at all ○ ○ ○ ○ ○ ○ Very much

Interesting

Sam thinks about health often.

It is interesting. I like to be engaged with my health

Is this like you?

Not at all ○ ○ ○ ○ ○ ○ Very Much

Do you think about your health often?

Never ○ ○ ○ ○ ○ ○ Always

Why is that?

Figure 2.2 An example of the visual questionnaire distributed in phase 3. The storyboards represent the concepts found within the consciousness category.

In phase three, we imported the Likert scores of the concepts and categories obtained from the questionnaire as variables into SPSS. We performed k-means cluster analyses on the concepts based on Euclidian distance for health, healthcare, and eHealth with SPSS. We determined the optimal number of clusters with the Elbow method using the factoextra and NbClust packages in R. We used an ANOVA to identify the concepts with significant ($p < 0{,}05$) contribution to the cluster segmentation. The concepts with an insignificant contribution were removed from further analysis. To validate the clusters, we performed an ANOVA with the category scores as independent and the clusters themselves as dependent variables. Using a post-hoc ANOVA, we defined the resulting clusters based on significant differences between mean scores of the concept variables. We created profiles by further clarifying and enriching these clusters by analyzing the qualitative data from the questionnaire and focus group discussions. This was done by extending on the existing categories and concepts and using the same grounded-theory approach as used in previous phases. Finally, we performed a principal component analysis (PCA) using the factoextra package in R to discover correlations between concepts from different profiles.

2.2.4 Ethics

The study protocol was approved by the Human Research Ethics Committee of Delft University of Technology (approval numbers 953, 1064, and 1141). Through our relationship-based CBPR approach we aimed to limit the impact of emotional and ethical challenges such as perceived harm, feelings of stigmatization, and anxiety toward research and the research team. In the first phase, we briefed our participants orally about the nature of the study as a formal written consent in this first introduction phase would obstruct a trustful interaction. The participants provided their consent verbally to the researcher (JF). In phases 2 and 3, when the relationship was more solid, written informed consent was provided.

2.3 Results

2.3.1 Participants

During the unstructured interviews in the first phase, we spoke with 16 different members of the community center. These members consisted of eight Vi's, two Vo's and six Kp's. In the second phase, we interviewed five Vo's and five Vi's. In phase one and two, we did not collect demographic data. In the third phase, 45 participants responded to the questionnaire. From these latter responses, we excluded three participants not living in our target neighborhood from analysis. The participants' mean age in this final sample was 52 years (SD = 11.10), 21% was male and 79% was female. Most of this sample (67%) had a low to medium education, which was defined as not having attained a follow-up education. This is relatively high compared to 59% in the Netherlands. Ten participants participated in the focus groups: two Kp's, five Vo's and three Vi's.

2.3.2 Phase 1 and 2 – Exploration and specification

The unstructured interviews of phase one yielded 30 pages of field reports containing 85 coded segments. The semi-structured interviews of phase two yielded ten interview transcripts containing 359 coded segments. The grounded theory analysis resulted in 58 concepts within nine categories related to attitudes toward health, healthcare, and eHealth. Examples of the categories found are consciousness about health, motivation to perform healthy behavior and satisfaction toward healthcare. Examples of identified concepts are Interest in health, Perceived barriers, and loyalty toward healthcare provider. Table 2.1 presents an overview of the concepts and categories included in the third phase. We excluded categories conveying a limited number of concepts (N = 1) or not fitting the attitude theory constructs (N = 1). We selected the concepts to include (N = 29) in the third phase based on the number of associated coded segments and discussion by the two analysts.

Table 2.1 Concepts (N = 29) under their categories (N = 9) resulting from grounded theory analysis including number (N) of associated codes, description, and exemplary quotes (translated).

Concept	N	Description	Quote
Category: Health Beliefs [Being healthy is…]			
Working on health	30	When one frequently performs healthy behavior such as physical activity and maintaining a healthy diet.	"I'm eating healthy, I only drink in the weekends […] I frequently do yoga […] Yes I think that I'm being healthy" (Vo3)
Absence of complaints	12	The absence of complaints, symptoms, and disease.	"There was a time when I was heavier. I struggled with shortness of breath and cholesterol, and I don't know what else." (Vi6)
Participation	12	Being able to go out and participate in society.	"The first thing you have to do is to get up early and just go somewhere […] Otherwise you will not have active contacts with people who provide a positive influence or create chances for you" (Vi3)
Balance	10	Maintaining a balance between unhealthy and healthy behavior.	"I have other things. I don't drink for instance so that makes up for it quite a lot." (Vo5)
Life under control	10	When you have a roof above your head and no major financial or social struggles.	"Unhealthy is when you don't have a roof above your head, and you have to roam the streets." (Vi5)

Table 2.1 Continued

Concept	N	Description	Quote
Category: Consciousness [about health is impacted by…]			
Complaints	19	The experience of health-related symptoms and complaints.	"I haven't visited the doctor in 30 years. My last painkiller I used when I was at high school" (Vo5)
Incident	13	The consideration of a health-related incident in the past.	"Yes, a significant impression. Before that [the incident] I was just flying blind." (Vo3)
Concern	11	The extent to which one is concerned about their health.	"You can come up with all sorts of graphs, but I don't, I just don't want to worry about it. Maybe it is just very easy the way I live." (Vi5)
Interest	3	The level of interest one has in their health.	"It doesn't interest me […]. I just eat whatever I like" (Vi3)
Category: Motivation [to perform healthy behavior is impacted by…]			
Future perspective	22	The consideration of its value toward future health.	"How important is the future for you?" "Well, I just hope to continue like this." (Vo3)
Perceived barriers	20	The amount of financial, social, and environmental barriers one perceives.	"I have always had a one-sided diet. A lot of cheese for example. We didn't have a fridge at work." (Vi1)
Feeling	6	The extent to it contributes to the subjective emotional state one experiences.	"Do you think it's important to do it [performing healthy behavior]?" "Yes, it makes you feel better." (Vo2)
Enjoyment	5	The extent to which it impacts the level of joy in one's life.	"No, I don't really consider it [being healthy] that much. You also would want to enjoy life" (Vo4)
Category: Control [One perceives to have over health is impacted by]			
Support	24	The amount of support one receives on managing their health.	"What facilitates you in doing it [healthy behavior]?" "To be honest, my friend. […] She supports me and shows me the ropes." (Vo2)
Self-efficacy	14	The level of capabilities one perceives to have to change health-related behavior	"But you are not eager to quit, are you?" "I am my boy, however, I'm not able to. If you have a pill for me that I take, and it makes me quit…" (Vi5)
Chance	13	The belief that what happens regarding health is all based on chance and coincidence.	"I'll not reach the age of 110, I'm not that healthy. Although, it doesn't say much actually because there are people who are 100 years old and they still smoke." (Vi5)
Fatalism	5	The belief that what happens regarding one's health is subjugated to fate or destiny.	"You can't really do something about it [getting sick]. The only thing you can do is watch out [for accidents], that is the only thing." (Vi3)
Category: Healthcare experience [Is impacted by…]			
Communication	13	The quality of communication with the healthcare provider.	"I would like them to take more time for people like me, who do not fully understand it. Sometimes I really feel like a foreigner." (Vo2)

Table 2.1 Continued

Concept	N	Description	Quote
Autonomy	11	The need one has to deserve autonomy within the healthcare process.	“I proposed it [not eating meat] once, however, my general practitioner told me not to do it. […] He didn’t go into depth or asked me why I wanted that. He just advised me to keep eating meat” (Vo4)
Authority	10	The amount of authority one perceives their healthcare provider to have.	“It is not possible to change something about it yourself. If they say there is no solution then it has to be that way […] yes you know, they are the doctor.” (Vo1)
Personal	4	The need one has to be treated on a personal and humane level.	It was a nice guy, a physiotherapist. He always brought a ball of Feyenoord (football club in the Netherlands). […] Yes, the soccer I liked. However, all the other stuff, walking around, walking with a sack, and all of that. At a certain moment, I thought like... man. (Vi5).
Category: Messages [reception is impacted by]			
Source Interpretation	4	The extent to which one perceives a conflict between different sources (e.g., healthcare, media, social environment) of health messages.	“The website that you visit… It can be that someone wrote it at home, and it is not true. However, it can also be a doctor who wrote it, in that case, it is true.” (Vo1)
Nuances	2	The extent to which one can understand and apply nuances within health messages.	“Yes, sugar, I have to minimize. […] Everything I have to minimize. Also, Carbohydrates.” (Vi1)
Rules	2	The extent to which one interprets health messages as rules.	“Recently we have had this [healthy-lunch café] […] Everything must be healthy, and you are not allowed to eat meat. Well, I really like my piece of meat […]. In that case, just let me be unhealthy. I don’t care; I just really like it.” (Vi5)
Doctor as information source	2	The fact that the health-related information came from a healthcare professional or not.	“I won’t go and try out stuff from the internet and stuff. It has to come from the doctor.” (Vo1)
Category: eHealth [intention to use is impacted by…]			
Enthusiasm	7	The belief in the positive aspects and potential of eHealth	“Yes, I find that really interesting. […] You just have to ask google what you have to do. For example, I bumped my toe a few times, and then you get an answer.” (Vi5)
Anxiety	7	The level of anxiety one experiences toward (prospective) usage of eHealth.	“It is too complicated. […] They told me I had to download something. Well, they did it for me. I don’t know how it works.” (Vo2)
Exposure	5	The extent to which a person is exposed toward eHealth.	“I’m not entirely up to date what it can mean to me. Maybe I’m still thinking in the old way. I don’t know what I’m missing.” (Vi3)
Trust	1	The level of trust in technology and its related privacy and safety risks.	“I always try to protect myself with anti-virus software […] If you have your gates open, you will collect all kinds of unwanted rubbish” (Vi2)

2.3.3 Phase 3 – Generalization

2.3.3.1 Profiles

The descriptive analysis of the overall sample revealed a high variance in the means of the different concepts. Variance ranged from 0.80 to 3.78 with a mean of 1.91. Therefore, it was all the more essential to investigate a segmented version of the data. The elbow method suggested that three clusters best segmented the data of each topic. We found significant differences between the category means, indicating the validity of our clusters. Figure 2.3 presents a graphical representation of the mean scores characterizing the clusters and Appendix 2A offers a detailed overview. Table 2.2 shows the demographic information of overall sample and the profiles. Although we found significant differences between the means of the concepts, we did not find significant differences between the clusters' demographic variables.

Table 2.2 Questionnaire respondent characteristics.

	N	**CV**	**Age**		**Gender %**		**Education %**	
			M	**SD**	**Male**	**Female**	**Low**	**High**
Sample	42	1.91	52	11.10	21	79	67	33
Concerned	16	1.46	54	9.70	31	69	75	25
Light-hearted	16	1.06	48	13.07	0	100	69	31
Encumbered	10	2.00	51	8.89	40	60	50	50
Loyal	25	1.06	53	10.81	24	76	68	32
Detached	12	1.05	48	8.62	0	100	58	42
Disadvantaged	5	2.01	48	12.54	60	40	80	20
Eager	20	1.21	48	12.44	15	85	65	35
Hesitant	16	1.72	55	8.34	37	63	75	25
Indifferent	6	1.96	52	12.10	0	100	50	50

Regarding attitudes toward health, the majority was represented by the Light-hearted and Concerned profiles (both 38%), which were characterized by higher scores on consciousness, motivation, and feeling. The Concerned profile was differentiated based on higher scores for concern, complaints, and lower control. The Encumbered profile represented lower scores on consciousness, motivation, self-efficacy, and interest and higher scores on perceived barriers.

For the attitudes toward healthcare, the Loyal profile (60%) was the most significant. This profile was marked by higher scores on satisfaction, personal, authority, and doctor as information source. The Disadvantaged profile was characterized by lower scores on satisfaction, communication, source interpretation, nuance, personal and higher scores on rules and autonomy. The Detached profile contained no specific concept that differentiated it from the other profiles.

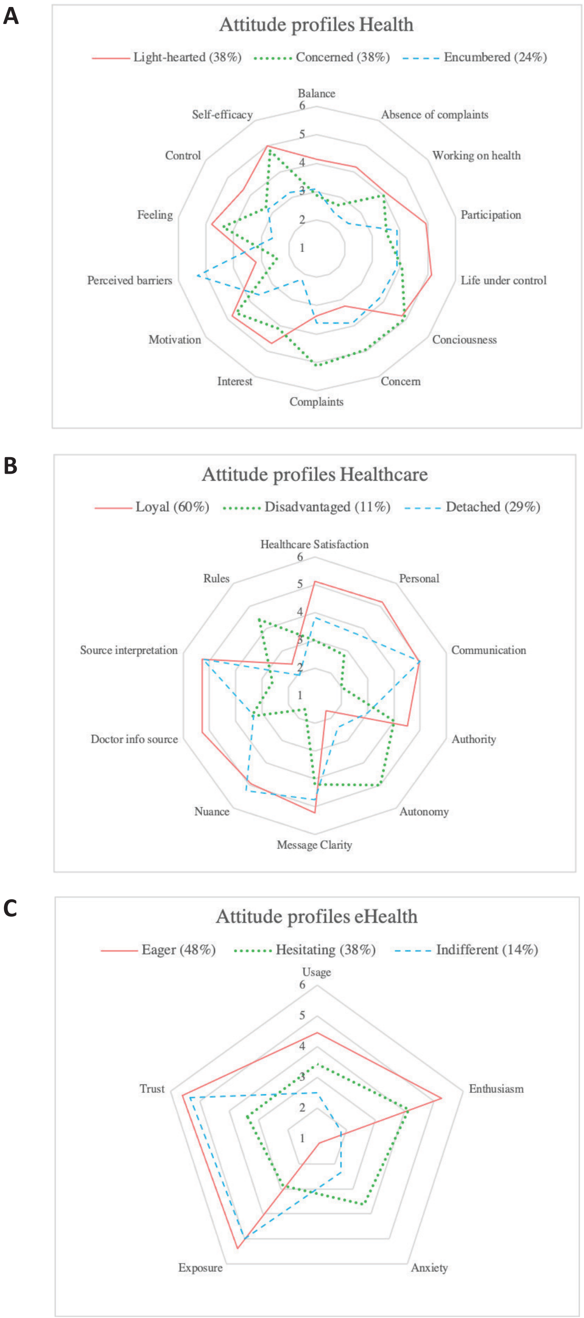


Figure 2.3 (A) Radar graph of concept means of the attitude profiles toward health. (B) Radar graph of concept means of the attitude profiles toward healthcare. (C) Radar graph of concept means of the attitude profiles toward eHealth.

Regarding attitudes toward eHealth, the Eager (48%) and Hesitating (38%) profiles represented the majority of the attitudes and were both characterized by a higher score on enthusiasm. The Hesitating profile could be differentiated based on lower scores on usage, trust, and exposure and a higher score on anxiety. The Indifferent profile was marked by lower scores on usage and enthusiasm.

2.3.3.2 Qualitative enrichment

The qualitative data from the questionnaire responses and three focus group discussions clarified and enriched the profiles with contextual information. Table 2.3 presents representative quotes for each profile. Regarding the health profiles, within the Concerned profile, 81% of the questionnaire participants referred to the experience of medical complaints, symptoms, and limitations as a reason for being more conscious about health. Within the Light-hearted profile, 69% of the questionnaire participants referred being healthy and seeing the importance of it. What stood out within the Encumbered profile was that 50% of the questionnaire participants expressed not enjoying healthy behavior and experiencing internal barriers regarding motivation. During the focus group discussions, we found that most participants recognized themselves with the Light-hearted and Concerned profiles. It stood out that some participants mentioned recognizing periods of the Concerned profile, especially when experiencing medical complaints or limitations. The participants did not fully identify with the Encumbered profile but rather ascribed this to an attitude they had in the past, frequently seen in the youth, or an attitude they 'sometimes' have.

> *"Sometimes I have, just like [Encumbered], my concerns about things. In that case you can find yourself in a slump. Life is not always going your way." (Vi10)*

Regarding the profiles toward healthcare, within the Loyal profile, 92% of the questionnaire participants referred to positive experiences such as good advice, a professional who shows understanding, and additional room for questions and discussion. Within the Detached profile, 46% of the questionnaire participants mentioned distrusting their doctors and not visiting them often. For the Disadvantaged profile, 67% of the questionnaire participants referred to communication barriers such as lack of time, complicated language, feelings of anxiety, and not being taken seriously. During the focus groups, the participants could identify with the Loyal and Detached profile. Regarding the Detached profile, which we positioned as an attitude not wanting to be dependent on healthcare, we gathered additional evidence that some of our participants were distrusting and wanting to avoid healthcare:

> *"Yes, I think I am a bit like [Detached]. Because I am not a doctor visitor. I seldom visit the doctor. […] I do not really like to take medication. Only when it is really necessary." (Vi11)*

Regarding the profiles toward eHealth, within the Eager profile, 75% of the participants referred to using eHealth and seeing the benefits of using it. Although we also found such positive responses toward eHealth within the Hesitating profile (56%), 38% of this profile's participants also referred to eHealth as not worth the effort, better suited for the youth, or being perceived more like gadgets. The Indifferent profile hosted participants referring to not wanting to be involved with technology for health (50%). During the focus groups, most participants identified with the Eager and Hesitating profiles. What stood out was that some participants who initially were Indifferent toward eHealth started to become interested in it because of the focus group discussion:

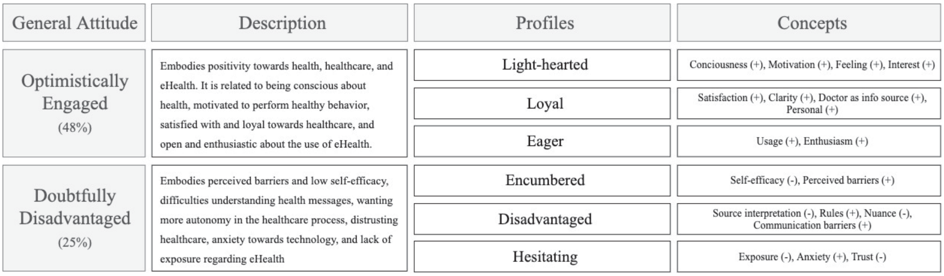
> *"Well, I definitely want to use it. Suppose I can do it with a device or something. My daughter also wanted to install an app for counting steps. However, I don't do a lot with phones. It is only now that we have this conversation that I start to think that maybe I should investigate it some more. I only use it for calling and text messaging. I do like it, but I don't know it." (Vi11).*

Table 2.3 Exemplary quotes per profile.

Profile	***Quote***
Light-hearted	*"I do what I can and what I want. When I feel good, it is good."*
Concerned	*"I try to prevent my health complaints from taking over my life. It is tough sometimes though […]"*
Encumbered	*"Exercising is exhausting and painful"*
Loyal	*"I feel that they listen well to me. Everything is explained clearly. Messages are clear and informative."*
Disadvantaged	*"They left me for too long with my complaints, and I'm not taken seriously" / "Sometimes they come with difficult words"*
Detached	*"I'm not coming to the doctor often, but when I do, I have the feeling they listen well. Probably extra because I never visit the doctor."*
Eager	*"I see it as a push in the back, and it's fun to keep track of things. I'm already above 950km this year :)"*
Hesitating	*"The technology of nowadays is more something for the younger generation"*
Indifferent	*"Not feeling like it"*

2.3.3.3 General attitudes

By investigating the inter-profile relationships, we could identify two attitudes toward health, healthcare, and eHealth in general. Figure 2.4 displays an overview of these attitudes. Correlation coefficients can be found in Appendix 2B. The most significant general attitude, Optimistically Engaged, could be described by positivity toward health, healthcare, and eHealth. It is related to being conscious about health, motivated to perform healthy behavior, satisfied with and loyal toward healthcare services, and open and enthusiastic about the use of eHealth. It was defined by the relationship between the characterizing scores of the Light-hearted (consciousness, motivation, feeling and interest), Loyal (satisfaction, clarity, doctor as info source, and personal), and Eager (usage and enthusiasm) profile. The average size, based on the questionnaire respondents, of the combination of these profiles is 48%. The second general attitude, Doubtfully Disadvantaged, reflected perceived barriers and low self-efficacy, difficulties understanding health messages, wanting more autonomy in the healthcare process, distrusting healthcare, anxiety toward technology, and lack of exposure regarding eHealth. It was defined by the relationship between the scores of the Encumbered (low self-efficacy and perceived barriers), Disadvantaged (source interpretation, rules, nuance, and communication barriers), and Hesitating (exposure, anxiety, and trust) profile. The average size, based on the questionnaire respondents, of the combination of these profiles is 25%. The Concerned, Detached, and Indifferent profiles did not have any specific relations with other profiles. They should be seen as individual profiles that could exist in any combination with other profiles. However, the Concerned profile's substantial representation within the questionnaire respondents (38%) makes it important to consider further. This profile was characterized by the experience of complaints, high concern, and low feelings of control because of the experience of a health-related incident or continuous experience of health complaints.



General Attitude	Description	Profiles	Concepts
Optimistically Engaged (48%)	Embodies positivity towards health, healthcare, and eHealth. It is related to being conscious about health, motivated to perform healthy behavior, satisfied with and loyal towards healthcare, and open and enthusiastic about the use of eHealth.	Light-hearted	Conciousness (+), Motivation (+), Feeling (+), Interest (+)
		Loyal	Satisfaction (+), Clarity (+), Doctor as info source (+), Personal (+)
		Eager	Usage (+), Enthusiasm (+)
Doubtfully Disadvantaged (25%)	Embodies perceived barriers and low self-efficacy, difficulties understanding health messages, wanting more autonomy in the healthcare process, distrusting healthcare, anxiety towards technology, and lack of exposure regarding eHealth	Encumbered	Self-efficacy (-), Perceived barriers (+)
		Disadvantaged	Source interpretation (-), Rules (+), Nuance (-), Communication barriers (+)
		Hesitating	Exposure (-), Anxiety (+), Trust (-)

Figure 2.4 Overview of the general attitudes resulting from the principal component analysis and their corresponding profiles and concepts.

2.4 Discussion

2.4.1 Principal findings

This study aimed to develop design-relevant knowledge about the attitudes of people with a low SEP toward their health, healthcare, and eHealth. Through a CBPR approach consisting of three phases, we identified two general attitudes based on nine distinct profiles. This knowledge could be used to develop a better understanding of existing attitudinal knowledge and to propose design recommendations that facilitate the alignment of health services toward these attitudes.

2.4.2 Relevance and implications

Since most of the attitudes toward health, healthcare, and eHealth were positive, we believe that there is a willingness from a large part of the target group to adopt eHealth interventions to improve their lifestyle. Nevertheless, we discovered a diverse range of different attitudes that have different implications for the design of eHealth interventions. The attitudes represented by the profiles can be used to develop design recommendations to improve the alignment of eHealth interventions toward attitudes of low-SEP groups.

2.4.2.1 Optimistically Engaged

The profiles (Light-hearted, Loyal, and Eager) represented by this general attitude have similarities and contradictions with existing literature. The Light-hearted profile was represented by high consciousness about health. Contrastingly, other studies found that low-SEP populations have a less conscious attitude toward health and think less about the future (Cutler & Lleras-Muney, 2006; Wardle & Steptoe, 2003). Complex social situations, caring responsibilities (Coupe et al., 2018), and time and energy constraints (Bukman et al., 2014) result in little room to act toward and think about long-term investments such as a healthy lifestyle. These contrasting findings could be explained by the current living situation of our participants. Almost all participants were either retired, unemployed or disabled and therefore were not constrained by their jobs or worried about finances as they receive financial support from the government. In Wardle and Steptoe (2003), all participants were employed, and in (Coupe et al., 2018), only 13% of the population was employed. Yet, the finding came from interviews with healthcare providers and not from the low-SEP population themselves. In a previous study in a community center in Rotterdam, participants indicated that a lack of time was a major reason for not visiting a community center (Hooghuis, 2010). Therefore, we argue that some participants in our sample, having the time to visit a community center, also had more time and capacity to think about and act toward a healthy lifestyle. Therefore, we recommend that eHealth researchers and designers should become aware of the person's life situation and use this knowledge to determine whether the person has the capacity available to fit the intervention into their life. People that do not have this capacity would benefit more from services that deliver support in social or financial aspects (Heutink et al., 2010; Troelstra et al., 2020). We argue that people that do have motivation and consciousness could benefit from being empowered to play a major role in their health management. This could be achieved through shared decision making, providing health information and facilitating self-management (Elwyn et al., 2014). It remains important for healthcare providers to be aware of this attitude as it is known that clinician perceptions of patients with a low SEP have been shown to affect clinical decision making. Based on common beliefs about people with a low SEP, physicians tend to delay diagnostic testing, prescribe more generic medications and avoid referral to specialty care and potentially lifestyle interventions (Arpey et al., 2017). The finding that most of our participants were doctor dependent (Loyal, 60%) conforms to other studies that claim that people with a low SEP are loyal to and rely on their doctor's advice (Schröder et al., 2018; Yin et al., 2012). Moreover, we found that our participants highly valued a personal interaction with their care provider. The importance of this personal touch is mentioned in various other studies on the interaction between people with a low SEP and healthcare providers (Bull et al., 2018; Latulipe et al., 2015; Schaffler et al., 2018; Troelstra et al., 2020). Since current healthcare systems are moving from a doctor-says, patient-does model toward a model of shared decision making and self-management, we expect that people relying on their doctor's advice will experience increasing difficulties in their health management. To improve the alignment of eHealth communication to these attitudes, we recommend that professionals should be mindful of 'dehumanizing' healthcare, as digital interactions lack the nuances of human interaction (O'Connor et al., 2016). Therefore, eHealth interventions should be designed to incorporate and enhance personal communication, interaction, and relationships with care providers, family members, and peers. This could be done for example by integrating a social role in the intervention through interactive and animated computer characters. Through simple speech, hand gestures and other non-verbal cues, these characters could simulate face-to-face counselling to establish trust and rapport in a virtual environment (Bickmore et al., 2010).

2.4.2.2 Doubtfully Disadvantaged

The Encumbered, Disadvantaged, and Hesitating profile, that represented this attitude, all embodied a perceived lack of control related to one's health, healthcare, or eHealth. Various previous studies support this finding. The lack of control over health is attributed to lower problem-solving skills (Mirowsky & Ross, 2017), environmental deprivation (Pepper & Nettle, 2017), and financial, environmental, and social limitations (Cutler & Lleras-Muney, 2006; van Wijk et al., 2019). Therefore, we recommend considering self-efficacy and perceived control enhancing strategies within eHealth interventions. Goal setting has been mentioned as a potentially successful strategy in various studies regarding other low-SEP populations (Bull et al., 2018; Coupe et al., 2018; Michie et al., 2009). A possible implementation is through persuasive game design. Through the game world the user could acquire feelings of competence and transfer these toward the real world (Visch et al., 2013). For example, one could help an avatar to progress through different life goals by earning points based on healthy snack choices (Schaefbauer et al., 2015). In addition, various studies also mention social support as a potentially effective strategy (Bukman et al., 2014; Troelstra et al., 2020). Emotional support could be offered through supportive conversations and buddy systems, informational support from educational information from peers and providers and appraisal could be offered through peers, providers or the eHealth system itself (Vorderstrasse et al., 2016). In addition, designers could think of ways to make technologies and information more accessible and easier to integrate into the persons' daily life. For example, cardiac telerehabilitation allows to reach patients in their home-environment and motivate them to participate even though they do not have the means (physically as well cognitive) to visit the rehabilitation center (Kraal et al., 2017; Nabutovsky et al., 2020). We found that participants characterized by the Disadvantaged profile were experiencing communication difficulties in the healthcare setting. Especially assessing and applying health knowledge was perceived as problematic. It is striking that this profile only represented a mere 12% of our sample, while these difficulties are widely discussed in previous studies on this topic (Adams et al., 2013; Yin et al., 2012). Since our participants were proficient in the Dutch language, we argue that communication for them was less problematic. Moreover, combatting health literacy is currently high on the agenda (Kickbusch et al., 2013). In fact, in the Netherlands, 60% of healthcare professionals report adapting their communication toward their patients' needs (Murugesu et al., 2018). Nevertheless, to include this part of the population, eHealth interventions should accommodate for varying literacy levels, for example by using visual aids and plain language. Besides, according to studies related to other low- SEP and literacy populations, medical advice should be tailored to increase its relevance. For example, by using lab results to select the appropriate advice given in a patient portal (Latulipe et al., 2015).

The participants within the Hesitating profile reported being unsure about using eHealth because they were unaware of how it could be of personal value. A previous study found that people who have a poor understanding of what eHealth can do for them have little interest in signing up and using it (O'Connor et al., 2016). It also seems that healthcare providers do not actively promote such interventions and provide little encouragement to use them, as they expect the intervention will not be adopted (Coupe et al., 2018). In addition, this subgroup of participants expressed concerns about not being capable enough to use eHealth. This finding is also reflected by Latulipe et al. (2015), where most usage concerns of low-income older adults relate to the difficulty of initially logging on to a system. Therefore, we recommend professionals to consider the perceived usefulness and usability of the eHealth intervention. Past studies have shown that this can be achieved through supportive healthcare providers and peers who can promote the eHealth interventions and provide technical assistance during usage (Hendrikx et al., 2013; Latulipe et al., 2015; O'Connor et al., 2016). One upcoming medium through which these interactions can take place is through social media. Social media is used as an effective recruitment and engagement medium for eHealth applications (O'Connor et al., 2016) and for people with lower income and education (Kontos et al., 2014). Another possibility to improve perceived usability is by offering primary task support through self-monitoring wearable devices (e.g., activity trackers) (Patel et al., 2015), reduction (e.g., list with food choices) or tunneling (e.g., offer treatment opportunities after an interactive test about tobacco addiction) (Oinas-Kukkonen & Harjumaa, 2009).

2.4.2.3 The Concerned profile

The participants represented by the Concerned profile indicated being motivated and conscious because they were living with medical limitations or have recently experienced a health-related incident. This concerned attitude could serve as potential entry point for researchers and designers to motivate healthy behavior. While people might already be aware of the susceptibility and severity of getting a disease, they might benefit from convenient cues to action such as reminders and suggestions provided either by a peer, professional or system (Orji et al., 2012). According to Bukman et al. (2014), people with a low SEP are especially motivated by the feedback they receive from their bodies. This conforms to some participants mentioning that their attitude had changed throughout their lives, resulting from experiencing health complaints or incidents. Therefore, it is challenging to motivate these individuals to engage in preventive behavior when they do not yet perceive complaints. Therefore, following Bukman et al. (2014), we recommend that for people that do not have the concern (yet), feedback should be provided in a visual, meaningful, and directly applicable way that conforms to the beliefs of the target group. According to Orji et al. (2012), self-monitoring, simulation and personalization and tailoring strategies are effective to help individuals develop accurate perceptions of own risk. Nevertheless, we could argue that data recorded by most activity trackers and self-monitoring applications currently is still of little value in facilitating meaningful reflection on lifestyle. In a previous study it was found that the participants from a low-SEP neighborhood rarely analyzed their self-monitoring experiences to derive insight about the meaning of data for their wellbeing (Saksono et al., 2019). One example of providing meaningful data is a smoking app that displays, besides the number of days without cigarettes, also the amount of money the person has saved by not smoking.

2.4.3 Recommendations

Based on our results, the reflection with previous literature, and existing recommendations, we propose some final recommendations for improved eHealth alignment to attitudes in low-SEP populations. First, we have identified a large part of our sample embodied an optimistic and engaged general health attitude. According to this attitude, someone is motivated, conscious, satisfied with healthcare, and open toward eHealth. Hence, we expect that for this attitude, healthcare services and interventions are generally appropriate.

However, we also identified attitudes that are less in line with our current processes and expectations. We identified profiles that embodied a disinterested, resisting attitude toward healthcare (Detached) and eHealth (Indifferent). We argue that tailoring eHealth interventions toward such attitudes is resource-intensive and would be more effective when directed at attitudes that are positive yet require support. These attitudes, in our study identified under the Doubtfully Disadvantaged general attitude, currently seem to hold the most potential for tailoring efforts. While the Encumbered profile benefits from social and emotional support, the disadvantaged profile benefits from additional support in understanding verbal and written health information and guidance during the healthcare process. The Hesitating profile has an open yet unsure attitude toward eHealth and therefore benefit from supportive and technology promoting healthcare professionals and peers. We recommend professionals to focus on these attitudes specifically, to become aware of the corresponding needs, and subsequently use and design eHealth as a tool to respond to these needs. While doing so, professionals are advised to establish a trustful relationship with the target group, which could be achieved through personal contact and/or through trusted doctors or other key persons (Stuber et al., 2020). In addition, future research endeavors should take into account the challenges related to recruiting and researching vulnerable populations and take the appropriate methodological strategies to minimize the impact of those challenges. This could help improve the accessibility and affordability of eHealth innovations and thereby help equalizing inequalities in healthcare.

2.4.4 Strengths and limitations

This study addressed the ever-increasing gap in health disparities by giving voice to a target group that is frequently overlooked in health research. Traditional approaches have received criticism as they, when executed irresponsibly, bring forth mistrust, feelings of stigmatization, and anxiety (Bastida et al., 2010). CBPR has gained increasing attention in addressing ethical challenges in health research, as it encourages equity and shared decision making and increases community involvement (Israel, 2013). By taking this approach, we ensured that our participants felt comfortable, safe, and especially involved during the research activities. The resulting insights directly carry our participants' voices and are, therefore, a meaningful contribution to responsible digital health. While frequently people with a low SEP are expected to adapt their attitudes toward the intervention, we aim to have a more complete idea of how we should design interventions to be adapted to them.

Although our study provides an in-depth insight into the attitudes of people living in a low-SEP neighborhood, the results are not generalizable toward all low-SEP contexts. First, we aimed at limiting possible feelings of stigmatization by sampling on neighborhood SEP. This would make it difficult to relate the findings directly to other studies that select participants on individual measures of SEP (e.g., education, income and, occupation). Yet, this different selection criterion allowed us to target a group that would otherwise have been excluded. For example, the questionnaire demographics indicate a relatively high percentage of participants who attained a follow-up education. In traditional studies, this part of the sample would have been seen as high-SEP and therefore excluded from the study. Socioeconomic determinants and barriers leading to disparities in health behavior are complex (Artiga & Hinton, 2018; van Wijk et al., 2019). Capturing them merely based on individual determinants is therefore problematic and has accumulated critique over the years (Braveman et al., 2005). Instead, our focus on neighborhood SEP takes into account other factors that have proven to have a significant relation to poor health outcomes (e.g., availability of healthy food, experiences of discrimination, and neighborhood poverty) (Schüz, 2017; Winkleby & Cubbin, 2003).

Another factor that could impact the generalizability is the context of the community center. According to an earlier report of another community center near Rotterdam, 36% of the visitors were unemployed (Werter & Koot, 2017). This percentage is significantly higher than the neighborhood in general (9,4%) and Rotterdam (7%) (IDEM Rotterdam, 2017). Since our participants had the motivation to visit the community center, they could also have been more motivated to perform healthy behavior. Finally, it should be taken into account that this study has taken place in an urban context with sufficient governmental support, developed infrastructure, and social support. Therefore, the results are not directly applicable to countries that do not have these facilities. While the results themselves might not be directly generalizable to other low-SEP populations, they provide a deep and contextualized understanding of a sample of the target group that can be applied in the design of eHealth interventions. According to (Crouch & McKenzie, 2006), such research inquiries in naturalistic settings often seek to discover social insights that extend beyond initial observations. This requires the researcher to be immersed in the research field, establish continuing fruitful relationships with respondents and through theoretical contemplation to address the research problem in depth. A small number of cases will facilitate the researcher's close association with the respondent. A review of CBPR approaches in the health domain confirms this statement as it reports sample sizes of roughly the same order of magnitude (Coughlin & Smith, 2016). Future research could be aimed at generalizing the results (e.g., profile characteristics) in larger-scale sample sizes. Finally, the concepts identified in this research are, although informed by supporting themes in literature, data driven and not a priori based on a specific theory or model. Hence, they provide a deeper layer and a supplementary perspective to existing knowledge. Nevertheless, researchers should act with discretion when interpreting the resulting insights using existing theory.

2.5 Conclusion

To develop successful eHealth interventions that support people with a low SEP in achieving a healthy lifestyle, it is crucial to consider their attitude toward this technology and their health and healthcare in general. This study explored attitudes of people living in a low-SEP neighborhood toward their health, healthcare, and eHealth using a community-based participatory research approach. This unique approach helped us discover novel and bottom-up insights that strengthen our current understanding of these attitudes. This understanding allows researchers and designers to have a more nuanced view of the attitudes in low-SEP populations. Intervention developers should be mindful of differentiating life situations, motivations, healthcare needs, and eHealth expectations. eHealth should fit into the person's daily life, ensure personal communication, be perceived as usable and useful, adapts its communication to literacy level and life situation, allow for meaningful self-monitoring and embody self-efficacy enhancing strategies. When these recommendations are taken into account when developing eHealth interventions for people with a low SEP, these interventions' alignment with their attitudes will improve. This will result in interventions that are more acceptable, satisfactory, and user-friendly. Consequently, eHealth interventions will finally move from widening toward narrowing current health disparities and thus align with societal health responsibilities.

CHAPTER 3

Participatory design for and with patients with low health literac

The previous chapter highlighted the crucial need to accommodate to diverse needs when designing eHealth interventions for individuals with a low socioeconomic position (SEP). However, professionals often face challenges in effectively involving these groups in design processes, a crucial step to align interventions with the needs of the intended target group. The research described in this chapter explored the value of participatory design in facilitating participation of people with a low SEP in bottom-up participatory research. We present a case study where participatory design methods were specifically applied to develop an eHealth intervention: a smart inhaler to improve medication adherence among asthma patients. This study paid particular attention to individuals with low health literacy, a characteristic often associated with a low SEP, which can be a significant barrier to participation in research and design processes. We focused on three participatory design methods: co-constructing stories, experience prototype exhibition, and video prototype evaluation. The chapter presents the potential and implications of these methods in effectively engaging and designing for and with the target group.

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All research data and code supporting the findings described in this chapter are available in 4TU. Centre for Research Data at 10.4121/bf21a04c-8c4b-4f51-85b0-0a6387f3a1e1

Abstract

Background | Current eHealth interventions are poorly adopted by people with low health literacy (LHL) as they often fail to meet their needs, skills, and preferences. A major reason for this poor adoption is the generic, one-size-fits-all approach taken by designers of these interventions, without addressing the needs, skills, and preferences of disadvantaged groups. Participatory design approaches are effective for developing interventions that fit the needs of specific target groups; yet very little is known about the practical implications of executing a participatory design project for and with people with LHL.

Objective | This study aimed to demonstrate the application of participatory design activities specifically selected to fit the needs and skills of people with LHL and how these were manifested within an overarching eHealth design process. In addition, the study aims to present reflections and implications of these activities that could support future designers to engage people with LHL in their design processes.

Methods | We used the design process of a smart asthma inhaler for people with asthma and LHL to demonstrate participatory design activities. The study was framed under 5 stages of design thinking: empathize, define, ideate, prototype, and test within 2 major iteration cycles. We integrated 3 participatory design activities deemed specifically appropriate for people with LHL: co-constructing stories, experience prototype exhibition, and video prototype evaluation.

Results | Co-constructing stories was found to deepen the understanding of the participant’s motivation to use or not to use maintenance medication. This understanding informed and facilitated the subsequent development of diverse preliminary prototypes of possible interventions. Discussing these prototypes in the experience prototype exhibition helped provoke reactions, thoughts, and feelings about the interventions, and potential scenarios of use. Through the video prototype evaluation, we were able to clearly communicate the goal and functionality of the final version of our intervention and gather appropriate responses from our participants.

Conclusions | This study demonstrates a participatory design approach for and with patients with asthma and LHL. We demonstrated that careful consideration and selection of activities can result in participants that are engaged and feel understood. This paper provides insight into the practical implications of participatory activities with people with LHL and supports and inspires future designers to engage with this disadvantaged target group.

3.1 Introduction

Over the past decades, digital health (eHealth) interventions have been developed to support self-management. Such interventions can combine patient monitoring and education and include multiple behavior change strategies (Hamine et al., 2015; Morrison et al., 2014; Timmers et al., 2020; van der Kleij et al., 2019; Webb et al., 2010). Examples of such applications are SMS text messaging systems to reinforce self-management skills, pill boxes generating alert messages when medication is missed, and interactive voice responses (Pouls et al., 2021).

One specific group of people that would benefit from such interventions are people with low health literacy (LHL). A large-scale survey showed that, in Europe, nearly half of all adults reported having problems with health literacy (Sørensen et al., 2015). People with LHL have problems in obtaining, processing, and understanding basic health information and communicating their needs to health care professionals (HCPs) (Ratzan, 2001). Furthermore, LHL is associated with lower patient activation. Patient activation refers to the “knowledge, skills, and confidence” of a person in managing their health and has also been called the “mindset” needed to change behavior (Hibbard et al., 2005; Yadav et al., 2018; Yadav et al., 2020). This is amplified by the fact that people with LHL have differentiating illness perceptions and beliefs about their medication (Brandstetter et al., 2017; Federman et al., 2013; Kale et al., 2015; Soones et al., 2017). As a result, they experience difficulties in following treatment recommendations, for example taking medication as prescribed (Apter et al., 2013; Mancuso & Rincon, 2006; Rosas-Salazar et al., 2012).

Approximately 50% of the people taking medication for chronic illnesses such as chronic obstructive pulmonary disease, diabetes, or cardiovascular disease are considered nonadherent (Burkhart & Sabate, 2003). Medication nonadherence has significant impact on patient’s quality of life and has been shown to lead to poor health outcomes and increased use of health care services (Chisholm-Burns & Spivey, 2012). Especially medication adherence in patients with asthma is consistently low, which results in unfavorable health outcomes such as increase in experience of symptoms and hospitalization (Murphy et al., 2012). Previous reviews have shown promising results on the effectiveness of eHealth interventions to enhance patients’ adherence to asthma medication (Jeminiwa et al., 2019; Linn et al., 2011; Pouls et al., 2021; van Buul et al., 2020). Yet, these interventions are mostly designed for patients with sufficient motivation, health literacy, and self-management skills and fail to address the needs, skills, and preferences of patients with LHL.

Within the design domain, it is acknowledged that involving users in the design of eHealth interventions facilitates alignment with their needs and preferences. Besides action- and community-based approaches (Faber et al., 2021), participatory design and its methods are increasingly receiving more attention. These approaches are based on the notion that when users are involved in the design and development of interventions, they are more likely to be successfully adopted (Neuhauser, 2017; Van Dooren et al., 2016; van Gemert-Pijnen et al., 2011). Participatory design could uncover potential reasons for nonuse and allow designers to discover, through their participants, how technologies could be acceptable and engaging (van Gemert-Pijnen et al., 2018).

Participatory design is human centered and especially useful in the context of LHL. First, participatory methods are visual, interactive, and concrete. This benefits people who have difficulties thinking in abstract terms (Neuhauser, 2017) or who have language barriers to understand and engage with the process (Kip et al., 2019; Neuhauser, 2017). The flexibility of a participatory approach also allows to adapt and align research methods if judged inappropriate. Second, participatory methods can also bridge the gap between researchers and participants by creating a more equal and collaborative environment. This can help reduce distrust, friction, and misunderstanding that can arise due to differences in social, cultural, and economic backgrounds. Finally, a participatory design approach is iterative, which allows multiple engagements with the end user. This benefits the development of rapport and mutual trust between researcher and participant, which is known to be a strong facilitator for participant retention (Mancuso & Rincon, 2006).

Nevertheless, participatory design is still seldom applied in intervention design among people with LHL. Only a few examples exist of participatory design studies on people with LHL (Davis et al., 2018; Salim et al., 2021). The time, resource, and skill intensity of such a process in combination with its results being difficult to generalize, decrease the attractiveness of the approach (Altman et al., 2018) and evidence regarding why and how to conduct such an approach in intervention design is falling short (Vandekerckhove et al., 2020). In addition, effectively involving disadvantaged groups, such as people with LHL, in research efforts is challenging. It has been marked by several barriers, such as participants having difficulties understanding the content of the study (Bonevski et al., 2014), finding it difficult to think in abstract terms (Nind, 2008), language or literacy problems (Bonevski et al., 2014), anxiety toward research or the research team (Birks et al., 2007), feelings of stigmatization (Auerswald et al., 2017; Millum et al., 2019), and limited exposure to technology and internet (Hofstede et al., 2014). While participatory design methods have the potential to overcome these barriers, scientific literature is unclear about which forms of participatory design can be used to develop eHealth (Vandekerckhove et al., 2020). Consequently, there is also no clear methodology on how to involve people with LHL in the participatory design process of an eHealth intervention.

Hence, the aim of this paper was to demonstrate how participatory design can be used to design an eHealth intervention that fits the needs and preferences of people with LHL. We present the development of an asthma medication adherence intervention for people with LHL to illustrate our approach.

3.2 Methods

3.2.1 Study design

The study was conducted between February and September 2019. The study was framed under the five stages of design thinking by Hasso Plattner Institute of Design (Plattner et al., 2011) and consisted of the following stages: (1) empathize to understand the user, (2) define to analyze and interpret the data, (3) ideate to explore and identify innovative solutions, (4) prototype to explore feasibility and develop a research instrument, and (5) test to evaluate usability and acceptance of the prototypes. While defined as distinct modes, in practice, the stages are iterative. This allows the researcher to reflect on previous activities and incorporate knowledge from the different stages.

Figure 3.1 displays an overview of the overall design process. It shows how the 5 design thinking stages were structured across 2 major design iterations, including design activities used and outcomes generated. Throughout this paper, we distinguish between the 3 participatory design activities and the other generic design activities, with a specific focus on the former to illustrate how people with LHL can be involved in a participatory design process of an eHealth intervention. We specifically chose to embed the participatory activities at the beginning (to develop an understanding) and end (to evaluate this understanding) of the design iterations.

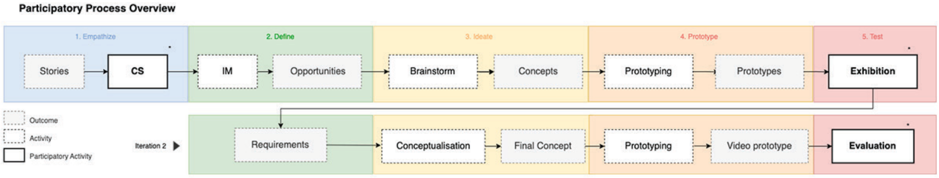

Figure 3.1 Schematic overview of the process, illustrating the different design thinking stages and their iterative character. *a participatory design activity. CS: co-constructing stories; IM: intervention mapping

3.2.2 Participatory design methods

3.2.2.1 Overview

Within this framework, we integrated 3 participatory activities deemed specifically effective for people with LHL. These were (1) "co-constructing stories" (Buskermolen & Terken, 2012), (2) "experience prototype exhibition" (Buchenau & Suri, 2000), and (3) "video prototype evaluation" (Zwinderman et al., 2013). These activities were specifically selected as they would allow to effectively engage with the target group and understand their perspective.

3.2.2.2 Co-constructing stories

The creation of stories helps to discover users' thoughts and beliefs regarding a particular phenomenon. In a previous study, for example, co-constructing stories was used to gather insights regarding an interactive system to support collaboration in a meeting room (Buskermolen & Terken, 2012). Stories can be presented visually, which decreases the interview's abstractness and verbality. As such, the use of visuals has been successfully applied in other LHL-related intervention design processes as conversation starters or design tokens (Koops van 't Jagt et al., 2016; Maceviciute et al., 2019; Wolpin et al., 2016). Apart from the benefits of visuals, using a fictional but relatable character in stories helps to shift the conversational focus from the individual, thereby decreasing possible anxiety-related barriers.

3.2.2.3 Experience prototype exhibition

Experience prototypes extend beyond the usability of a product and focus on understanding a person's attitude toward a product by envisioning what it might be like to engage with it (Buchenau & Suri, 2000). People with LHL have little prior experience regarding the use of technologies for health (Hofstede et al., 2014). Using these technologies in an experience prototype evaluation session could, therefore, provoke responses and reveal attitudes toward new technological solutions that would otherwise remain undiscovered. Moreover, the physical and interactive nature of the experience prototypes allows the researcher to describe the concepts nonverbally, thereby increasing the engagement of participants with communication difficulties.

3.2.2.4 Video prototype evaluation

Paper-based prototypes are a common tool to evaluate design concepts of eHealth interventions (Vandekerckhove et al., 2020). Nevertheless, these prototypes often fail to adequately represent the concept's core functions and interaction scenarios. A combination of paper and video prototype would be more effective in communicating the concept toward people with LHL than paper-based prototypes alone (Maceviciute et al., 2019; Zwinderman et al., 2013). Videos have proven to be an effective tool in other intervention research and design efforts for asthma patients with LHL (Olanrewaju, 2014; Sobel et al., 2009).

3.2.3 Participants and recruitment

The participants involved in the study included patients with asthma who have LHL and stakeholders. Patients with asthma and with LHL (n=5) were recruited by the first author and an HCP working in a disadvantaged neighborhood in The Hague, Netherlands. Qualitative and explorative approaches that aim to develop a pragmatic and in-depth understanding of a small number of participants have been argued to be effective in research approaches where not the generalizability, but the values, beliefs, and attitudes of individuals are central. This benefits the study by allowing for more flexibility and in-depth investigation of the included participants (Johnston & Johnston, 2013; Sandelowski, 1996). The patients were purposively sampled based on a self-reported diagnosis of asthma, being prescribed medication, and a subjective health literacy assessment based on the person's characteristics (e.g., migration background, occupation, educational level, and cognitive disorder) by the involved HCP. We decided to not objectively assess participants' health literacy as this was likely to be perceived as stigmatizing and imped building a trustful relationship. The first and second authors also recruited other stakeholders, consisting of respiratory nurses (n=5), health literacy experts (n=2), design experts (n=3, TD, NRH, VTV), and eHealth researchers (n=4, NHC). These stakeholders were selected because they had a long-standing experience with treating asthma, people with LHL, or participatory design methodology. We recruited 5 "language ambassadors" through an expertise center in health disparities to evaluate the final concept.

3.2.4 Ethics approval

The study protocol was cleared by the Ethical Committee of the Leiden University Medical Center (approval number: P18.158). Informed consent was obtained prior to study participation. If written informed consent could not be given, participants provided verbal informed consent, which was recorded.

3.3 Results

3.3.1 Stage 1 – Empathize

The empathize stage served to understand the thoughts, beliefs, and perceived barriers of patients with asthma and with LHL regarding medication adherence. In this stage, we wanted to validate and discuss literature-based personas with patients with asthma and with LHL. Personas often consist of a detailed written description (Adlin & Pruitt, 2010), which was deemed suboptimal as a research tool for people with LHL as understanding and processing this type of information is often cognitively demanding for people with LHL (Nind, 2008). Therefore, we converted the written persona descriptions into visual storyboards (Figure 3.2) using the “storyboard that tool” (Clever Prototypes L. L. C., 2014).

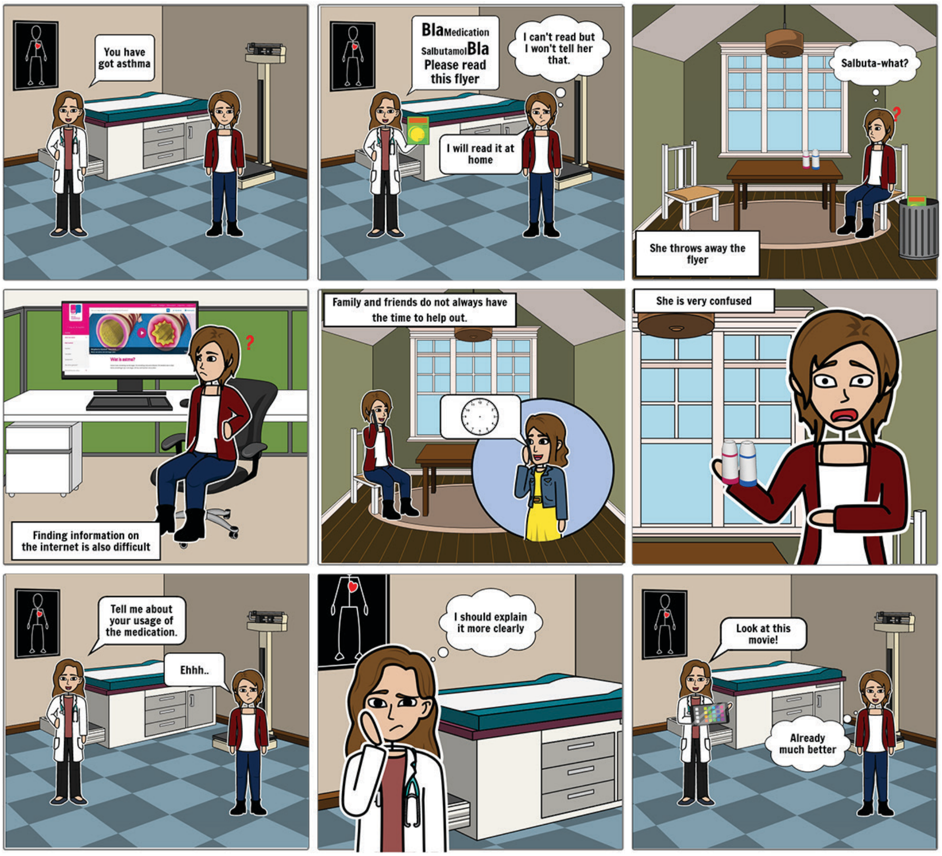

Figure 3.2 An example storyboard used during the co-constructing story sessions (translated into English).

Two participants with asthma and LHL participated in the co-constructing stories sessions. The sessions took place at the facilities where the participants worked, lasted approximately 1 hour, and were audio recorded. Observations and impressions about reasons for nonadherence and the co-constructed stories were collected in the form of a written report after the sessions. Using the storyboards, we asked nondirective questions such as: “How does this character experience the instructions given by the caregiver?” “How do you experience these instructions?” and “can you relate with the character and why or why not?”

The sessions helped to deepen our understanding of the preliminary insights from the initial literature review. For instance, we learned from the literature that an important reason for medication nonadherence in LHL groups is that the patients have misconceptions about the medication (Brown & Bussell, 2011; Federman et al., 2013; Soones et al., 2017). However, through our sessions, we gained a more nuanced view of these beliefs. The participants reported trusting their doctor’s expertise blindly, as they had difficulties understanding the purpose of the maintenance medication. Despite trusting the advice, they used their reliever inhaler instead when they experienced symptoms. When asked, participants indicated not knowing or remembering the explanations given by their HCP:

> *“According to the doctor, I just have to use it [the medication]. That is what I know.” [Male]*

3.3.2 Stage 2 – Define

We used the intervention mapping approach (Bartholomew et al., 1998) to translate the user insights, through change objectives, toward practical design opportunities. We discussed the 22 identified change objectives with the stakeholders and developed 3 overarching design opportunities (Table 3.1). In a consensus meeting with design experts, we agreed on the most feasible and important design opportunity—creating awareness about the effects of medication on symptoms through patient engagement in logging and monitoring.

Table 3.1 Design opportunities

Design opportunity	Determinant	Description
Improve the capabilities of patients to understand and organize their medication intake behavior.	Capabilities	Empower the patient to gain authority and confidence in self-managing their asthma.
Create patient awareness about the importance and effect of the medication.	Awareness	Let the patient see the effect of the medication on the body and the relation between usage and experience of symptoms.
Change patients’ attitudes to sustain motivation over a longer period.	Attitude	Help the patient acknowledge that long-term benefits of a maintenance inhaler are as important as directly noticeable effects of the reliever inhaler.

3.3.3 Stages 3 and 4 – Ideation and prototyping

The ideation and prototyping stages were directed at developing ideas and concepts that could be used to reach the design objective that resulted from the first 2 phases. To achieve this, the first author executed a brainstorming session with industrial design students to explore engagement strategies for the monitoring process (e.g., monitor asthma symptoms and monitor inhaler use) and how the data can be presented to patients with LHL to promote awareness.

Four overarching design concepts resulted from these sessions, each combining multiple solution possibilities. The concepts included are (1) a smart wheeze-detecting sensor to objectively monitor asthma state, (2) an immersive experience using augmented reality to engage the user in the monitoring process, (3) a playful spirometer, and (4) a wake-up experience, displaying the result of nocturnal asthma symptoms. We translated the concepts into low-fidelity prototypes to explore their feasibility and facilitate the upcoming feedback session with the participants. The prototypes consisted of cardboard mock-ups, physical artifacts, and off-the-shelf products, such as an augmented reality t-shirt with a projection of the lungs (Figure 3.3).

Figure 3.3 Low-fidelity prototypes and visual explainers positioned in an exhibition-style setup during the evaluation.

3.3.4 Stage 5 – Test

Three patients with asthma and with LHL participated in the experience prototype evaluation sessions. The evaluations took place at the health facility in their neighborhood, were audio-recorded, and took approximately 1 hour. Participant responses (e.g., experiences, attitudes, thoughts, and needs) for each (part of the) prototype were captured with corresponding quotations. Two days before the session, the participants received a link to a short introduction video. In the video, the researcher introduced himself and explained in lay terms the research setup. This helped set a familiar face, manage expectations, and build initial rapport. This was deemed essential to facilitate the participants' engagement, as anxiety toward research and the research team is a common barrier in socially disadvantaged groups (Bonevski et al., 2014).

The session started with a brief individual interview about the demographics, living conditions, and how the participant experienced their asthma. Thereafter, the first author presented the prototypes and invited the participant to interact freely with them. Verbal and nonverbal responses were carefully observed and documented. Following initial responses, probing questions were asked, such as: "What aspects do you like about this product?" and "How do you envision yourself using this product daily?" The prototypes were discussed in random order. At the end of the session, the first author asked the participant to name the prototype or combination of prototypes they liked or did not like the most and why.

The experience prototypes were successful in provoking reactions, thoughts, and feelings about the product concepts and potential scenarios of use. Through the monitoring aspects of the concepts, we learned that participants were positive about the possibility of tracking symptoms over time, as they expected symptom tracking to give them a better understanding of their respiratory health. Through the sensor-patch included in the wake-up experience, we learned that tracking should occur almost automatically, as the participants wanted the monitoring process to be as effortless as possible.

> *"It is just like sticking a bandage on your wound. You feel nothing, and after a while, you just remove it." [Male]*

Through the augmented reality experience (projecting life-like lungs on the body using augmented reality technology on a t-shirt), we learned that the participants were particularly enthusiastic about novel and innovative technologies, as they improved the perception of the product's usefulness. The augmented reality visualization of the respiratory tract provided a realistic presentation of the lungs as "their own." It allowed them to explore the respiratory system entirely by zooming into its various aspects, such as airways and alveoli. As one of the participants expressed:

> *"Sometimes, I think the medication is not that important. […] Only when you really experience complaints you look for your medication. However, when you use something like this [augmented reality t-shirt], and you see it is not going well over there, you directly are going to use it. Yes, I have the feeling that now I want to use my maintenance medication. [Male, 44]"*

Based on the gathered insights regarding the target group's attitudes toward the prototypes, three design requirements were formulated: (1) The design should be able to objectively monitor the user's respiratory health semiautomatically over time. (2) The design should engage the user in this monitoring process by providing a feeling that the product is innovative and useful. (3) The design should create awareness about respiratory health through feedback that is realistic and displays the respiratory system in its entirety.

3.3.5 Second iteration – The final concept

Following the formulated design requirements, we conducted a second iteration consisting of another ideate, prototype, and test stage to arrive at a final concept. This process consisted of concept detailing and technical design, with descriptions extending beyond this paper's scope. The final concept aims to provide awareness through a smartphone app demonstrating data on inhaler use and asthma control. The system allows the user to zoom in on the lungs and explore relations between respiratory concepts. Simplistic icons and illustrations are used to visualize the more complicated underlying physiological processes. For example, a blue arrow that depicts a person's asthma state is presented as the amount of air that can flow through the bronchi. Inhaler data, a proxy for underlying respiratory inflammations, are visualized as respiratory cilia being "in- or out-of-balance," depending on the frequency of maintenance inhaler use. Hence, the maintenance medication is framed as a "helper" to bring back balance to the disturbed respiratory system.

An animation video describing the concept, its functionality, and scenarios of use was developed by the first author with Adobe Premiere Pro (Adobe) (Adobe, 2022). The video communicated the concept in a concise and engaging way to the participants. In addition, the first author developed paper-based visual prototypes of the key interface screens that would facilitate the discussion afterward.

For the evaluation sessions, Pharos, an expertise center familiar with developing and evaluating education material for people with LHL invited 5 people with LHL to participate in 1.5-hour interview sessions during which the prototype was discussed. A trained and experienced employee of the expertise center conducted the interviews. Each interview started with displaying the video-prototype, after which the participants were asked about their opinion and if they had any questions. Subsequently, the interface screens were presented and discussed following an interview topic guide. Interview questions included “what do you think they mean with this?” or “what do you think is presented here?” Whenever an element was unclear, we asked the participant to provide suggestions for improvement. The representative of Pharos provided a summary with recommendations for improvement after the last session. In addition, observations and participant responses by the investigator were collected in a written report.

Overall, the participants were positive about the concept as they felt that it would help them gain awareness of being nonadherent to their maintenance medication and the consequences for their lungs. The visual presentation style was understood, and the overall system was perceived as useful and innovative. However, some interface details were unclear, confusing some of the participants. For example, colors were deemed confusing when they were unrealistic (e.g., a blue lung). In addition, a color-coded performance bar was suggested to visualize the improvement of the cilia.

3.4 Discussion

3.4.1 Principal findings

This paper demonstrates a participatory design approach of a medication adherence intervention for patients with asthma and LHL. We explored the potential of applying several participatory design techniques in health intervention design for a LHL population. These consisted of co-constructing stories, an experience prototype exhibition, and a video prototype evaluation. The demonstrated activities provide novel insight in the practical use and implications of participatory design activities with people with LHL and have positive indicative value for supporting their participation in the design process.

There is a need for more insight in new and adapted methods to effectively reach and engage disadvantaged groups. Current approaches are insufficient in reaching and retaining underserved populations (Bonevski et al., 2014; Janson et al., 2001). While participatory design is increasingly receiving more attention, it is still seldom applied by designers with people with LHL. Models, approaches, and guidelines for participatory design do exist; yet they do not provide concrete steps that fit specific contexts and people. A previous study suggests there is a need for a broad range of methods that facilitate the practical application of these models (Kip et al., 2019). The demonstration of these methods in specific contexts and target groups (e.g., patients with psychiatric illness (Kip et al., 2019) and LHL) could severely improve the alignment of interventions with disadvantaged populations.

Indeed, we believe that some of the reasoning behind the activities will also apply to other disadvantaged groups. First, our activities are aimed at facilitating our participants to "tell" their stories using probes of visual scenarios and story elements (Brandt et al., 2012). Several sources on this topic state that groups experiencing communication barriers, such as people with low (health) literacy, learning difficulties, and cultural differences have difficulties understanding the purpose and contents of participatory research activities and vocalizing their thoughts and experiences (Bonevski et al., 2014; Nind, 2008). Using scenarios and story elements as a "probe" has helped our participants in telling their stories without relying merely on verbal communication skills. In addition, the probes helped to shift the focus from the individual. This has helped our participants to become more at ease with the research setting, which could be observed based on the extensiveness of their responses. This is deemed especially helpful for groups at risk of stigmatization (e.g., LHL, obesity, and mental illness) (Auerswald et al., 2017; Birks et al., 2007; Millum et al., 2019). We propose that the nonverbal and low-threshold nature of such probes positively impacts collaboration with disadvantaged groups. Besides storyboarding and scenarios, other nonverbal participatory probing tools, such as cards, artifacts of discussion, taking pictures, and using emoticons could be equally useful (Budig et al., 2018; Nakarada-Kordic et al., 2017; Vandekerckhove et al., 2020).

Second, another facet of participatory design we applied in this project was allowing our participants to "enact" future scenarios by physically trying out new concepts (Brandt et al., 2012). Age and education are associated with having limited knowledge of and experience with health technologies (Hofstede et al., 2014). Therefore, we expect that societal groups, such as people with low socioeconomic status or the elderly, could experience barriers in imagining technologies and usage scenarios. "Priming" is a participatory facet that allows participants to immerse themselves in a domain (Sanders et al., 2010). Our use of experience and video prototypes has helped the participants to get a feeling of possible technologies and imagine scenarios of future use. This could be observed, for example, through the responses the augmented reality t-shirt provoked in our participants. Therefore, we propose participatory tools that facilitate interaction and immersion, such as prototypes, mock-ups, and role-play to facilitate priming for technologies.

Some aspects of the approach demonstrated in this paper could also be used in practice settings. For example, a practice nurse can use co-constructing stories to discuss multiple aspects of medication use in an easy-to-understand, nonobtrusive, and more concrete way with the patient by presenting and discussing recognizable but fictional situations. Hence, it would be interesting to explore co-constructing stories as a low-cost tool during consultations.

3.4.2 Strengths and limitations

Through the participatory activities, we were able to gather important insights into the needs, skills, and preferences of people with LHL that would otherwise remain unarticulated.

However, the findings of this study should be interpreted in the context of its limitations. Like most studies that address LHL, recruitment was challenging. Having practice nurses identify and invite patients for participation was effective. However, it could also have led to selection bias, resulting in, for example, people who were above average engaged with their health.

Moreover, recruitment was intensive as it required efforts to build rapport and trust and resulted in a relatively small number of participants. The small sample size should be considered regarding the representativeness of the acquired insights for the adherence intervention for patients with asthma and with LHL. In addition, researchers should be mindful in adapting the practical implications mentioned in this paper to fit their context and target group.

While the study provides insight into the practical implications of using participatory methods with people with LHL, we did not thoroughly assess the impact of this approach. Previous research has shown that participatory design can improve the process on many levels. It improves participant advocacy, trust, and sense of purpose; leads to better usability and desirability of the intervention; and achieves better health outcomes, equity, and access (Jacob et al., 2022). Therefore, future researchers could set the next step by studying if a participatory process leads to more desirable and effective health interventions for people with LHL.

An important facet of participatory design that was not integrated into our approach is allowing the participants to “make” and embody thoughts in physical artifacts (Brandt et al., 2012). In this study, the “making” stages (e.g., ideating and prototyping) were done without the active involvement of people with LHL. Engaging participants in co-creating prototypes helps to generate ideas for the physical manifestation of the intervention and has been done to align interventions to the needs of disadvantaged groups (Bollard & Magee, 2020; Sanders et al., 2010). Considering the nonverbal and tangible nature of such activities, these could have yielded fruitful interactions.

3.5 Conclusion

In this study, we demonstrated a participatory design approach for and with people with LHL. We showed how the participatory activities could result in engagement and mutual understanding within the research process. The eHealth intervention concept resulting from this design process was perceived as an acceptable solution that creates awareness about medication adherence through understandable feedback on medication use and asthma symptoms. The participatory methods applied in this study provide a first step and inspiration for succeeding efforts to help overcome common challenges in the involvement of people with LHL in the design of eHealth interventions.

PART B:
DEVELOPMENT OF THE KNOWLEDGE TOOL

The inclusive eHealth Guide

CHAPTER 4

Guide development for eHealth interventions targeting people with a low socioeconomic position

In Chapters 2 and 3, our approach to knowledge collection has been predominantly bottom-up, involving direct collaboration with the target group and through a handson case study. However, to ensure a comprehensive understanding, it was essential to complement the bottom-up, nuanced insights with a broader top-down perspective that sheds light on overarching patterns and systemic factors. Therefore, Isra Al- Dhahir adopted a top-down perspective, conducting a scoping review of existing literature and engaging with professionals to identify common barriers and facilitators in the field. The current chapter is centered on combining bottom-up and top-down perspectives to develop the Inclusive eHealth Guide (IeG). We aimed to synthesize previously gathered knowledge into a practical tool for professionals (e.g., developers, researchers, healthcare providers) to make a tangible impact in the field. To ensure the guide’s applicability, we employed a participatory approach with these professionals.
This resulted in the first version of the IeG.

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The IeG developed in this chapter can be found at:
https://www.tudelft.nl/inclusive-ehealthguide.

All research data and code supporting the findings described in this chapter are available in 4TU. Centre for Research Data at 10.4121/ddad2577-1cb5-4447-8d95-6417011f04ff

Abstract

Background | People with a low socioeconomic position (SEP) are less likely to benefit from eHealth interventions, exacerbating social health inequalities. Professionals developing eHealth interventions for this group face numerous challenges. A comprehensive guide to support these professionals in their work could mitigate these inequalities.

Objective | We aimed to develop a web-based guide to support professionals in the development, adaptation, evaluation, and implementation of eHealth interventions for people with a low SEP.

Methods | This study consisted of 2 phases. The first phase involved a secondary analysis of 2 previous qualitative and quantitative studies. In this phase, we synthesized insights from the previous studies to develop the guide's content and information structure. In the second phase, we used a participatory design process. This process included iterative development and evaluation of the guide's design with 11 professionals who had experience with both eHealth and the target group. We used test versions (prototypes) and think-aloud testing combined with semi structured interviews and a questionnaire to identify design requirements and develop and adapt the guide accordingly.

Results | The secondary analysis resulted in a framework of recommendations for developing the guide, which was categorized under 5 themes: development, reach, adherence, evaluation, and implementation. The participatory design process resulted in 16 requirements on system, content, and service aspects for the design of the guide. For the system category, the guide was required to have an open navigation strategy leading to more specific information and short pages with visual elements. Content requirements included providing comprehensible information, scientific evidence, a user perspective, information on practical applications, and a personal and informal tone of voice. Service requirements involved improving suitability for different professionals, ensuring long-term viability, and a focus on implementation. Based on these requirements, we developed the final version of "the Inclusive eHealth Guide."

Conclusion | The Inclusive eHealth Guide provides a practical, user-centric tool for professionals aiming to develop, adapt, evaluate, and implement eHealth interventions for people with a low SEP, with the aim of reducing health disparities in this population. Future research should investigate its suitability for different end-user goals, its external validity, its applicability in specific contexts, and its real-world impact on social health inequality.

4.1 Introduction

Global progress in improving health has been challenging. For example, the burden of noncommunicable chronic diseases, such as cardiovascular disease, diabetes, and obesity, is higher among racial, ethnic, and lower socioeconomic (below-average occupational position, educational level, and income) groups (Adler & Stewart, 2010; Drewnowski et al., 2014; Latulipe et al., 2015; Mackenbach et al., 2008; Shishehbor et al., 2006). A low socioeconomic position (SEP) is associated with a higher prevalence of unhealthy lifestyles compared to a high SEP (Pampel et al., 2010; Schultz et al., 2018; Stringhini et al., 2010). A large segment of our society comprises people with a low SEP. For instance, in the Netherlands in 2019, there were 574,000 households with incomes below the low-income threshold, accounting for 7.7% of all households (CBS, 2021). Studies suggest that people with a low SEP face many challenges that impact their health (Pampel et al., 2010; Teuscher et al., 2015). For example, people with a low SEP may have low literacy or live in poverty under stressful conditions such as money-related stress, unfavorable work environments, or unemployment (Heutink et al., 2010). Various efforts have been made to reduce the incidence of noncommunicable chronic diseases in current societies through lifestyle change, including the use of eHealth interventions. eHealth interventions, such as monitoring devices, web-based communication platforms, and persuasive applications, have proven effective in changing behavior and promoting a healthy lifestyle when tailored appropriately toward the needs and preferences of the individual (Kelders et al., 2012; van Gemert-Pijnen et al., 2011).

The use of smartphones and social media is not exclusive to people with a high SEP. These technologies have gained acceptance among people with a low SEP, particularly among less educated working young adults (Simons et al., 2018). Recognition of the benefits of eHealth for lower-SEP groups is growing (Brown et al., 2014; Latulippe et al., 2017; Lee et al., 2022; van Gemert-Pijnen et al., 2011). Many studies acknowledge that tailoring eHealth interventions to specific needs improves patient engagement and leads to more durable behavior changes (Kelders et al., 2012; van Gemert-Pijnen et al., 2011). People with a low SEP can particularly benefit from the asynchronous communication and multimedia patient education provided by eHealth (Evers et al., 2014), as they report lower satisfaction with patient-provider communication than those with a higher SEP (DeVoe et al., 2009). eHealth also has the potential to improve access to care (McMaughan et al., 2020) by reducing barriers such as the need for long-distance travel and its costs and allowing for personalized consideration of social, economic, and physical factors that may impact their lifestyle (Yardley et al., 2016). Finally, information individualized toward a person's level of health literacy can improve knowledge and be more readily recalled (Michie et al., 2009). Despite the potential benefits of eHealth for people with a low SEP, there is a significant lack of clarity in this area (Al-Dhahir et al., 2022). The available information on the effective components of eHealth interventions for such groups is limited, leaving room for doubt and uncertainty. For example, a scoping review highlighted variations in the components of eHealth interventions and the barriers and facilitators involved in their development and implementation (Al-Dhahir et al., 2022).

Sufficient practical guidance that can be directly applied by professionals (e.g., eHealth developers, researchers, health care providers, and policy makers) in the field is missing. What does exist are some basic approaches to making eHealth more accessible to people with a low SEP. These include adapting the content of the interventions by avoiding medical terminology, using more pictures, and using simple user interfaces (Choi & Dinitto, 2013). However, while improving the readability of and accessibility to information is important, achieving successful behavior change requires tailoring interventions that extend beyond focusing on simplicity and understandability and improve the deeper factors related to motivation on social, cultural, and economic levels (Davis et al., 2015).

Moreover, there are challenges in designing interventions for this target group. First, professionals often see eHealth as a one-size-fits-all solution, but this approach can exclude lower-SEP groups (Braveman et al., 2005). While there is knowledge available about involving these groups, for example, through participatory methods (Cheng et al., 2020; Faber et al., 2023b; Lee et al., 2022), they are often not implemented due to the limited availability of resources, expertise, knowledge, and awareness about lower-SEP groups within a project or team (Al-Dhahir et al., 2023).

Second, although there is abundant knowledge on barriers to and facilitators for including the target group in interventions, there are still difficulties faced by professionals in the field, including eHealth developers, researchers, and health professionals, in reaching people with a low SEP and ensuring their adherence to eHealth interventions. Interventions that are not tailored toward the needs, skills, and preferences of the target group can and will be less effective (Bull et al., 2015; Busch & van der Lucht, 2012; Busch & Schrijvers, 2010; Latulipe et al., 2015; Michie et al., 2009; Reiners et al., 2019). To enhance the development and adaptation of eHealth interventions for people with a low SEP, it is essential to acknowledge the current challenges faced by professionals in using informational resources and tools. These difficulties include information overload and comprehension difficulties (Brajnik & Gabrielli, 2010; Swallow et al., 2014), difficulties in aligning theory with practice (Gagliardi et al., 2016; Greenhalgh et al., 2014; Hekler et al., 2013; Lavis et al., 2006), and the lack of a human-centered approach leading to generalized information (Greenhalgh et al., 2014). The World Health Organization provides guidelines for digital interventions aimed at enhancing health systems (WHO, 2019). However, despite guidelines being comprehensive and credible, professionals often struggle with the practical implementation of these guidelines. The guidelines by the United Nations (Vosloo, 2018) provide more applicable guidance, yet they focus mainly on skills and literacy barriers faced by end users without assisting professionals during the development process. To the best of our knowledge, there is currently no accessible and applicable guidance available to assist professionals throughout the process of developing eHealth interventions for people with a low SEP.

The objective of this study was to address the challenges faced by professionals in developing, adapting, evaluating, and implementing eHealth interventions (e.g., lifestyle interventions) for people with a low SEP. To overcome these challenges, our aim was to develop a comprehensive guide that supports professionals throughout this process. This guide is intended to provide guidance and assistance to professionals working in the field of eHealth (e.g., lifestyle interventions) across a wide range of settings, such as health care facilities (e.g., hospitals and cardiac rehabilitation) and individual self-management for chronic disease. We aimed to ensure that the guide is user-friendly and accessible by identifying and incorporating design requirements derived from the needs and preferences of professionals in relation to such a guide.

4.2 Methods

4.2.1 Study design

This study uses a 2-phase qualitative research approach that includes a secondary analysis of existing data and a participatory design process (Figure 4.1). In the first phase, we performed a secondary analysis of data from 2 existing qualitative and quantitative studies. In the second phase, we adopted a participatory design process, involving the prospective end users (professionals who would be using the guide) directly in the development process.

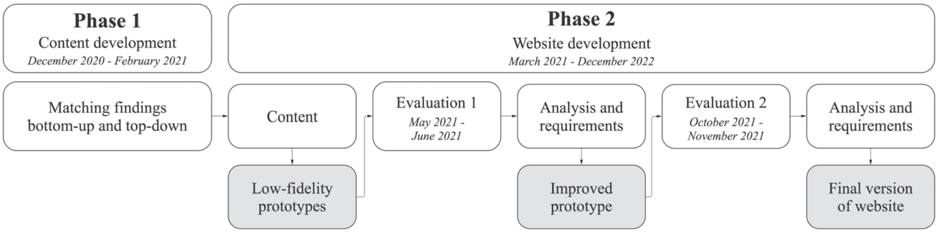

Figure 4.1 Schematic overview of phases, methods, and iterations.

4.2.2 Procedure and materials

4.2.2.1 Phase 1 – Secondary analysis and development of the content

The goal of this phase was to develop the content and information structure of the guide. Activities included secondary analysis with the goal of combining data from previously conducted Delphi and community-based participatory research (CBPR) studies. The Delphi study was performed with professionals and identified their experienced barriers and facilitators regarding eHealth development, reach, adherence, implementation, and evaluation for people with a low SEP (top-down) (Al-Dhahir et al., 2023). The CBPR study was conducted with people with a low SEP and resulted in different profiles of their attitudes toward health, health care, and eHealth (bottom-up) (Faber et al., 2021). Analyzing these studies through a qualitative secondary analysis allowed us to extract, combine, and synthesize insights that we used to develop the content and structure of the guide (Heaton, 2008). The combination of bottom-up and top-down approaches represents an innovative methodology that is not widely used. eHealth interventions exhibit limited alignment with the needs and preferences of people with a low SEP, thereby resulting in their underuse by this target group (Latulippe et al., 2017; Reiners et al., 2019). Professionals are crucial in adjusting these interventions to meet the target population's needs. By integrating the perspectives of professionals (as guide users) and people with a low SEP who engage with eHealth interventions, we can develop a comprehensive guide that substantially enhances interventions for this group.

The secondary analysis embodied the analysis, discussion, and synthesis of data obtained from the previous studies. For the analysis, both first authors (JSF and IAD) independently analyzed the barriers and facilitators of the Delphi study (Al-Dhahir et al., 2023) and considered which profiles of the CBPR study (Faber et al., 2021) could be influenced by them. For example, the Delphi study identified a barrier where professionals lacked sufficient knowledge about the daily lives of people with a low SEP, which aligned with attitude profiles from the CBPR study characterized by difficulty in comprehending written materials and limited digital skills. Another example is provided in Figure 4.2. Both authors independently documented their associations in Microsoft Excel.

For the discussion, the first authors discussed their associations and documented their alignment using color coding in Excel, making distinctions between "full alignment," where both authors found the same association; "to be discussed," where alignment did not match; and "not applicable," where both authors did not find an association between the 2 studies. A second discussion round followed, in which both authors discussed the "to be discussed" associations and developed a mutual agreement on the corresponding association. Finally, during synthesis, the first authors developed the association scheme (Appendix 4A).

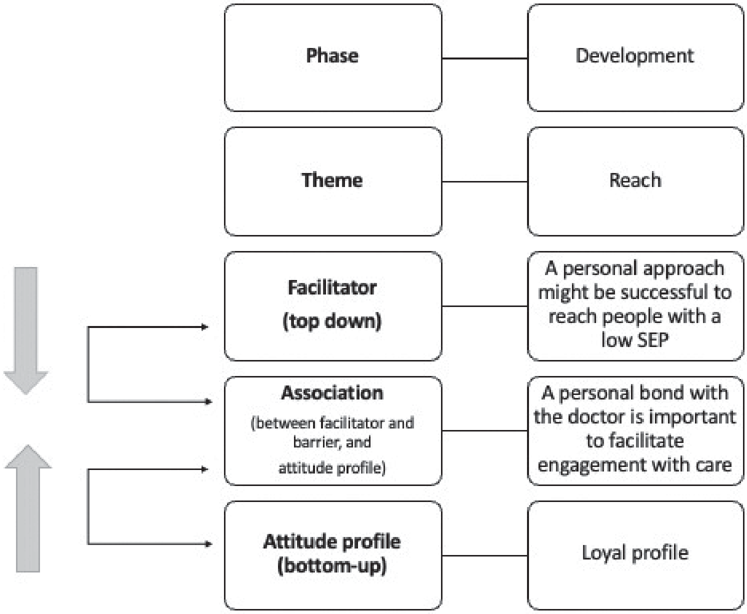

Figure 4.2 An example of an association made between a facilitator identified through the top-down approach and an attitude profile identified through the bottom-up approach. SEP: socioeconomic position.

4.2.2.2 Phase 2 – Participatory development of the guide

The goal of the second phase was to use the findings from phase 1 to create a guide through an iterative process with end users. In this phase, we used a participatory design approach. Participatory design, also known as co-design, is an approach that emphasizes the active involvement of end users in a design or development process to ensure that the result meets their needs (Sanders & Stappers, 2008; Smith et al., 2017). Participatory design is often used in an iterative manner. The iterative process allows for continuous reflection on intermediate results and enables ongoing learning to make improvements. For this reason, we engaged the professionals in 2 rounds of prototype evaluation (simple representation of the final product) of the guide.

We aimed to recruit end users that would eventually make use of the guide: professionals working within the development, adaptation, implementation, or evaluation of eHealth. Consequently, we did not involve people with a low SEP to evaluate the guide, primarily because they are not the direct users of the guide. The inclusion criteria for participation were that the professional should have experience with eHealth within their role as well as experience with developing, adapting, evaluating, and implementing eHealth in the context of low-SEP populations. We used scientific literature and input from the Delphi study to identify the roles of professionals to be included: policy officers, health care providers, eHealth developers, and researchers. To contact these professionals, we used expert recommendations and snowball sampling. For the first evaluation session, we invited at least 1 of each type of professional through email. For the second evaluation session, we invited, through email, professionals from round 1 as well as new professionals. In web and usability design, the rule of thumb is that testing with just 5 participants can uncover at least 80% of user insights when the aim is to generate insights rather than validate them (Nielsen & Landauer, 1993). Although this number can vary depending on the project (Bevan et al., 2003), we followed this guideline by targeting a minimum of 2 participants for each role to ensure a well-rounded set of user insights. It is important to note that qualitative research aims to understand the human experience in a comprehensive, nuanced manner. While it may not quantify the prevalence of a specific experience or need in the same way as quantitative research, it aims to explore the depth, meaning, and significance of such experiences or needs within a specific context or population.

4.2.2.3 Development of prototypes

For the first prototype evaluation session, we developed 3 low-fidelity (quick and dirty) prototypes of the website. These prototypes provoked our participants to comment on the ideas instead of specific features (e.g., colors used and button placement). To develop these prototypes, we gathered inspiration on navigation, credibility, tone of voice, applicability, communication style, and user perspective from existing tools (e.g., guidelines and roadmaps) on eHealth development, inclusivity, low SEP, low health literacy, accessibility design, and general design using the Miro whiteboard platform (RealtimeBoard, 2022). We identified reoccurring elements, such as dos and don'ts, personas, examples, and tips. As a final step, we synthesized the individual elements into 3 clickable prototypes in Microsoft PowerPoint. For the second prototype evaluation session, we developed an improved prototype based on the results of the first evaluation using the Wix website builder (Wix.com Limited, 2022).

4.2.2.4 Evaluation of the prototypes and content

Both evaluation rounds comprised individually conducted semi structured interviews and used the think-aloud method, where participants verbalized their thoughts, to gather information. Semi structured interviews are an effective approach for collecting information, while the think-aloud method serves as a valuable technique to gain insights into user thoughts and perceptions (Jaspers, 2009). These methods enabled us to understand the target group better and contributed to the creation of an appealing prototype (Maguire, 2001). The first evaluation was performed to determine professionals' goals and needs based on content, system, and service level. The second evaluation was conducted to determine how the participants valued the recommendations (content) and to get an indication of user acceptance of the prototype.

We ran a pilot for both evaluation rounds with 2 researchers to refine the protocol. The first evaluation was conducted on the internet (in accordance with COVID-19 regulations), while the second evaluation was conducted either on the internet (Microsoft Teams; Microsoft Inc) or face-to-face based on the preference of the participant. The sessions lasted between 45 and 60 minutes and were recorded using a voice recorder or through Microsoft Teams. The determination of the number of interview sessions conducted in each evaluation round was based on the input received from the participants in the study, which played a crucial role in guiding this decision. After consultation with the research team, it was concluded that both evaluation sessions yielded sufficient data to proceed with the development of the website. In the first evaluation round, we started asking participants about their background information, including their role, age, experience with eHealth, and the target group. Subsequently, we discussed the 3 low-fidelity prototypes. We first introduced the participant to a predetermined scenario. The scenarios were written according to different roles: eHealth developer, researcher, and health care provider. An example scenario for researchers was:

"Imagine you are involved in a study on eHealth and people with a low SEP. The problem is there is too much information available. You are looking for a central place to find all the information. A colleague tells you about an online guide for the development of eHealth interventions for people with a low SEP. You decide to visit. Your goal is to quickly get a good overview of the information and to quickly access the information source through the website."

We also asked participants to try each prototype and offer a brief verbal evaluation. In the last part, we asked questions about the prototypes and the content: "Which prototype do you like the most? Which specific themes or topics do you want to see in the guide?"

In the second evaluation round, we again started with collecting relevant background information from the new participants. Thereafter, we asked all participants to execute 5 tasks while verbalizing their thoughts: (1) explore the pages, (2) find a barrier on a specific topic, (3) find an associated facilitator, (4) find the associated practical tips, and (5) find the associated user perspective. Finally, at the end of the interview, we administered a short questionnaire as an assessment tool to evaluate the prototype and assess the likelihood of acceptance of the final guide among study participants. We developed this questionnaire based on the usability, satisfaction, and ease-of-use (USE) questionnaire (Lund, 2001); the unified theory of acceptance and use of technology (UTAUT) questionnaire (Venkatesh et al., 2003); and the internet evaluation and utility questionnaire (IEUQ) (Ritterband et al., 2008; Thorndike et al., 2008) questionnaires. It comprised 13 questions regarding the intention to use, usefulness, and usability of the design, as well as the relevance, understandability, and trustworthiness of the content. The items were rated on a 5-point Likert scale, ranging from 1 “certainly not” to 5 “certainly” (Lin et al., 2018). To analyze the questionnaire responses, we calculated the percentages (means and SDs) and classified scores as negative (1 or 2), neutral (3), or positive (4 or 5) for each item (Allen & Seaman, 2007; Jansen-Kosterink et al., 2021).

4.2.3 Data analysis

Since this study adopted a participatory approach, we used the data from the first session to develop the prototype and the data from the second session to refine the prototype guide (Lentferink et al., 2020; van Velsen et al., 2018; Wentzel et al., 2014). Thematic analysis was applied to both sets of data, following the method outlined by (Braun & Clarke, 2006). The first authors coded and themed data separately using the qualitative data analysis ATLAS.ti software (version 9; ATLAS.ti Scientific Software Development GmbH). Themes were coded through open coding and thereafter categorized through axial coding within 3 predetermined categories: service, system, and content, as provided in (Kelders et al., 2013). The system category describes the website’s layout and information structure. The content category describes the usefulness of the information and the understandability of the text on the website. The service category describes the process of care given by the website, including credibility and long-term implementation.

We identified recurring themes and items of interest that offered insights into the wishes and needs of professionals. Initial codes and themes were discussed in several sessions, and the results were then compared and merged by consensus. The codes were also given a positive, neutral, negative, and recommendation label. After each interview round, we used the themes resulting from the analysis to synthesize a list of requirements for the next prototype. For this, we examined the frequency of occurrence and the number of participants who mentioned the themes. Positive themes related to aspects that should be kept and elaborated upon. Negative aspects were paired with recommendations for improvement. The requirements were related to content, system, and service and encompassed the most important needs, wishes, and preferences of the participants.

Background information was analyzed using descriptive summary statistics. Quantitative data about the acceptance of the prototype in the second evaluation session were descriptively analyzed using SPSS Statistics 25 (IBM Corp).

4.2.4 Ethical considerations

Ethical approval for the study was obtained from the Human Research Ethics Committee of the Delft University of Technology (approval 1495). All participants were informed about the study and signed an informed consent form before participating. Participants were reimbursed for their participation with a €15 (US $15.88) donation to a low-SEP oriented charity.

4.3 Results

4.3.1 Phase 1: Content and information structure

Based on the secondary analysis, an association scheme was created to present the content and information structure categorized under 5 different aspects of eHealth development (development, reach, adherence, evaluation, and implementation). Within each category (e.g., development), different themes could be found that relate to this category. Within each theme, associations could be found between barriers, facilitators, and attitude profiles. For instance, under the development aspect, themes such as "developing with the target group" can be identified (Figure 4.2). The overall information structure is visually presented in Figure 4.3.

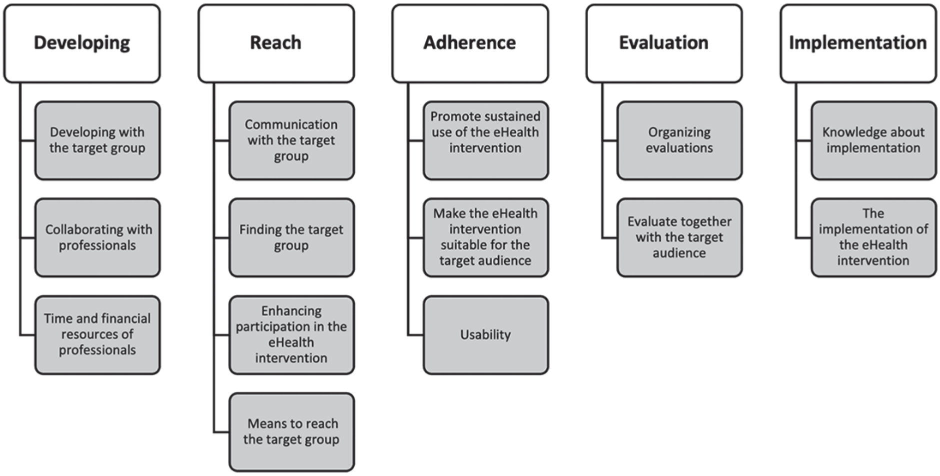

Figure 4.3 Overall information structure of the content of the guide resulting from the secondary analysis.

4.3.2 Phase 2: Design of the Inclusive eHealth Guide

The results from the participatory process with potential end users (professionals) of the guide consist of several recommendations on system, content, and service aspects of the guide. These insights were subsequently translated into an interactive web-based guide aimed at facilitating eHealth.

4.3.2.1 Participants

In total, 11 professionals participated in this study. In the first interview session, 7 professionals participated. A total of 10 participants contributed to the second interview session; 6 of them also participated in the first interview session. The participants had experience working with people with a low SEP and consisted of eHealth developers, health care providers, researchers, and policy officers (Table 4.1).

Table 4.1 Participant characteristics

P	Interview Session	Sex	Role	eHealth Experience (Years)	Activities
1	1	Male	Developer	4	eHealth interventions development
2	1 and 2	Female	Health care provider and researcher	8	Scientific research, eHealth intervention development, and health care practice
3	1 and 2	Female	Researcher	6	Scientific research
4	1 and 2	Female	Policy officer	3	Policy development
5	1 and 2	Male	Developer	10	eHealth intervention development
6	1 and 2	Male	Developer	10	eHealth intervention development
7	1 and 2	Female	Policy officer and developer	9	eHealth intervention development, eHealth intervention application, and policy development
8	2	Female	Researcher	5	Scientific research and eHealth intervention development
9	2	Male	Developer	19	eHealth intervention development
10	2	Male	Health care provider	7	eHealth intervention application, and healthcare practice
11	2	Female	Policy officer and developer	Not available	Policy development and eHealth intervention development

P: Participant

4.3.2.2 Requirements based on prototype evaluation

The analysis of both interview rounds generated 96 themes, with 39 themes arising from interview 1 and 57 themes from interview 2. The subsequent synthesis resulted in the formulation of 16 requirements for the final guide design, covering content, system, and service aspects. Table 4.2 presents examples of participant quotes and the resulting requirements.

Regarding the system category, the guide is required to have (1) an open navigation strategy that allows different types of users to reach their desired information through multiple pathways instead of a predetermined (closed) navigation route. This should be facilitated by a (2) starting scheme that serves as both a starting and come-back "reference" point to improve the navigation experience. From this starting point, the user should be directed deeper into more detailed and (3) specific information about, for example, the barriers and facilitators. (4) Visual elements should be included, while the amount of text should be reduced, and the overall system should be made visually appealing to make the navigation more enjoyable. Both barriers and facilitators needed to follow (5) a concurrent presentation rather than a sequential presentation that highlighted barriers before facilitators. A balanced depiction is needed to avoid any dominance of one over the other. Long pages should be subdivided and categorized into more digestible (6) shorter separate pages.

For the content, the guide is required to provide (7) comprehensible information that is supplemented and made credible with (8) scientific evidence, for example, by referring to literature. The content should provide (9) a realistic user representation to improve empathy toward the target group. This user information should be short and be accompanied with interpretable (10) abstract user information (e.g., tell exactly what the users' barriers are instead of "hiding" them in a story). The barriers and facilitators should be accompanied by information about the (11) practical application, for instance, by providing examples and practical tips. Finally, (12) the tone of voice should be personal and informal to improve the persuasiveness of and engagement with the content.

Service requirements included improving (13) the suitability for different professionals, such as health care providers and developers, which have different needs and goals. In addition, a key requirement was to ensure (14) the long-term viability of the website. This involves considering the costs associated with maintaining the website and ensuring that the information present is constantly up to date. To achieve this, the guide should become (15) a dynamic community hub that connects various instances, people, and research groups for sharing knowledge. Finally, there is a need for increased (16) focus on the implementation of intervention development. This was deemed essential for ensuring the success and impact of interventions within the target group.

Table 4.2 Content, system, and service requirements based on the first and second interviews.

Requirement	Description	Quote
System		
Open navigation	Present an open overview about the information structure and possible navigation strategies.	*"In terms of user experience, I would like to navigate through different pathways. That would be my most important requirement." [P5]*
Starting scheme	Provide both a starting point and a persistent reference point for maintaining an overview while navigating	*"I saw that overview at the beginning; I actually keep going back to it." [P11]*
Specific information	Provide direction down specific path allowing the user to switch quickly between generic and specific information	*"It feels like a nice step, you have two new categories within a category. So, you are talking about reach, and you can see for yourself which aspect of reach is important to me." [P4]*
Visual elements	Incorporate visual elements to enhance the overall appeal and user experience.	*"If you have different icons, this would be useful." [P9]*
Concurrent presentation	Present barriers and facilitators concurrently instead of sequentially to avoid dominance of one over the other.	*"… and indeed, what I just said, seeing a lot of barriers among each other is a deterrent, all those exclamation marks among each other." [P6]*
Shorter separate pages	Make use of more categories and shorter pages to improve the reader's retention	*"You really don't have to go down that much. I don't like scrolling that much." [P10]*
Content		
Comprehensible information	Information should be clear and understandable, avoiding technical jargon	*"For the attitude part it was not directly clear for me that you were talking about the patient, till I started reading." [P1]*
Scientific evidence	Information should be backed-up by scientific evidence to improve its credibility	*"That I can trace back: Where does it come from? Where is it based on?" [P6]*
Realistic user representation	Use realistic user representations to enhance empathy instead of relying on fictional quotes and examples	*"I would like to see real practical examples in case studies." [P5]*
Abstract user information	Accompany user related information with more abstract statements that are easier to interpret	*"My mind works better with more abstract or conceptual information than with examples." [P4]*
Practical application	Include practical guidance on how to implement the recommendations through concrete examples and practical tips	*"I would have expected more guidance, say I visit the website and want to adapt something, how should I do it?" [P2]*
Informal tone-of-voice	Use a personal and informal tone-of-voice to improve the persuasiveness of the content	*"It is very much written in policy language." [P7]*

Table 4.2 Continued

Requirement	Description	Quote
Service		
Suitability for different professionals	Ensuring accessibility and usefulness for different groups of professionals (e.g., developers and healthcare providers)	*"Well, I do think that it would appeal to healthcare practitioners toward people they see in their daily practice." [P7]*
Long term viability	Keeping the website up to date, maintained and disseminated	*"This is one of the most challenging aspects; you can make a beautiful website, but who is going to visit it? Who knows you are there? Who is going to manage it? What is the business case? It is a beautiful initiative, but an initiative without a business case." [P1]*
Dynamic community hub	The guide should serve as a platform for professionals to dynamically contribute and update information	*"Imagine, I have a barrier, where else can I add it?" [P11]*
Focus on implementation	Improve the focus on implementation as it is a crucial component of intervention development	*"It is part of its development, but it is also a huge success factor for the use of eHealth, and how you implement it is most certainly different for the low SEP." [P5]*
General		
Enhance credibility	Demonstrating the credibility of the website	*"Yes, maybe it could be a little clearer who all this information comes from. Just you as researchers are connected to the university, things like that." [P2]*

4.3.2.3 Quantitative evaluation of the prototype

As part of the second interview, the participants evaluated the prototype of the guide across various dimensions (Table 4.3). All participants completed the questionnaire; however, only the data of 9 out of 10 participants were included in the analysis. The exclusion of 1 participant was due to the questionnaire being modified for clarity and comprehensiveness after receiving feedback from the first participant. Table 4.3 presents an overview of the participant responses to the questionnaire. In terms of content (e.g., barriers and facilitators), participants expressed positive opinions regarding its understandability (89%, 8/9 positive), usefulness (100%, 9/9 positive), and level of interest (100%, 9/9 positive). On the service level, the website was found to be credible (56%, 5/9 positive) and useful (67%, 6/9 positive), and participants would recommend it to a colleague (100%, 9/9 positive). However, most participants did mention they would not want to regularly use the guide (33%, 3/9 positive) since, according to the participants, most of the needed information could be obtained in 1 visit.

Table 4.3 Descriptive statistics of questionnaire responses in the second session (n=9).

Question	Score, mean (SD)	Positive, n (%)	Neutral, n (%)	Negative, n (%)
General				
Try the guide	3.9 (0.3)	8 (89)	1 (11)	0 (0)
Service				
Regularly use the guide	2.7 (1.3)	3 (33)	3 (33)	3 (33)
Recommend the guide to a colleague	4 (0.0)	9 (100)	0 (0)	0 (0)
Usefulness of the guide	3.4 (1.0)	6 (67)	2 (22)	1 (11)
Meeting the user's expectations	2.6 (1.5)	4 (44)	1 (11)	4 (44)
Credibility of the website and information	3.3 (1.0)	5 (56)	3 (33)	1 (11)
Content				
Usefulness of the barriers and facilitators	4.0 (0.0)	9 (100)	0 (0)	0 (0)
Interest of the barriers and facilitators	4.0 (0.0)	9 (100)	0 (0)	0 (0)
Usefulness of the practical stories	3.8 (0.4)	7 (78)	2 (22)	0 (0)
Clarity of the barriers and facilitators	3.7 (1.0)	8 (89)	0 (0)	1 (11)
Understandability practical stories	3.7 (1.0)	8 (89)	0 (0)	1 (11)
System				
Ease of use	3.4 (1.1)	6 (67)	2 (22)	1 (11)
Pleasant to use	3.7 (0.5)	6 (67)	3 (33)	0 (0)

4.3.2.4 The Inclusive eHealth Guide

The final product is an interactive web interface (Appendix 4B). The main component on the website will be used as a starting point, which the user can use as a navigation scheme that shows the phases (e.g., development, reach, and adherence) and their corresponding categories (reach strategies and user-friendliness). Using this scheme allows the user to navigate to the category that applies to their specific situation. Within this category, the user will find barriers and their corresponding facilitators. The barriers and facilitators are complemented with practically applicable information such as tips, examples, external tools, resources, and literature. When possible, according to the association scheme of phase 1, user portraits are shown to communicate the users' perspective. The user portrait consists of an illustration complemented by quotes from the CBPR study. They present a concise and visual representation of key attitudes that provide additional explanation and illustration. Finally, a separate background page provides information about the authors, research team, affiliations, and studies.

4.4 Discussion

4.4.1 Principal findings

In this study, we developed an applicable and user-centric guide that supports professionals during the development, adaptation, evaluation, and implementation of eHealth interventions for low-SEP populations. We gained insight into professionals' needs and preferences regarding system (e.g., presentation of information and navigation structure), content (e.g., terminology and tone of voice), and service (e.g., credibility and viability). Based on these insights, we formulated 16 requirements for the design of the guide. According to these requirements, we developed the final version of the Inclusive eHealth Guide.

4.4.2 Feedback on content and design

The professionals found the second iteration of the prototype to be beneficial, useful, and usable. We attribute these findings to the integration of their needs and preferences in both its content and design.

On the design level, we found that this second prototype of the website, with its open navigation structure allowing users to switch between general and specific information, was perceived as user-friendly. It is common for researchers to distribute their knowledge through traditional means such as lengthy summaries, reviews, or guidelines (Greenhalgh et al., 2014). However, these methods can be confusing and frustrating for users. Our guide aims to provide accessible information that can be easily accessed by professionals in the field. In terms of content, professionals appreciated the collection of scientific knowledge and applicable information presented in the prototype. Currently, knowledge about eHealth and people with a low SEP is scattered, making it challenging for professionals to obtain a complete understanding of how to develop eHealth interventions for this target group (Al-Dhahir et al., 2022). Our guide could serve as a centralized hub for acquired knowledge in this area, as it would contain all the necessary information for professionals in one place, taking a significant step in uniting this knowledge and facilitating its wider dissemination.

4.4.3 Different user goals

Despite not distinguishing between the various roles of professionals during the interviews, the results underscore the fact that professionals who visit the guide have different goals and needs. This highlights that the existing static materials (e.g., summaries, reports, and scientific papers) are not suitable to cater to all professionals' needs. For example, the developers who participated in this study needed information on various phases (e.g., development and evaluation) because they are likely to be involved in different phases of intervention design. This result aligns with previous studies indicating that, within eHealth development, there is a need for flexible and agile development (van Gemert-Pijnen et al., 2018). The health care providers in this study seemed to express less interest in the design process and more in using eHealth and reaching the target group. This is not surprising, as care professionals face many obstacles during the implementation of eHealth interventions due to the lack of explicit training materials and assistance for eHealth users (Swinkels et al., 2018). Some health care providers do not know how to motivate their patients with a low SEP and support them to use eHealth interventions. Swinkels et al. (2018) conclude that explicit instructions and tips (from other health care professionals) are needed to encourage and persuade patients to use eHealth. The researchers that participated in this study specifically wanted to develop a comprehensive view of the available information to increase awareness of developments in eHealth and vulnerable groups and further organize their research. Researchers in this area mainly use an explorative approach that relies on trial and error (Du & Evans, 2011), making it an uncertain search strategy. As a result, they may not have a clear path for gathering the information. It is notable that policy makers were the least enthusiastic about the current content of the guide. According to the literature, health policy professionals want to make well-informed decisions based on the best available evidence (Oxman et al., 2006). This may explain why the policy makers in this study valued formal evidence-based information more than user perspectives, indicating that reports and guidelines may better fit their goals than practical information or user perspectives. Understanding the guide users' goals can help us make the guide more suitable for their needs.

4.4.4 User perspective

A noteworthy finding in this research is that professionals acknowledge the significance of incorporating the perspective of the low-SEP target group. Our findings align with the perspectives of (Kayser et al., 2015) and (van Velsen et al., 2012), who emphasize the importance of considering user perspectives, as losing focus on the user perspective can lead to overlooking the needs of the stakeholders. However, we encountered challenges in determining effective ways to represent this user perspective. Our findings suggest that user representations of the low-SEP target group that offer a balance between abstract concepts and realistic representations are preferred over fictional, detailed, and extensive descriptions. Initially, we intended to integrate persona-like user representations on our website, as they are popular tools for communicating user scenarios (Adlin & Pruitt, 2010).

Nevertheless, because of the need for short, realistic, and visual representations, personas were not considered the most suitable tool for communicating user perspectives. Instead, we opted for user portraits, which describe a certain user perspective briefly and visually through realistic quotes. The inclusion of user perspectives on the website makes the guide more engaging for the professional and can be a valuable way to share information about the low-SEP group, especially when professionals lack familiarity with this target group. It is important to offer user perspectives because professionals can have different views of low-SEP groups that, at times, do not correspond with reality. Moreover, this approach has the potential to facilitate greater empathy toward this target group.

4.4.5 Strengths and limitations

In this study, we used a broad definition, extending beyond education level, income, and occupation, to describe the low-SEP group. Defining the SEP group is complex because of the high heterogeneity within it, which is why we aimed for broadness to cover not a specific subgroup but to include the lower-SEP group. However, it is important to ensure that the recommendations are indeed applicable to a specific target audience or context. For example, a recommendation that is highly relevant for groups with low health literacy might not be as applicable to groups facing cultural barriers or adverse life events. The guide's application may vary not only among different low-SEP subgroups but also across patient groups in diverse health care settings and geographical locations. In addition, an argument might be given that using recommendations of the guide, such as simplicity and user-centered design, could also benefit higher-SEP populations. We, therefore, recommend that professionals take additional precautions and consider their specific situation when taking advantage of the different recommendations offered by the guide.

Another important limitation of this research is that we only obtained insights from Dutch professionals. This may decrease the generalizability of the guide to other countries. Hence, the current guide is only available in Dutch. However, it is noteworthy that the challenges faced by, for example, health care professionals in the Netherlands are not unique to this country, as similar barriers are encountered by professionals worldwide (Al-Dhahir et al., 2022; Bonevski et al., 2014; Clarke et al., 2019). Therefore, a future step would be to make the guide also available in English.

The content of the guide is based on 2 relatively small-scale studies. Although they provide a valuable perspective by combining insights from both professionals and people with a low SEP themselves, a future step would be to validate the final version of the guide with professionals and to apply the guide in a real-world scenario to learn about its practical applicability in specific contexts.

4.5 Conclusion

In this study, we developed a guide to support professionals during the development, adaptation, evaluation, and implementation of eHealth interventions specifically for low-SEP populations. Through our participatory process, we ensured that the guide aligned with professionals' needs and preferences and provided information and tools to help them develop appropriate interventions to bridge part of the social health inequality gap between the lower-SEP groups and other groups. Future research should validate the guide to determine its applicability for professionals who want to develop eHealth interventions for people with a low SEP and investigate its practical application in specific scenarios.

PART C:
APPLICATION CYCLE

Application of the Inclusive eHealth Guide

CHAPTER 5

Application of the Inclusive eHealth Guide during the development of an eHealth intervention for andwith cardiac patients with a low socioeconomic position

Building upon the development of the Inclusive eHealth Guide, this chapter delves into its practical application. Given its adaptability to different contexts, project goals, and professionals, it is essential to test and refine the guide by implementing it in real-world situations. As a start, this chapter presents a case study on designing an eHealth intervention for individuals with low socioeconomic position (SEP) in the context of cardiac rehabilitation (CR). During this study, we identified the need of patients with a low SEP to feel more certain and guided during their waiting period preceding CR. In response, we developed a tailored eHealth intervention with the target group to address this need. Implementing the guide during this project yielded four key lessons learned that could guide future designers in similar case-specific applications: the need for resource management, the value of participatory methods, and the importance of personalization and simplicity in eHealth design.

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All research data and code supporting the findings described in this chapter are available in 4TU. Centre for Research Data at 10.4121/2ece98da-bebd-4a00-9534-47a432944b4e

Abstract

Background | Despite the growing body of knowledge on designing eHealth for low-SEP groups, the practical application of this knowledge remains difficult, partly due to a lack of detailed descriptions of design processes and limited use of practical guidance.

Objective | In this study, we aimed to refine the Inclusive eHealth Guide (IeG) through a case study in cardiac rehabilitation (CR), exploring its application, describing the design process, and evaluating the developed eHealth intervention's acceptance.

Methods | We used the IeG as a reference throughout the design process, involving 16 cardiac patients with a low SEP and seven healthcare professionals. The outcome was a tailored digital intervention aimed at empowering patients during the pre-CR waiting period.

Results | We applied 64% of the IeG's recommendations, with some exceptions due to inapplicability or resource constraints. Key lessons learned emphasized flexibility, stakeholder engagement through participatory methods, personalization features, and a focus on core functionalities for resource allocation and user acceptance. The resulting prototype received positive acceptance from the target group, with median scores (out of 5) for usability (4.5), experience (5), and perceived impact (4.5).

Conclusion | In conclusion, this study provides practical insights into enhancing the IeG's applicability and inform future researchers and practitioners undertaking similar design studies.

5.1 Introduction

Individuals with a low socio-economic position (SEP) tend to have higher rates of unhealthy behavior compared to those with a high SEP, which puts them at increased risk for chronic conditions such as cardiovascular disease, diabetes, and obesity (Mackenbach et al., 2008; Psaltopoulou et al., 2017; Rosengren et al., 2019; Schultz et al., 2018; Stringhini et al., 2010). While eHealth interventions like monitoring devices, online platforms, and serious games have shown to be effective in promoting healthy lifestyles in various populations, they are generally less successful in people with a low SEP, often due to low acceptance and adoption rates (Kontos et al., 2014; Reiners et al., 2019). A crucial factor in the success of eHealth interventions, especially for people with a low SEP, is aligning their design and design process (e.g., recruitment strategies, and design activities) with the needs, skills, and preferences of the target group (Kerkhoff et al., 2022; Lee et al., 2022). An intervention that requires extensive digital skills to be operated, will be abandoned by those inexperienced with digital devices (Sieck et al., 2021). Likewise, an intervention that provides complex and textual descriptions will disengage those with lower literacy levels (Estacio et al., 2019), and an intervention that requires active self-monitoring and goal-setting will not be adopted by those with lower motivation or other priorities (Coupe et al., 2018; Faber et al., 2021; Heutink et al., 2010).

However, to develop understanding of and tailor interventions toward the needs, skills, and preferences of the target group also poses challenges. Designers and developers often come from different socio-economic, cultural, or professional backgrounds than the target group, which makes it difficult for them to fully understand the barriers, intentions and motivations of these individuals (Manstead, 2018). Despite the growing body of research about the design of eHealth with and for people with a low SEP (Al-Dhahir et al., 2023; Al-Dhahir et al., 2022), the process of translating this research into practical interventions remains challenging. Due to a lack of sufficient practical resources and the limited description of how design projects are carried out, existing information lacks applicability and concreteness to inform intervention design and design process. To bridge the gap between theory and practice, professionals (e.g., researchers, developers, healthcare providers) therefore need more applicable insights, how-to knowledge, and context-specific examples of design cases (Gagliardi et al., 2016; Greenhalgh et al., 2014; Hekler et al., 2013; Lavis et al., 2006).

The recently developed Inclusive eHealth Guide (IeG) helps to bridge the gap between theory and practice to support professionals with the development, adaptation, evaluation, and implementation of eHealth interventions for low-SEP groups (Faber

& Al-Dhahir et al., 2023). The guide combines existing knowledge about barriers and facilitators during eHealth development for individuals with a low SEP (Al-Dhahir et al., 2023) and attitudes of the target group regarding health and eHealth (Faber et al., 2021). It is designed to be a modular tool by presenting the barriers, facilitators, and attitudes and providing recommendations, arranged according to different aims during designing eHealth interventions: development, reach, adherence, evaluation, and implementation. Professionals using the guide can adaptively combine the recommendations based on the unique needs and complexities of their specific design challenge. Given the modular nature of the guide, its utility extends beyond singular contexts or specific problems. Therefore, it is imperative that this guide will be applied across various contexts and refined through iterative cycles to strengthen its practical foundation.

This brings us to the primary aim of the present study: to contribute to this ongoing refinement by exploring the application of the IeG in a particular setting – a case study. This case study, focusing on an eHealth intervention in cardiac rehabilitation (CR), will serve as a testing ground to uncover lessons learned through experienced challenges and applied solution strategies that would not become apparent in a theoretical setting. Through this, we seek to gain a better understanding of how the IeG can be used to address complex design questions in specific settings with use of different combinations of its recommendations. For our secondary aims, we describe the design process and resulting intervention design to provide professionals with concrete how-to information that can serve as inspiration for other design cases, and we evaluate the acceptance of the resulting eHealth intervention.

For this specific case study, we chose to design an eHealth intervention targeting individuals with a low SEP in CR. CR is a multicomponent lifestyle intervention that includes information and advice on healthy behavior and supervised exercise. It plays a crucial role in cardiac patients to prevent progression of the disease, complications and mortality and has been shown to improve patient outcomes like physical fitness and health-related quality of life (Eijsvogels et al., 2020; Goel et al., 2011). CR provides a useful setting for this study because of its focus on lifestyle changes and involvement of a range of lifestyle interventions that could be delivered effectively through eHealth. In addition, its outcomes are impacted by socio-economic disparities, with patients with a low SEP dropping out earlier, attending fewer sessions, and experiencing more barriers to participation (Apfelbaum, 2016; Shanmugasegaram et al., 2013).

5.2 Methods

5.2.1 Guide application and evaluation

In this study, conducted between June 2021 and June 2023 we used the IeG as a backbone throughout the design process of the CR eHealth intervention. The recommendations provided by the guide were used as guiding principles, informing our choices and approach at every stage of the intervention development. The guide was used as a reference point in selecting appropriate methods and recruitment strategies and making design decisions.

Upon concluding the design process and evaluation of our intervention prototype, the first author conducted an evaluation of the recommendations' application within the intervention design and design process. For this assessment, the recommendations were represented as facilitators into an enumerated recommendation table (Table 5.1). The table was organized according to specific codes that correspond to categories within the IeG: Development (D), Reach (R), Adherence (A), Evaluation (E), and Implementation (I). A documentation followed whether each recommendation was deemed relevant to the project. For instance, recommendations related to improving the reach and implementation of an already existing intervention were deemed not applicable to this specific project. In addition, it was documented whether the recommendation was applied, and if so, whether its application was extended across one or more phases of the design process or within the intervention design itself. Recommendations applied prior to the inception of the design process were classified under "set-up". This included already made arrangements and planning with the CR facility. Rationale was documented for the decisions pertaining to whether a recommendation was applied or whether it was deemed not applicable to this type of project in the recommendation table. For the recommendations that were put into practice, it was detailed how each one was applied. Furthermore, a reflection was incorporated of the specific challenges encountered during each recommendation's application and the strategies we employed to address those challenges. Finally, the first author analyzed the challenges and solution strategies using ATLAS.ti (GmbH Scientific Software Development) to develop overarching themes that we used to formulate the lessons learned resulting from applying the IeG in this case study.

Table 5.1 Enumerated table of IeG recommendations for development, reach, adherence, evaluation, and implementation.

Development	Reach	Adherence	Evaluation	Implementation
D1. Involve the target group during the design process	**R1.** Adapt written communication toward the target group	**A1.** Make use of realistic, achievable goals	**E1**. Provide insight into the added value of evaluation	**I1.** Evaluate the effectiveness
D2. Incentivize the target group for their participation	**R2.** Use of visual material	**A2.** Send reminders	**E2.** Engage evaluation experts	**I2.** Engaging various stakeholders in a timely manner
D3. Inquire about technology use of the target group	**R3.** Use of multiple languages during recruitment	**A3.** Provide insight into the added benefit of the intervention	**E3.** Setting up an evaluation plan	**I3.** Educating professionals
D4. Aligning with the needs and interests of the target group	**R4.** Use the expertise of organizations to reach the target group	**A4.** Reward the target group for adherence	**E4.** Step-by-step design and testing	**I4.** Find resources for structural funding of the intervention
D5. Collaborate with experts from diverse disciplines	**R5.** Make use of common meeting places	**A5.** Apply gamification	**E5.** Simple evaluation methods	**I5.** Ensure structured and coordinated project management
D6. Make stakeholders enthusiastic about eHealth	**R6.** Make use of key persons to earn trust of the target group	**A6.** Provide insight into own behavior	**E6.** Provide evaluation feedback after project completion	**I6.** Involve specialists during the implementation of the intervention
D7. Work together with different professionals	**R7.** Collaborate with diverse disciplines	**A7.** Involve the social environment	**E7.** Create a positive evaluation experience	**I7.** Ensure the privacy of the target group
D8. Aligning resources with the team, target group and stakeholders	**R8.** Motivate the target group to use the eHealth intervention	**A8.** Add group components to the intervention	**E8.** Reward the target group	
D9. Find investment partners	**R9.** Involve the social environment of the target group during the intervention	**A9.** Approach the target group positively	**E9.** Early involvement of diverse parties	
	R10. Incentivize the target group	**A10.** Make eHealth devices available for the target group	**E10.** Getting to know the target group	
	R11. Alignment with the target group	**A11.** Align with the life situation of the target group		
	R12. Allocate time and resources	**A12.** Simplify communication toward the target group about their health.		
		A13. Combine eHealth with face-to-face support		
		A14. Offer technical support		
		A15. Optimize usability		

5.2.2 Description of application of IeG in design process and intervention design

5.2.2.1 Process overview

To illustrate how the IeG was practically applied and to elucidate the specific design decisions that emerged from this application, this section provides a detailed description of the design process. It refers to the guide's recommendations as outlined in the recommendation table (Table 5.1).

In line with the IeG, to successfully develop an eHealth intervention for low-SEP groups, we engaged in a participatory process with both patients and healthcare providers in every phase of the project (D.1, E.9) and worked with a multi-disciplinary team with expertise in rehabilitation science, cardiology, design, behavior change, eHealth, and vulnerable populations (D5, R.7). This process was conducted between June 2021 and December 2022, and followed the CeHRes Roadmap (van Gemert-Pijnen et al., 2011) as its methodological approach (See Figure 5.1). The CeHRes Roadmap is a structural framework for eHealth development grounded in participatory development, human-centered design, and persuasive design. Based on the roadmap, we engaged in the following phases with corresponding participatory activities: (1) Contextual inquiry and value specification - context mapping to develop a patient journey and discuss it with patients, care providers, and stakeholders (e.g., researchers, management) to define patient needs and the design opportunity; (2) Design - ideation cycles with design experts, focus groups with patients and care providers and the development of a prototype; and (3) Evaluation – a formative, preliminary, evaluation with cardiac patients with a low SEP to determine initial acceptance.

5.2.2.2 Recruitment

We recruited different participants for each phase of the design process, which included: current CR patients with a low SEP who were within the first two weeks of their CR, former CR patients with a low SEP, and health professionals. See Figure 5.1 for an overview of participants in each project phase. We followed different procedures for recruiting current and former CR patients. We recruited current CR patients in phases one and two through care providers from various training locations of the CR center, following the IeG's recommendation to engage participants via key persons (R.6). These locations were situated in areas generally associated with diverse socio-economic backgrounds. Before engaging with participants, we confirmed that their residential postal code corresponded to a neighborhood characterized by low SEP. We defined the SEP of neighborhoods based on the proportion of residents with low income and low educational attainment (CBS, 2022). Specifically, we referred to a list of 40 neighborhoods identified by the Dutch government that were originally selected for their high prevalence of socio-economic challenges, making them a relevant benchmark for our study (Minister voor Wonen Wijken en Integratie, 2007). We took this approach to mitigate potential feelings of stigmatization that could arise from approaching participants based on their individual SEP measures. Eligible individuals were approached face-to-face during a training session to get to know them, explain the nature of the research and to invite them to participate (E.10). For recruiting current CR patients for the third phase, we contacted eligible patients based on the neighborhood SEP by phone. For recruiting the former CR patients in phases one and two, we emailed CR patients with a postal code within low-SEP criteria and who had been involved in earlier research at the rehabilitation facility and had consented to be contacted again for research activities. Health professionals were recruited through email and by posting a message on the rehabilitation facility's intranet. Following the IeG's recommendation (D.7), we carefully curated a diverse range of expertise among the health professionals involved in our study. This included the inclusion of a nurse, physiotherapist, dietician, psychologist, and social worker, ensuring a comprehensive and multidisciplinary approach to our research. In accordance with another IeG's recommendation (R.1), we made sure to discuss and gain agreement from both our research team and the stakeholders at the CR facility on comprehensibility of all communications directed toward the target group. This included materials such as information letters, emails, phone call scripts, and consent forms. All patient participants received a 15-euro gift voucher for their participation (E.8).

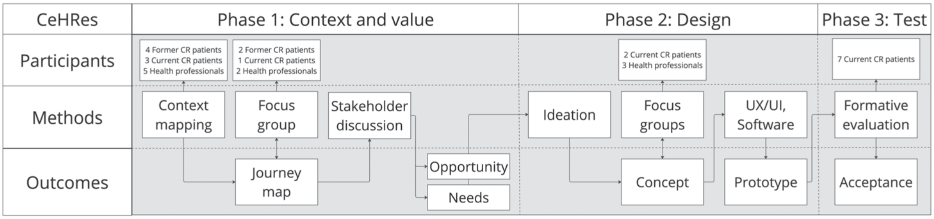

Figure 5.1 Overview schematic of the design process and recruitment

5.2.2.3 Phase one: Contextual inquiry and value specification

To develop a thorough understanding of the context around and needs of cardiac patients with a low SEP throughout their rehabilitation journey (D.4), we used the design technique context mapping (Sanders & Stappers, 2012). Context mapping is a method that uses qualitative and exploratory techniques to learn about the needs, wishes, motivations, and experiences of participants and incorporates them into the design process. It makes use of concrete and visual tools (e.g., workbooks, images, and prototypes) making it more comprehensible for the target group compared to traditional, language-based techniques such as interviews and questionnaires (R.2).

The context mapping process included preparation, collection, and analysis stages. In preparation, we developed a workbook based on literature and IeG recommendations. During collection, participants completed workbook assignments to prepare for interviews, focusing on their motivation and experiences during CR, including attitudes, barriers, and facilitators mentioned in the IeG. One assignment involved drawing a "motivation graph" and decorating it with images and quotes provided in an attachment (R.2). Understanding patients' motivation is key in rehabilitation, helping identify potential disengagement points. The workbook served as a discussion basis during interviews, exploring the motivation and experiences of cardiac patients with a low SEP in rehabilitation. Due to COVID-19, some interviews with health providers were online, while patient interviews were conducted face-to-face in line with governmental regulations. The interviews, lasting about an hour, were audio-recorded. The analysis stage involved thematic analysis of interview transcripts, identifying key barriers, facilitators, and attitudes of patients with a low SEP in rehabilitation.

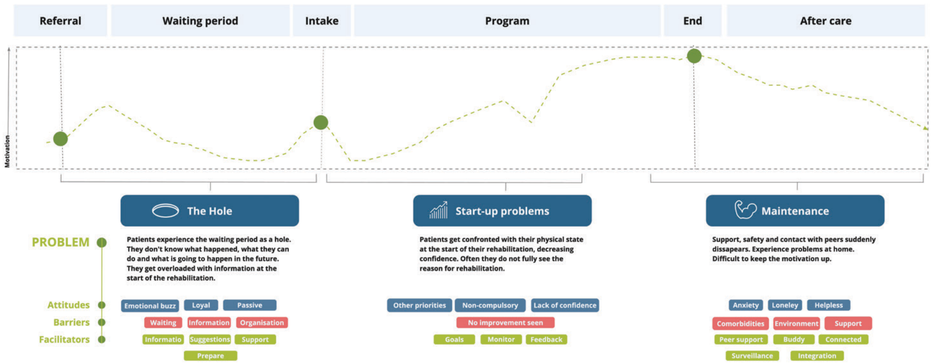

Figure 5.2 Motivation journey, three design opportunities and associated attitudes, barriers, and facilitators.

To validate our findings, we created a preliminary patient journey, discussed in a 1.5-hour focus group with patients and health professionals. The journey provides a visual format effective for communicating the findings to the target group (R.2) (Joseph et al., 2023; Ly et al., 2021). We used interactive whiteboard software Miro (RealtimeBoard, 2022) for discussion, employing colored stars to rank concepts. The group mapped these concepts into a matrix, identifying key ones for further exploration. Our final patient journey, incorporating interview and focus group inputs, identified three design opportunities (see Figure 5.2). One critical opportunity, “The Hole,” focused on the vulnerable period between hospital discharge and rehabilitation start, where patients face emotional vulnerability and lack of information. This period often leads to demotivation at the rehabilitation’s onset. Aligned with the opportunity and insights from context mapping, we identified several key needs that our intervention would need to address (see Table 5.2). In general, our intervention would require guiding patients through the waiting period, offering information to enhance understanding and encouraging small preparatory steps toward rehabilitation, thereby fostering a sense of certainty and guidance.

Table 5.2 Needs of cardiac patients during their waiting period preceding CR and their corresponding descriptions.

Need	Description
Certainty during waiting period	To gain a sense of security in patients during their waiting period, ensuring they feel confident and comfortable about their current health situation.
Physical activity confidence	To feel less fear of medical incidents when being physically active.
Rehabilitation expectancy	To achieve a clear understanding of what can be expected during CR and insight into their future healthcare journey.
Managing emotions	To foster positive emotions, gain calmness and reduce stress levels, thereby improving emotional wellbeing
Health status understanding	To receive comprehensive information about the current medical situation, including what has happened and the underlying cause of the health condition.
Pre-rehabilitation guidance	To receive guidance on the lifestyle activities that can be done while waiting for rehabilitation to begin, ensuring an understanding of what actions are safe and beneficial to perform.

5.2.2.4 Phase two: Design

We developed a range of potential solutions that resonated with the identified design opportunity and needs. We employed several design thinking techniques, including group brainstorming, brainwriting, and mind mapping (Tassoul, 2009). Subsequently, we refined a selection of the most compatible ideas into a preliminary intervention concept that was discussed and iterated upon in two co-creation sessions with both patients and health providers (D.1). In these sessions, we specifically gathered feedback about the concept and co-developed ideas on the topics: parameters to track, tone-of-voice

(A9), and desired strategies to promote adherence. The sessions lasted approximately 1.5 hours and were audio-recorded. We used the feedback and suggestions gathered in these co-creation sessions to improve the intervention concept.

The resulting intervention concept represented a smartphone application aimed at empowering patients with a low SEP during the waiting period, taking on average six weeks, preceding CR (see Figure 5.3). The concept utilizes a metaphor of going on a train journey, represented through a calendar-based progression system, which automatically marks the passage of days. The intervention provides daily messages consisting of introductory videos from different CR disciplines (e.g., cardiology, physiotherapy, dietetics), as well as spoken stories about experiences and successes of other cardiac patients and short textual messages providing actionable advice. Engagement with the messages is optional and not required to make progress in the intervention. By utilizing this playful metaphor, we aimed for a positive tone-of-voice (A.9) and with the daily, optional, manageable chunks of information we aimed to respect possible daily stressors of the target group (A.11). The messages were made comprehensible by avoiding difficult jargon and utilizing multimedia formats (A.12).

[redacted]
Bekijk de video waarin in mezelf voorstel

[redacted]
Bekijk mijn voorstel video

[redacted]
Bekijk mijn voorstel video

Figure 5.3 Visualization of the eHealth intervention, presenting the home page with daily messages (left) and the “done pile” indicating completed messages and progress toward the next goal (right).

Although engagement with the content was optional, we integrated persuasive gamification elements to encourage interaction (A.5). Completed messages are collected in a “done pile”, visualized as a travel bag, that symbolized progress. Achieving the fill-goals of this bag is rewarded with aesthetic upgrades (A.4), encouraging short-term goal attainment (A.1). In addition, we included a reminder notification in case of inactivity to prompt adherence (A.2). The intervention also provides contact information for technical support (A.14). To translate the concept into a working functional prototype that could be formatively evaluated, we worked together with a software development agency to develop the back-end functionality of the intervention. In addition, a trained user experience designer developed the front-end visual style and layout of the prototype to ensure good usability (A.15).

5.2.2.5 Phase three: Formative evaluation of intervention

We used the prototype to evaluate the acceptability of the intervention using a mixed methods approach. Quantitative measures were used to evaluate usability, user experience and perceived impact on the previously identified needs, while qualitative feedback was gathered to provide deeper insights into these constructs. The evaluations were performed individually with patients with a low SEP and took place at the same facility where they had their training sessions. The evaluations took approximately 45 minutes and were audio-recorded. We started with explaining the prototype, followed by instructing the participant to perform three key tasks within the interface. After this, we asked the participants to fill in short questionnaires about usability (based on the NASA TLX questionnaire (Hart, 2006)), user experience (containing usefulness and satisfaction based on the USE questionnaire (Lund, 2001)), and perceived impact of the intervention (designed for the purpose of this study and based on the previously identified needs) on a five-point Likert scale. After filling in the questionnaires we asked the participant to shortly explain their scores. We kept the questionnaire and questions short to keep the evaluation simple for the participant (E.5). We descriptively analyzed the Likert scale responses, including median and interquartile range (IQR). We also classified the Likert scores as negative (1 or 2), neutral (3), or positive (4 or 5) for each item and calculated the percentages of participants within each classification. For the qualitative data, we first transcribed the audio-recordings followed by a thematic analysis using ATLAS.ti.

5.2.3 Ethics and data management

This study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Human Research Ethics Committee of Delft University of Technology (approval numbers 1691 and 2157). Written informed consent was obtained from all study participants prior to their involvement in the study, and they were informed of their right to withdraw at any time. All data were pseudonymized, ensuring that personally identifiable information was replaced with unique identifiers. The study team ensured that all data were handled securely and in accordance with data protection laws and regulations. No conflicts of interest were identified.

5.3 Results

5.3.1 General guide application

Out of the 53 recommendations provided in the IeG, we applied 34 (64%) recommendations throughout the intervention design and design process. Nine (17%) recommendations were deemed not applicable as they pertained to the implementation and delivery of an existing intervention, which fell outside the scope of our project. Ten (19%) recommendations were not applied due to resource-related decisions, such as translating research materials into multiple languages or incorporating the social environment into the intervention. Below, we delve into the details of this application of the recommendations.

5.3.2 The design process: Lessons learned

In the thematic analysis, four themes emerged regarding challenges and solution strategies in the design process. The first challenge theme, *resource management* underscored the complexities of balancing the resource-intensive aspects of user involvement—such as logistics and trust-building—with other project requirements. The related *efficiency and flexibility* solution strategy theme revolves around a counterbalance by optimizing resource use and incorporating flexibility into the study design. For instance, we expanded our recruitment strategies to include former cardiac patients as well. The challenge theme, *stakeholder communication*, revealed the difficulties of maintaining consistent engagement with stakeholders across multiple locations. This challenge is related to the *participatory methods* solution strategy theme, which encompasses the involvement of stakeholders in participatory design processes, such as focus groups, to ensure sustained engagement. Two key lessons can be drawn from these themes: (1) Adopting a flexible and resource-efficient approach is essential, especially when the study demands extensive user involvement and (2) Utilizing participatory methods is crucial for sustaining active and consistent stakeholder engagement and shared understanding throughout the project.

5.3.3 The intervention design: lessons learned

In the design of the intervention, four major themes emerged concerning challenges and corresponding solution strategies. The first challenge centered on *personalization*, highlighting the need to consider variations in user preferences, physical abilities, and usage patterns. To tackle these issues, the theme of *adaptive design* revolves around solutions that focus on self-adaptive features or allow users to tailor the design, content, and tone to their specific needs. The second significant challenge pertained to the intervention's *limited functionality*. Given our constrained resources and the need for a user-friendly design, we included only essential features, which consequently reduced the intervention's overall functionality. The solution theme, *embracing simplicity,* suggests that the optimal approach is to start with a straightforward, usable app, avoiding the risk of overcomplicating it with unnecessary features. The main lessons learned are twofold: (3) Personalization of aspects of the design and content to be able to tailor the intervention to user needs, capabilities, and interaction styles is crucial for maximizing the intervention's alignment with the target group, and (4) Opting for a minimalist approach in the design, by concentrating on core functionalities and ease of use, helps to reduce resource expenditure and enhances user engagement.

5.3.4 Formative evaluation of intervention design

For our secondary research question regarding the formative acceptance of the intervention prototype, we found that participants generally rated the usability of the intervention positively (see Table 5.3). Six (86%) participants reported that it required a manageable level of *effort* and six reported it caused minimal *frustration*. All participants reported being positive about their performance in executing tasks. Five (72%) participants found the prototype *easy to use*. The participants did also identify a few minor usability issues. These included confusion about how to revisit completed messages and a lack of awareness of the scrolling functionality within the interface.

Furthermore, regarding the experience with using the intervention, the majority (57%) indicated they would have found it *useful* during their waiting period. The participants who did not think the intervention would be useful to them indicated a preference for face-to-face contact instead and not having a clear idea about the value of the content. Six (86%) participants expressed a high degree of *enjoyment* in using the intervention and six expressed a strong likelihood of recommending it to others. As a reason for this, the participants mentioned appreciating the playful nature of the interface, remarking that its engaging design fostered a positive, uplifted mood. Furthermore, they expressed a sense of anticipation and curiosity about the daily messages they would receive.

Five (71%) participants reported that the intervention would foster a sense of *certainty during waiting period* and five acknowledged that the *rehabilitation expectancy* could help them feel more certain about their situation. Some of these participants specifically expressed that the videos helped them to “see” what they could expect during the rehabilitation. However, the participants also expressed a preference for different delivery forms of information such as face-to-face interactions. Five (71%) participants found that the intervention could provide *pre-rehabilitation guidance* and four (57%) agreed that the intervention could improve their *physical activity confidence*. A minority (43%) of the participants reported that the intervention could help them with improving their *health status understanding*.

Table 5.3 Descriptive statistics of questionnaire responses of the formative evaluation.

Questionnaire item	Median (IQR)	Positive N (%)	Neutral N (%)	Negative N (%)
Usability	**4.5 (0.75)**	**6 (86)**	**1 (14)**	**0 (0)**
Ease of use	4.0 (1.5)	5 (72)	1 (14)	1 (14)
Effort	4.0 (1.0)	6 (86)	1(14)	0 (0)
Frustration	5.0 (0.0)	6 (86)	1 (14)	0 (0)
Performance	5.0 (1.0)	7 (100)	0 (0)	0 (0)
Experience	**5.0 (1.5)**	**5 (71)**	**2 (29)**	**0 (0)**
Usefulness	5.0 (2.0)	4 (57)	2 (29)	1 (14)
Aligns with needs	4.0 (2.0)	4 (57)	3 (43)	0 (0)
According to expectations	4.0 (1.5)	5 (71)	2 (29)	0 (0)
Enjoyable to use	5.0 (1.0)	6 (86)	1 (14)	0 (0)
Would recommend to a friend	5.0 (0.5)	6 (86)	1 (14)	0 (0)
Works like you would like to	4.0 (0.5)	5 (71)	2 (29)	0 (0)
Perceived Impact	**4.5 (1.25)**	**4 (57)**	**3 (43)**	**0 (0)**
Certainty during waiting period	4.0 (0.5)	5 (71)	2 (29)	0 (0)
Physical activity confidence	4.0 (1.5)	4 (57)	3 (43)	0 (0)
Rehabilitation expectancy	5.0 (1.5)	4 (57)	3 (43)	0 (0)
Managing emotions	4.0 (1.5)	5 (71)	2 (29)	0 (0)
Health status understanding	3.0 (1.5)	3 (43)	4 (57)	0 (0)
Pre-rehabilitation guidance	4.0 (1.5)	5 (71)	2 (29)	0 (0)

5.4 Discussion

5.4.1 Principal findings

Our study aimed to identify lessons learned regarding the application of the IeG within the intervention design and design process of an eHealth intervention for and with people with a low SEP within the context of CR. We found that the IeG proved instrumental in directing the design and design process of an eHealth intervention aimed at groups with a low SEP. Key lessons learned underline the necessity of a flexible and resource-efficient approach, the vital role of participatory methods in maintaining robust stakeholder engagement, the importance of including personalization features to ensure close alignment with the target group, and the need for a design that focuses on essential functionalities and ease of use to facilitate resource allocation and user acceptance.

Our study found that involving users and stakeholders at every project stage was crucial, as it facilitated the successful application of other recommendations, aligning interventions with participants' lifestyles and technology use, and maintaining stakeholder engagement. However, this participation, particularly from low-SEP groups, required significant resources—a common challenge in eHealth development for such populations (Lee et al., 2022). Despite our resource constraints, we focused exclusively on low-SEP populations in CR, effectively recruiting and retaining participants. We suggest that future projects should develop a clear, strategic plan and commit resources specifically for including participants with a low SEP, as their involvement might be overlooked in projects where they are not the primary focus.

We also found that usability was a key factor for the acceptance of our eHealth intervention. Ensuring good usability is especially crucial for low-SEP groups, as they face additional barriers like limited digital literacy (Lee et al., 2022). The high rating for usability could be attributed to the simplicity of the intervention. This approach aligns with the recommendations provided in the IeG, which advises against making interventions too complex. Some studies support the idea that complex, multi-component eHealth interventions with multiple behavior change techniques can be effective in realizing behavior change (Duff et al., 2017). This could indeed be beneficial to some users, as it allows users to engage with functionalities that fit best with their needs and interests. Yet, for some less digitally literate users, such interventions can often be overwhelming, by presenting the user with too many options (Michie et al., 2009). The simplicity of the intervention in this study may have made it easier for participants to engage with the content and complete the intended actions.

The study highlights several key improvements for the IeG. Firstly, the guide would benefit from a section suggesting different implications during its application. This section should highlight the importance of selectively and adaptively applying recommendations, tailored to the unique needs and contexts of specific projects, rather than rigidly adhering to, or trying to incorporate all recommendations indiscriminately. Furthermore, incorporating the recommendation table from this study as a downloadable resource would enhance the guide's utility. This table, which proved effective in our case study for organizing and evaluating the recommendations, could assist future researchers in similar tasks. Lastly, the study identifies three recommendations as particularly impactful: engaging the target group (D.1), allocating time and resources to reach them (R.12), and prioritizing usability (A.15). These were especially significant due to their direct relation to the lessons learned in the study. We suggest refining the IeG to elevate these recommendations to main principles. This approach could potentially extend their relevance beyond this specific case study to inclusive eHealth design in general. However, their broader applicability should be validated through future case studies in various contexts.

5.4.2 Strengths and limitations

While the evaluation of the intervention was limited by its small sample size and lack of a direct comparison group with an intervention developed without the IeG, the initial positive reception in a typically hard-to-reach population may indicate a beneficial influence of the guide. We should note that this should be interpreted with caution. Future studies could strengthen these findings by directly comparing interventions developed with and without the IeG. Moreover, the intervention evaluation was limited to a brief interaction with a prototype rather than a full-scale intervention. The effectiveness of the intervention in a real-world setting remains untested. Our future research agenda includes a pilot evaluation where the intervention will be implemented on a small scale, providing a more comprehensive understanding of its feasibility, acceptance, and potential effectiveness.

The pre-existing experience and engagement of the investigator with the contents of the IeG and the level of empathy toward the target group play a crucial role in the application process of the guide and the design process of the intervention respectively. Having been deeply involved with the target group for two years prior to this study as well as the development of the IeG, the level of empathy and intuition of the first author should be considered regarding the shaping of the guide application, intervention design, and design process. This level of engagement may have yielded a more nuanced understanding of the target group's needs and preferences and may have influenced the utilization and positive evaluation of the guide. This therefore raises the question of whether professionals with less immersion or experience will utilize the guide in the same manner. While this initial exploration is an important first step, it also underscores the need for further research into the experiences of other professionals using the guide in other settings and addressing other target groups.

5.5 Conclusion

This study evaluates how the IeG can be applied in the intervention design and design process of an eHealth intervention targeting cardiac patients from low socio-economic backgrounds. Key lessons emphasize the need for a flexible, efficient approach, strong stakeholder engagement through participatory methods, personalization to align with the target group, and a user-friendly design focusing on core functionalities for better resource use and acceptance. This research serves as an initial step toward making existing knowledge on inclusive eHealth design more actionable and impactful.

CHAPTER 6

Feasibility and effects of an eHealth intervention to support patients with a low socioeconomic position during their waiting period preceding cardia rehabilitation

Building upon the development of the Inclusive eHealth Guide, this chapter delves into its practical application. Given its adaptability to different contexts, project goals, and professionals, it is essential to test and refine the guide by implementing it in real-world situations. As a start, this chapter presents a case study on designing an eHealth intervention for individuals with low socioeconomic position (SEP) in the context of cardiac rehabilitation (CR). During this study, we identified the need of patients with a low SEP to feel more certain and guided during their waiting period preceding CR. In response, we developed a tailored eHealth intervention with the target group to address this need. Implementing the guide during this project yielded four key lessons learned that could guide future designers in similar case-specific applications: the need for resource management, the value of participatory methods, and the importance of personalization and simplicity in eHealth design.

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All research data and code supporting the findings described in this chapter are available in 4TU.Centre for Research Data at 10.4121/c7e2a63a-9699-4d7c-9cbb-9ac443400033

Abstract

Background | Cardiac rehabilitation (CR) shows lower effectiveness and higher dropouts among people with a low socioeconomic position (SEP) compared to those with a high SEP.

Objective | This study evaluated an eHealth intervention aimed at supporting patients with a low SEP during their waiting period preceding CR.

Methods | Participants with a low SEP in their waiting period before CR were randomized into an intervention group, receiving guidance videos, patient narratives, and practical tips, or into a control group. We evaluated adherence (usage metrics), acceptance (modified USE questionnaire), and changes in feelings of certainty and guidance between the waiting period's start and end. Semi-structured interviews provided complementary insights.

Results | The study involved 41 participants (median (IQR) age 62 (14) years; 33 males), with 21 participants allocated to the intervention group, using the eHealth intervention for a median (IQR) duration of 16 (10) days, using it on a median (IQR) of 100% (25) of these days, and viewing 88% of the available messages. Key adherence themes were daily routine compatibility and curiosity. Acceptance rates were 86% for usability, 67% for satisfaction, and 43% for usefulness. No significant effects on certainty and guidance were observed, but qualitative data suggested that the intervention helped to inform and set expectations.

Conclusion | The study found the eHealth intervention feasible for cardiac patients with a low SEP, with good adherence, usability, and satisfaction. However, it showed no effect on feelings of certainty and guidance. Through further optimization of its content, the intervention holds promise to improve emotional resilience during the waiting period.

6.1 Introduction

Cardiac rehabilitation (CR) is a multicomponent lifestyle intervention that includes information and coaching on healthy behavior and supervised exercise training (Nederlandse Vereniging voor Cardiologie, 2011; Piepoli et al., 2016). CR is crucial for cardiac patients to prevent secondary health problems and decrease mortality rates. It has been shown to improve patient outcomes like physical fitness and health-related quality of life (Eijsvogels et al., 2020). However, the effectiveness of CR is not uniformly experienced. Specifically, individuals with a low socioeconomic position (SEP) often show lower participation rates in these programs and drop out more frequently (Ades et al., 2022; Harlan et al., 1995; Valencia et al., 2011). This disparity can be attributed to various barriers to participation (Shanmugasegaram et al., 2013), such as stressful life situations (Marmot, 2005), environmental accessibility issues (Coupe et al., 2018), inadequate social support (Moroshko et al., 2011), stigma and distrust in healthcare (Armstrong et al., 2007), and low health literacy (Paasche-Orlow & Wolf, 2007). Due to these disparities, CR is not fully benefitting patients with a low SEP, underscoring the need for solutions to make CR more inclusive and accessible.

Our previous research highlights an opportunity to address the barriers faced by cardiac patients, especially those with a low SEP, during the waiting period between hospital discharge and the start of CR(Faber et al., 2023a). This waiting period lasts, on average, six weeks (Fell et al., 2016). It is marked by emotional vulnerability and uncertainty, as patients often leave the hospital with unmet informational needs about their condition and self-care (Barnason et al., 2012; Keessen et al., 2022; Mai Ba et al., 2020; Sunamura et al., 2017). The absence of adequate guidance during the waiting period, exacerbated by the initial shock of diagnosis or surgery, leads to a passive patient attitude (Lie et al., 2012; Neubeck et al., 2012; Timmins & Kaliszer, 2003) and a disjointed transition between healthcare settings (Coleman et al., 2006). Patients with a low SEP feel this lack of guidance more strongly. Their additional challenges increase their vulnerability and uncertainty during the waiting period (Liao et al., 2022). As a result, this group is less likely to adopt the necessary "readiness" to successfully engage with CR. This leads to lower participation and higher dropout rates during CR (Clark et al., 2012; Rao et al., 2020).

eHealth interventions are a promising strategy to overcome barriers that arise during the waiting period. They can better prepare cardiac patients with a low SEP for CR. For example, these interventions can fill the existing information and guidance gap by leveraging online information platforms (Keessen et al., 2022) and goal-monitoring tools (Su & Yu, 2021). Due to rising healthcare costs, addressing these needs through face-to-face sessions during the waiting period may not be feasible (Goryakin et al., 2020;

Manteghinejad & Javanmard, 2021; Moro Visconti & Morea, 2020). In theory, eHealth interventions offer a cost-effective alternative to face-to-face sessions (Frederix et al., 2017; Kraal et al., 2017; Manteghinejad & Javanmard, 2021; Moro Visconti & Morea, 2020; Scherrenberg et al., 2020). However, in practice, people with a low SEP often do not adhere to these interventions due to low technology access, low digital literacy, and other life priorities (Arsenijevic et al., 2020; Reiners et al., 2019). The success of these interventions depends on tailoring them to the specific needs, abilities, and preferences of this group (Kerkhoff et al., 2022).

We recently developed the Inclusive eHealth Guide (IeG) to support the design of tailored eHealth interventions according to the specific needs of individuals with a low SEP (Faber & Al-Dhahir et al., 2023). The guide combines existing knowledge on barriers and facilitators in eHealth development for individuals with a low SEP (Al-Dhahir et al., 2023). It considers, amongst others, the target group's context, needs, preferences, and skills (Faber et al., 2021). We applied the IeG in a participatory design process of an eHealth intervention specifically for and with cardiac patients with a low SEP. The intervention addresses their needs during the waiting period before CR (Faber et al., 2023a).

This study aimed to evaluate the feasibility of this eHealth intervention tailored toward CR patients with a low SEP in the domains of adherence and acceptance. Additionally, it explored the effects of the eHealth intervention on feelings of certainty and guidance, factors associated with changes in these constructs, and dropout rates during subsequent CR.

6.2 Methods

6.2.1 Study design

The feasibility study was executed between February 2023 and September 2023 at Capri Cardiac Rehabilitation, a CR center with sites in Rotterdam and The Hague (The Netherlands). The participants were randomized to an intervention group and control group, and outcomes were assessed at the start and end of the waiting period before CR started.

6.2.2 Recruitment

Eligible participants were adults aged 18 or above living in a low-SEP neighborhood, referred to CR by their cardiologist, able to understand Dutch (with assistance), and had a mobile device with internet access. Postal codes of potential participants were sent to the principal investigator (JF) to assess neighborhood SEP, based on the neighborhood residents' average income and education levels. We used a list of 40 neighborhoods identified by the Dutch government for their socioeconomic challenges as a benchmark (Minister voor Wonen Wijken en Integratie, 2007). A representative from the CR center first contacted potential participants for consent. Interested patients were then contacted by the investigator (JF), who explained the study. If they agreed to participate, they received an information letter and had an appointment scheduled for the initial assessment.

6.2.3 Measures

6.2.3.1 Adherence

Adherence to the intervention was measured using the metrics (1) *use period length*: the number of days between the first and last day the intervention was used; (2) *percentage of active days*: percentage of days the intervention was used; (3) *daily use time*: average time spent on the intervention per active day within the use period, and (4) the *total number of viewed messages*.

6.2.3.2 Acceptance

Acceptance was measured using a modified Usefulness, Satisfaction, and Ease of use (USE) questionnaire. The original USE questionnaire consists of 30 items on a 7-point Likert scale focusing on usefulness, satisfaction, ease of use, and ease of learning (Lund, 2001). In alignment with the specific needs and challenges faced by our target population of individuals with a low SEP, we recognized that lengthy questionnaires often lead to disengagement among this group (Bonevski et al., 2014). Therefore, we adapted the original questionnaire to a more manageable version with only 9 of the original items (3 per category) on a 5-point Likert scale, focusing on usefulness, satisfaction, and ease of use (see Supplementary Appendix 1). The questions retained were chosen for their relevance to the unique context and goals of the current intervention.

6.2.3.3 Certainty and guidance and influencing factors

We developed the Certainty and Guidance Questionnaire (CGQ), consisting of 7 items measured using a 5-point Likert scale, for use in this study (see Supplementary Appendix 1). High scores indicate good certainty and guidance. The questionnaire focuses on patient needs identified in a previous study (Faber et al., 2023a). These needs include feeling certain during the waiting period, confidence to be physically active, managing expectations about the contents of CR, good management of emotions, the feeling of hope for future recovery, understanding the current health status and feeling guided before the start of CR. The questions are derived from existing scales, including the Motivation for Traumatic Brain Injury Rehabilitation Questionnaire (MOT-Q) for motivation (Chervinsky et al., 1998), the Patient Evaluation of Emotional Comfort Experienced (PEECE) for experienced emotional comfort (Williams et al., 2017), and the Credibility and Expectancy Questionnaire (CEQ) for expectancy and credibility (Devilly & Borkovec, 2000) to strengthen the validity of our measurements. Finally, to better understand the factors influencing changes in feelings of certainty and guidance, we explored associations between age, education level, length of waiting period, baseline level of CGQ, and the change in CGQ scores in both the intervention and control group.

6.2.3.5 Qualitative insights

In line with our mixed-methods approach, we complemented the quantitative data for adherence, acceptance, and feelings of certainty and guidance with qualitative insights collected with semi-structured interviews. We asked questions relating to reasons for adherence (e.g., Why did or did you not succeed in using the intervention daily?), acceptance (e.g., What was your experience with using the intervention?) and effects on feelings of certainty and guidance (e.g., How has the intervention been able to help you the most during the waiting period?). See Supplementary Appendix 2 for the full interview guide.

6.2.4 Procedures

We performed assessments in both study groups during two contact moments: initially upon enrollment in CR (T_1) and again just before the CR program began, usually 2-8 weeks after T_1 (T_2) (See figure 1). At T_1, participants were briefed on the study, signed consent forms and completed demographic and CGQ questionnaires. The intervention group received additional information about the smartphone app and help installing it. At T_2, both groups completed a second CGQ questionnaire, with the intervention group also submitting usage data, filling out an acceptance questionnaire and participating in a phone interview. Participants received a 20-euro gift voucher for their participation.

6.2.5 Intervention

The CapriXpress application is a tailored digital intervention developed to support patients with a low SEP during their waiting period between discharge from the hospital and the start of their CR. This intervention was co-designed in a participatory design study with the target group (Faber et al., 2023a). The CapriXpress application addresses the need for certainty and guidance for people with a low SEP during their waiting period. To enhance patient adherence and acceptance of the intervention, we ensured that the intervention is grounded in established theoretical frameworks, namely the Taxonomy of Behavior Change Techniques (BCT) (Michie et al., 2013) and the Persuasive Systems Design model (PSD) (Oinas-Kukkonen & Harjumaa, 2009) (see Table 1). Combining the two frameworks is valuable as it combines the rigor of scientifically validated methods for behavior change with engaging, user-focused aspects of persuasive technology design (Asbjornsen et al., 2020). Additionally, the intervention integrates recommendations derived from our previously developed IeG (Faber & Al-Dhahir et al., 2023), which served as a foundational resource (see Table 1).

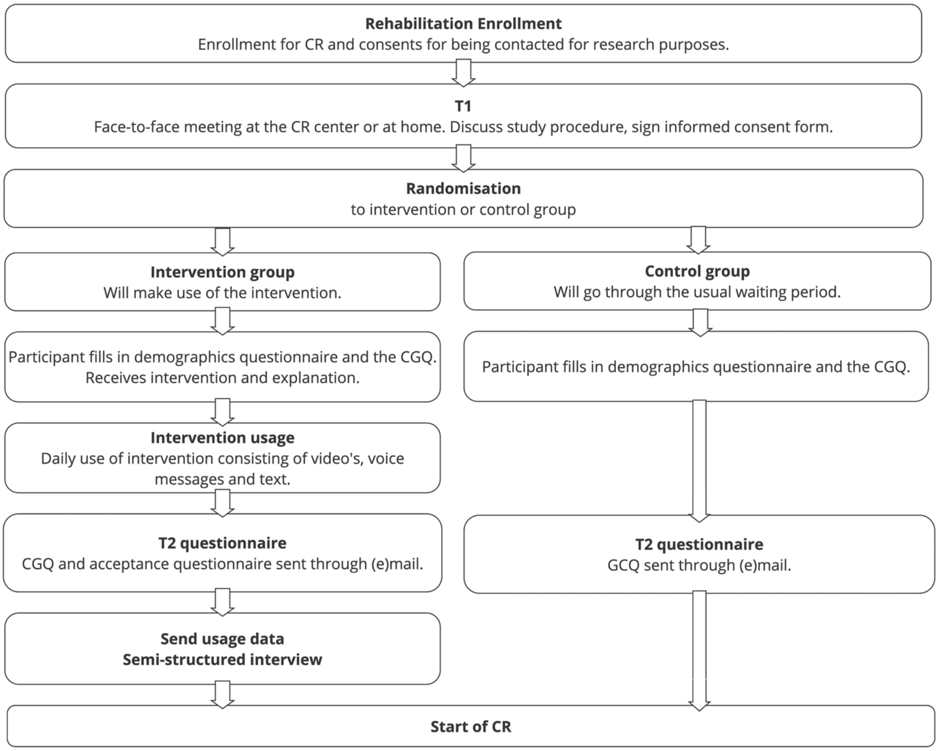


Figure 6.1 A visual overview of patient enrollment and study procedures. CR = Cardiac Rehabilitation, CGQ = Certainty and Guidance Questionnaire.

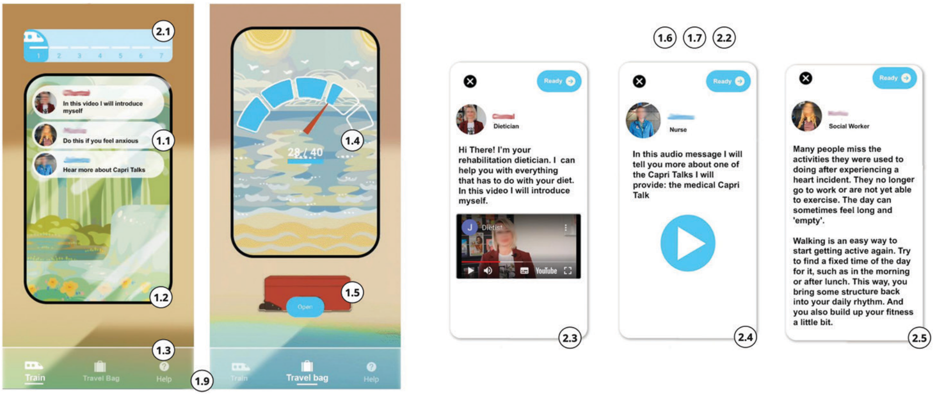
The content of the CapriXpress application is divided into concise, manageable units, with a limited number of messages presented per day (Figure 2, 1.1). The interface is designed to be playful, aesthetically pleasing, and simple to understand (Figure 2, 1.2 and 1.3). A “travel bag” feature stores completed messages, giving patients a sense of achievement. When the bag is filled to a certain level, it receives an aesthetic upgrade as a reward (Figure 2, 1.4 and 1.5). The information is primarily conveyed through multimedia formats and is articulated in easily understandable language, adopting a positive tone (Figure 2, 1.6). A push notification is sent if the participant has not engaged with the intervention for two consecutive days. The “help” section provides contact information for research or application-related questions (Figure 2, 1.9).

Several intervention features have been implemented to address the target group's needs during the waiting period. The application uses a calendar-based train journey metaphor to symbolize the patient's progression toward the start of cardiac rehabilitation (CR) (Figure 2, 2.1). This progression occurs automatically over time, aiming to provide a sense of certainty during the waiting period. The app delivers a total of 43 multimedia messages, defaulting to three per day, with the frequency adjusting based on the patient's specified CR start date. Patients can choose from three message types: introductory videos from healthcare providers like a physiotherapist, dietitian, and psychologist to inform and connect with the CR team (Figure 2, 2.3); audio narratives from former patients to offer emotional support and hope (Figure 2, 2.4); and actionable advice promoting healthy activities and improving understanding of their condition and the rehabilitation process (Figure 2, 2.5).

Table 6.1 Intervention features that address adherence and acceptance, linked to principles from the IeG, BCT and PSD framework, and features that address patient needs as identified in our prior study.

Features addressing adherence and acceptance				
#	**Feature**	**IeG* recommendation**	**BCT****	**PSD*** Principle**
1.1	Limited number of daily messages	Realistic, achievable goals, align with life situation	Graded tasks	Reduction
1.2	Playful interface	Positive approach		Liking
1.3	Simple interface	Simplicity		Reduction
1.4	Done pile tracker	Short-term goals, apply gamification	Self-monitoring /Feedback	Self-monitoring
1.5	Bag upgrade	Reward for adherence, apply gamification	Non-specific reward	Rewards
1.6	Use of multimedia and simple language	Simplify communication		Tailoring
1.7	Tone-of-voice	Positive approach		
1.8	Notification	Send reminders		Reminders
1.9	Support page	Offer technical support		
Features addressing patient needs				
#	**Feature**	**Needs**		
2.1	Calendar-based progression	Certainty during waiting period, pre-CR guidance		
2.2	Information provided by healthcare provider	Certainty during waiting period, pre-CR guidance		
2.3	Video introductions	Certainty during waiting period, CR expectancy		
2.4	Spoken peer stories	Certainty during waiting period, managing emotions, future recovery		
2.5	Textual advice	Physical activity confidence, Health status understanding		

*Inclusive eHealth Guide (IeG) (Faber & Al-Dhahir et al., 2023), **Behaviour Change Technique (BCT) taxonomy (Su & Yu, 2019), and ***Persuasive System Design (PSD) model (Oinas-Kukkonen & Harjumaa, 2009)



[redacted]
In this video I will introduce myself

[redacted]
Do this if you feel anxious

[redacted]
Hear more about Capri Talks

[redacted]
Hi There! I'm your rehabilitation dietician. I can help you with everything that has to do with your diet. In this video I will introduce myself.

[redacted]
In this audio message I will tell you more about one of the Capri Talks I will provide: the medical Capri Talk

[redacted]
Many people miss the activities they were used to doing after experiencing a heart incident. They no longer go to work or are not yet able to exercise. The day can sometimes feel long and 'empty'.

Walking is an easy way to start getting active again. Try to find a fixed time of the day for it, such as in the morning or after lunch. This way, you bring some structure back into your daily rhythm. And you also build up your fitness a little bit.

Figure 6.2 Key interface screens from the CapriXpress intervention. From left to right: Journey-based progression home page, done-pile tracker and travel bag, and multimedia messages from healthcare professionals.

6.2.6 Data analysis

We analyzed our quantitative data in RStudio (Version 2023.06.0, Posit Software, PBC). We utilized medians, interquartile ranges (IQR), and non-parametric statistical tests to ensure robustness and minimize assumptions about data distribution, given our limited sample size. The level of significance was set at p £ 0.05.

We transformed the raw intervention usage data into specific metrics to evaluate adherence. We calculated the use period length from the first day of use (T1) to the last completed message. The percentage of active days was determined by dividing the number of days the intervention was used by the total use period length. Daily use time was derived by summing the duration of all visits and dividing it by the number of active days. We also totaled the number of viewed messages. Adherence was considered satisfactory if participants used the intervention on at least half the days and viewed more than half the available messages.

To analyze the acceptance from the adapted USE questionnaire, we classified the Likert scores as negative (1 or 2), neutral (3), or positive (4 or 5) and calculated the percentages of participants in each category. We then calculated individual scores for usability, usefulness, and satisfaction and determined the median, IQR, minimum and maximum scores for these metrics across intervention group participants. Overall acceptance was similarly assessed using these statistics. For this prototype, a score was deemed good if over 60% of the participants rated it positively.

To assess the intervention's effect on certainty and guidance during the waiting period, we calculated the median Likert scores for the CGQ items for each participant and determined group medians for both the intervention and control groups. Wilcoxon rank-sum and Mann-Whitney U tests were used to assess within- and between-group differences, respectively. Rank correlation tests examined the relationship between changes in CGQ scores and factors such as age, education level, initial CGQ scores, and waiting period length. Fisher's exact test was used to analyze differences in dropout rates.

For the qualitative data, we performed a thematic analysis (Braun & Clarke, 2006) using ATLAS.ti (Version 9.1.3, ATLAS.ti Scientific Software Development GmbH). Interviews were transcribed verbatim, followed by coding individual quotations and corresponding interpretations. These codes were then grouped into overarching themes related to the outcome measures, such as adherence, acceptance, and impact on feelings of certainty and guidance.

6.2.7 Ethics and data management

This study adhered to the Declaration of Helsinki principles and was approved by the Medical Ethics Committee of Erasmus MC (MEC-2022-0483) and registered in clinicaltrials.gov (NCT05698121). Written informed consent was obtained from all study participants.

6.3 Results

6.3.1 Participants

Out of the 835 patients referred to the CR center during the recruitment period (January 2023 to June 2023), 149 patients (18%) were eligible, of which 42 patients (28%) consented to participate. Frequently reported reasons for non-participation were personal circumstances, logistical issues, lack of interest, technological barriers, and language and cognitive barriers. Twenty-one participants were assigned to the intervention group and 21 to the control group (see Figure 6.3). One participant in the control group dropped out during the study due to the burden of participation. Eighteen participants from the intervention group participated in a semi-structured interview and 19 participants from the intervention group sent their usage data for the adherence analysis. The majority of the sample was male (80%), with a median (IQR) age of 62 (14) years. Ischemic heart disease was the most common condition (63%). The median (IQR) waiting time from hospital discharge to the start of CR was 55 (43) days and 29 (13) days from enrollment at the CR facility to the beginning of the program. See Table 6.2 for more details.

Table 6.2. Participant characteristics.

Characteristic	**Intervention Group (n = 21)**	**Control Group (n = 20)**	**Sample (n = 41)**
Demographics			
Male, n (%)	17 (81)	16 (80)	33 (80)
Age (years), median (IQR)	63 (13)	59 (13)	62 (14)
Low education, n (%)	15 (71)	18 (90)	33 (80)
Employed, n (%)	4 (19)	6 (30)	10 (25)
Unemployed, n (%)	1 (5)	2 (10)	3 (7)
Retired, n (%)	11 (52)	7 (35)	18 (44)
Unfit for work, n (%)	5 (24)	5 (25)	10 (24)
Medical history, n (%)			
Ischemic Heart Disease	15 (70)	11 (55)	26 (63)
Cardiac Arrhythmia	2 (10)	1 (5)	3 (7)
Other, cardiac disease	4 (20)	7 (35)	11 (27)
Other, non-cardiac disease	0 (0)	1 (5)	1 (3)
Waiting time in days, median (IQR)			
Hospital Discharge – Start CR	66 (31)	43 (32)	55 (43)
Enrollment CR – Start CR	28 (13)	29 (11)	29 (13)

6.3.2 Adherence to the intervention

The median (IQR) *use period length* was 16 (10) days. During this period, the median (IQR) percentage of the days the participants accessed the application was 100% (25), with a median (IQR) *daily use time* of 4 (2) minutes. Sixty-seven per cent of the participants opened the application every day. Regarding content interaction, the median (IQR) *total number of messages viewed* was 38 (24) out of 43. Half of the participants viewed all the messages available. Figure 4 presents the relationship between the number of days since first usage and the cumulative messages completed by participants. The trend line shows continuous completion of messages over time with a slight decrease in the number of messages completed each day after approximately 2 weeks. Two qualitative themes related to these adherence patterns emerged (see Supplementary Appendix 3 for a complete overview of the qualitative themes). First, almost three-quarters of the participants stated that the intervention aligned well with their daily routines. As one participant expressed:

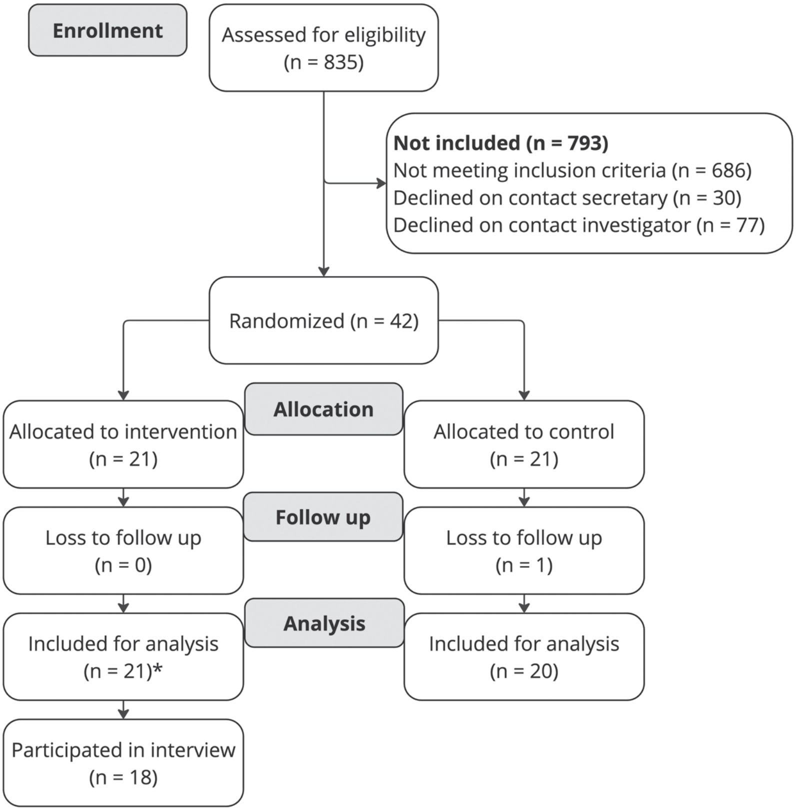


Figure 6.3 Flowchart participant inclusion. *19 participants sent their usage data and were included for the adherence analysis

> *"We used to sit in the morning for coffee. Yeah, we would sit down for a while, and I received them [the messages], and then I had my phone in my hand. Well, I went through it; I even turned it on so that the lady could listen along and that way. Yeah, it's also at a fixed time. You have to be careful not to leave it for a whole week and then review it after a week. Because that will not work, I think. If you throw everything together, it is just a matter of sifting through it and fulfilling a duty." [Male, 73]*

Second, we found that more than half of the interviewed participants cited curiosity as their driving factor for usage. As one participant stated:

> *"I was curious about it every day. I also opened it every day. I went through the entire program. I was, well, actually, looking forward to seeing what news they had to say today. Yeah, it was actually more curiosity." [Male, 69]*

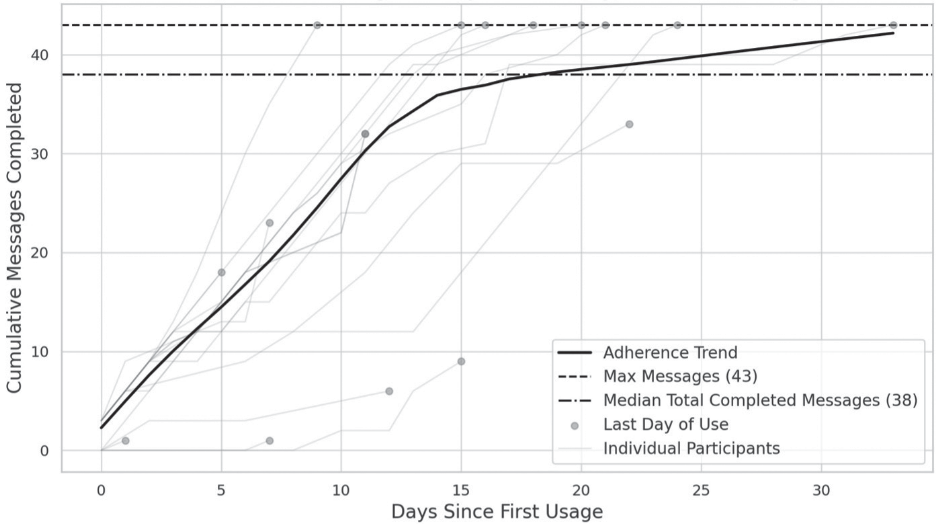


Figure 6.4 Cumulative messages completed vs days since the first usage (Median ± IQR).

6.3.3 Acceptance of the intervention

Seventy-one per cent of the participants displayed overall positive acceptance. We found that 86% of the participants were positive about the intervention's usability, and 67% were satisfied. Forty-three per cent felt that the intervention was useful for them (see Table 3 for a complete overview of the acceptance scores). Within the qualitative data, we found that participants mainly appreciated the *ease of use* and the *playful interface*. As one participant expressed:

> *"Well, you know, I found it enjoyable. It's more enjoyable than just a boring list or something, you know. Yeah, it's funny that they thought of it like, oh yeah, let's pretend it's a journey. With your stories in a suitcase, very amusing. You're on a journey to your rehabilitation." [Female, 60]*

We also found qualitative themes that related to the usefulness. More than half of the participants suggested the need for more *personally relevant information* better aligned with their health concerns and the severity of their conditions. As one participant expressed:

> *"All those social workers and such... For me, I think it's not interesting. I only do it to become physically well. That's my goal. I don't think I have any other issues. I think the app is limited in that aspect." [Male, 76]*

Additionally, approximately half the participants suggested a need for *additional depth and detail* in the provided information. As one participant expressed:

> *"The dietitian gave a very brief explanation of what she does. […] But she didn't really delve into the topic. For example, what can you tell about your sugar or salt levels being too high? What are the consequences of that? Could you get paralysis? Could you have a heart attack? So, the information was lacking, in my opinion." [Male, 63]*

Table 6.3. Overview of acceptance scores, displayed as medians, IQRs and percentages of participants in the categories positive, neutral, and negative on usability, satisfaction, and usefulness.

Question	Median (IQR) Min – Max	Positive (4-5) n (%)	Neutral (3) n (%)	Negative (1-2) n (%)
Overall	**3.8 (0.8) 2.7 – 5.0**	**15 (71)**	**6 (29)**	**0 (0)**
Usability	**4.0 (1.0) 2.7 – 5.0**	**18 (86)**	**3 (14)**	**0 (0)**
Is easy to use	4 (1) 3 – 5	18 (86)	3 (14)	0 (0)
Required no effort	4 (1) 2 – 5	19 (90)	1 (5)	1 (5)
Allowed to perform well	4 (2) 2 – 5	15 (71)	5 (24)	1 (5)
Satisfaction	**4.0 (0.7) 2.3 – 5.0**	**14 (67)**	**6 (28)**	**1 (5)**
Is fun to use	4 (1) 3 – 5	14 (67)	7 (33)	0 (0)
Would recommend to others	4 (1) 2 – 5	18 (85)	2 (10)	1 (5)
Aligns with needs	4 (1) 1 – 5	14 (67)	3 (14)	4 (19)
Usefulness	**3.3 (1.0) 2.3 – 5.0**	**9 (43)**	**10 (47)**	**2 (10)**
Is useful	4 (1) 3 – 5	13 (62)	8 (38)	0 (0)
Aligns with needs	3 (1) 2 – 5	7 (33)	11 (52)	3 (15)
Aligns with expectations	4 (1) 2 – 5	11 (52)	6 (29)	4 (19)

6.3.4 Effects on certainty and guidance

We found no significant changes in CGQ scores between T_1 and T_2 in both the intervention (Δ = - 0.14 (IQR 0.57), p = 0.94) and control group (Δ = -0.07 (IQR 0.32), p = 0.51). In addition, we did not find a significant difference in the changes in CGQ scores between the two groups (p = 0.51).

The qualitative data highlighted areas that did address improvements in feelings of certainty and guidance during the waiting period. Participants suggested that the intervention improved their expectancy about the CR, as one participant mentioned:

> *"You know, when all those people introduced themselves and told stories about different participants. Yeah, that was nice because you know beforehand what to expect when you start the rehabilitation. So, that was quite pleasant." [Male, 73]*

In addition, it helped them to feel generally better informed about their current condition by providing additional knowledge they usually would not receive. As one participant expressed:

> *"I received a lot of information that I wouldn't normally get. If you haven't had a heart attack, you don't even think about all the information you've received. So, for me, it was a kind of recognition. And it was very good. So, as I said, it made me wise." [Male, 63]*

Finally, the participants highlighted the intervention helped to reduce uncertainties by providing guidance during the waiting period gap. As expressed by one participant:

> *"Well, in terms of reducing uncertainties, the app did help me because if you didn't have that app, you would fall into a void between being discharged from the hospital and starting rehabilitation. So, in that sense, the app was able to provide assistance in filling that void at some point." [Male, 74]*

6.3.5 Factors associated with the effect on certainty and guidance

The length of the waiting period had a significant negative correlation with the change in CGQ score in the control group ($\rho = -0.51$, $p = 0.02$) but not in the intervention group ($\rho = -0.04$, $p = 0.86$). In addition, higher CGQ scores at T_1 were negatively correlated with changes in CGQ scores in both the intervention group ($\rho = -0.56$, $p = 0.01$) and the control group ($\rho = -0.49$, $p = 0.03$). Age and education were not significantly correlated with changes in CGQ scores in both intervention ($p = 0.16$ and $p = 0.26$, respectively) and control ($p= 0.94$, $p = 0.66$, respectively) group.

6.3.6 Effects on dropout during CR

Two (10%) of the participants dropped out of the subsequent CR program in the control group compared to none in the intervention group. This difference was, however, not significant ($p = 0.23$).

6.4 Discussion

6.4.1 Principal findings

In this study, we evaluated the feasibility and explored the effects on feelings of certainty and guidance and on dropouts of a newly developed eHealth intervention for CR patients with a low SEP during their waiting period before starting a CR program. We found good adherence with the participants often using the intervention daily and engaging with 88% of the messages. Most participants (71%) displayed positive overall acceptance of the intervention. However, only 43% were positive about usefulness. The intervention did not affect feelings of certainty and guidance (CGQ) or dropout rate. However, while the length of the waiting period was negatively associated with feelings of certainty and guidance in the control group, no such association was observed in the intervention group. Qualitative feedback suggested that the intervention had helped participants to set expectations and be better informed about their condition and CR journey.

Usage data indicated consistent adherence over time, although there was a slight reduction in daily message interactions after the first two weeks. This decrease aligns with the intervention's dynamic content distribution system, which recalibrates the frequency of messages once participants enter their CR start dates. When the starting date is further in the future, the system automatically reduces the number of messages provided daily to extend the usage period. Despite this, continued message views suggest sustained adherence, which contrasts with the relatively low eHealth adherence often observed in people with a low SEP (Arsenijevic et al., 2020; Reiners et al., 2019). Many participants cited the intervention's integration into daily routines as crucial. Past studies indicate that individuals with a low SEP often face stressful daily challenges, limiting their time and cognitive capacity for engaging with eHealth interventions (Crielaard et al., 2021).

Additionally, curiosity was reported as a key factor in the patient's adherence to the intervention, aligning with the gamification theory that presents curiosity as a strategy to enhance engagement with a system (Chou, 2015). This facet of the intervention might have been an important contributor to the observed adherence. Regarding acceptance, the intervention's well-received usability contrasts with findings in existing literature. Typically, individuals with a low SEP encounter more challenges with the usability of eHealth interventions (Choi & Dinitto, 2013; Estacio et al., 2019; Kontos et al., 2014; Yao et al., 2022). The intervention's consistent adherence and positive overall acceptance could be attributed to its participatory design, which followed the IeG's recommendations for equitable eHealth development. Failing to achieve adherence and acceptance could negatively influence overall effectiveness, irrespective of any inherent benefits of the intervention (Venkatesh et al., 2003). Given our promising outcomes on adherence and acceptance, we recommend future researchers to apply the IeG and engage in tailored participatory approaches to develop eHealth interventions for individuals with a low SEP in different settings.

While we did not find a significant intervention effect in this feasibility study on feelings of certainty and guidance or dropout in subsequent CR, we did find some trends pointing toward potential intervention effects. First, the qualitative findings suggest that the participants felt that the intervention contributed to their feelings of certainty and guidance. The interview results suggested improved expectations for future CR, better information, and guidance during the waiting period. These insights hint at the intervention enhancing participant readiness and motivation for CR. Second, the finding that the length of the waiting period was negatively associated with the change in feelings of certainty and guidance in the control group but not in the intervention group suggests that the intervention could serve as an emotional buffer for patients facing longer waiting periods. Qualitative feedback further supports this, with participants reporting that the intervention helped to set expectations and provide information regarding their rehabilitation journey. Although it did not directly improve certainty and guidance, the intervention might have fostered a sense of readiness for rehabilitation by giving information and early engagement with the program. In future versions of the intervention, its content should be focused more directly on improving the patient's feeling of certainty and guidance. Lastly, although the difference in dropout rates between the intervention and control group was not significant, the 10% dropout rate in the control group is consistent with the general dropout rate in CR (Brouwers et al., 2021). The absence of dropouts in the intervention group could suggest that the intervention may have boosted participant's commitment to CR. This should, however, be confirmed in a sufficiently powered trial.

Our study found participants preferred more personally relevant content and additional depth and detail in information. This suggest that the intervention's one-size-fits-all approach may not meet varying needs for content depth and relevance. This desire for personalized content also aligns with previous research findings (Tenbult-Van Limpt et al., 2022; Yates et al., 2018). Personalized information, as opposed to generic information, has demonstrated a greater positive impact on wellbeing (Doets et al., 2019), health plan decision making (Kaufmann et al., 2018), and lifestyle behavior (Tong et al., 2021). Within CR, several studies have shown to be effective that employed dynamic personalization techniques, such as using initial screenings (van den Brekel-Dijkstra et al., 2016) or artificial intelligence algorithms to adapt the content and delivery in real-time based on user's interactions and responses (Aharon et al., 2022; Doets et al., 2019). Future research could explore developing personas or patient profiles reflecting diverse content needs based on health concerns, condition severity, and motivation (Vosbergen et al., 2015). These profiles would guide the creation of tailored pathways for pre-cardiac rehabilitation content, accommodating different patient types during their waiting period. Pathways may vary by exercise difficulty aligned with disease severity and information delivery adjusted to individual knowledge and health literacy levels.

6.4.2 Strengths and limitations

This feasibility study lays the groundwork for designing effective interventions for patients with a low SEP during their waiting period before starting CR. Such studies are essential for refining intervention designs to improve impact when scaled up (Skivington et al., 2021). A strength of our research is the mixed-methods approach, which offered insightful explanations for our findings and laid a foundation for future research and development. Additionally, it is noteworthy that we have maintained a participant retention rate similar to other trials conducted at Capri Cardiac Rehabilitation (den Uijl et al., 2023; Ter Hoeve et al., 2018), despite our emphasis on people with a low SEP, who are typically underrepresented in these earlier trials.

While our study provides important exploratory insights, the results should be approached with caution and seen as suggestive rather than conclusive. It is important to consider the small sample size and single-center data collection when interpreting these findings, as the limited sample size particularly affects the robustness of the p-values. While our use of a self-designed questionnaire may have affected validity, we mitigated this by basing our questions on established instruments and employing a mixed-methods approach to triangulate the quantitative data with qualitative data (Moon, 2019). Additionally, excluding a participant who dropped out from the analysis could further limit our study's integrity. We recommend validating our results in a larger, more robust trial, with validated instruments, conducted across multiple rehabilitation centers.

Another potential limitation of our study lies in the composition of our participant sample, which, due to neighborhood-level sampling, possibly included individuals with higher SEP. Although our data indicate a low percentage of highly educated individuals within our sample, this metric alone may not provide a comprehensive picture of SEP. SEP is a multi-faceted concept influenced by various factors beyond formal education levels. Additionally, our recruitment approach might have favored those more experienced with digital tools and comfortable in their current situation. Additionally, the interpretability of our results may have been affected by technical difficulties encountered during the early phase of the study, resulting in some participants not receiving messages for a few days. While this issue was promptly resolved, it might have influenced acceptance and adherence scores. As we plan for a larger, more robust trial, it is crucial to thoroughly test the intervention's technical functionality before its commencement.

Finally, a notable limitation of our study concerns the interpretability of the CGQ scores, particularly due to the timeframe of the intervention and its overlap with interactions (e.g., scheduling appointments and intake sessions) in both the intervention and control group at the CR facility. Most of these facility interactions occur in the final weeks, coinciding with the period when we evaluated the intervention's effect. Moreover, the duration of intervention use, approximately two weeks, was relatively brief when contrasted with the average waiting period of eight weeks in the Capri Cardiac Rehabilitation center. These limitations might explain the discrepancy between the quantitative and qualitative findings. For future research, initiating the intervention immediately at hospital discharge would be beneficial, thereby exposing patients during the entire waiting period. The final measurements could be conducted before interactions with healthcare providers at the CR center to minimize their influence on feelings of certainty and guidance.

6.5 Conclusions

The developed eHealth intervention was well adhered to and accepted by the target group. Yet, usefulness should be improved, and we did not find effects on feelings of certainty and guidance or dropouts. Despite this, the findings from this feasibility study yield important insights into the design of eHealth interventions tailored to people with a low SEP. Through further optimization, for example through personalization and an extended timeframe for offering the intervention, the intervention holds promise as an effective tool to enhance participation in CR and improve adherence among patients with a low SEP, thereby mitigating health disparities in CR and improving its effectiveness. While researchers should acknowledge the limitations of this feasibility study, including its small sample size and focus on a single center, it represents a first step toward equitable eHealth interventions. Healthcare professionals and intervention developers can leverage these findings to develop and tailor interventions that align with the needs and preferences of individuals with a low SEP, thereby improving their adherence and acceptance.

CHAPTER 7

General discussion

7.1 Part A – Knowledge inquiry: Attitudes and participatory design

7.1.1 Main findings

In part A, we aimed to contribute to design knowledge for eHealth equity by addressing two knowledge gaps. First, in Chapter 2, we examined the attitudes of people with a low SEP toward adopting health-promoting behavior and using eHealth solutions for this purpose. Approximately half of the participants exhibited what we have termed an “Optimistically Engaged” attitude, suggesting that a considerable portion of the target group has a positive attitude toward engaging with eHealth to improve health. However, the study also uncovered a spectrum of attitudes toward health, healthcare, and eHealth, suggesting that designers must thoroughly grasp and carefully tailor eHealth interventions to varied perspectives within the low-SEP target group. Specifically, people with a “Doubtfully Disadvantaged” attitude are expected to gain the most from eHealth interventions that better align with their needs. This is because they are generally open to using eHealth for health improvement but face insecurities and barriers that could be addressed through thoughtful and inclusive eHealth design.

In pursuit of the second knowledge gap, Chapter 3 delves into the potential of participatory design methods in actively engaging individuals with low health literacy – a common challenge among groups with a low SEP – in the design process of an eHealth intervention. We suggest that participatory design has the potential not only to facilitate reciprocal communication but also to help diminish stigma and empower participants to discuss future technologies. Co-constructing stories, experience prototype exhibition, and video prototype evaluation emerged as valuable methods. Nonetheless, there still is an urgent need for clear, practical guidelines to effectively apply participatory design techniques together with and for people with a low SEP.

7.1.2 Discussion

In our initial hypothesis, we expected that individuals with a low SEP might exhibit less favorable attitudes toward health, healthcare, and eHealth, potentially limiting the effectiveness of eHealth interventions within these groups. It is commonly understood that health behavior strategies employed in eHealth interventions, like goal-setting and self-monitoring, require a certain willingness to change (Hardcastle et al., 2015). However, our findings introduce a more nuanced perspective. We discovered that around three-quarters of the individuals with a low SEP in our study, categorized as either “Optimistically Engaged” or “Doubtfully Disadvantaged,” showed a willingness to participate in health improvement activities and eHealth interventions. This observation challenges the stereotype that low-SEP populations uniformly hold negative attitudes toward health and are less inclined toward future-oriented health planning (Heutink et al., 2010; Wardle & Steptoe, 2003). Although less positive attitudes were present, they represented a minor segment of our sample. Particularly, the “Doubtfully Disadvantaged” group could benefit from eHealth interventions tailored to their specific barriers, such as low self-efficacy and insufficient social support. Adopting strategies like peer support, employing a positive tone, setting short-term, manageable goals, and simplifying information could benefit this group (Bukman et al., 2014; Coupe et al., 2018; Michie et al., 2009; Reiners et al., 2019; Troelstra et al., 2020). Despite the proven effectiveness of these approaches to benefit people with a low SEP, they remain underutilized in digital health interventions (Ronteltap et al., 2022).

According to existing literature, in contrast to generally unfavorable attitudes toward health, attitudes toward eHealth are more favorable. For instance, data from the Netherlands reveal that over half of individuals with lower education levels or a migration background are open to using eHealth solutions (Beuningen, 2019). Similarly, another study indicated that interest in personal health records and related platforms is comparable among low-SEP groups and their higher-income counterparts (Patel et al., 2011). These observations are consistent with our study’s findings. However, our research also identified a notable degree of hesitancy toward technology, primarily due to concerns about needing more necessary skills for practical use. This ‘technology anxiety’ is a recognized issue in the literature and represents a significant obstacle to the broader adoption of eHealth solutions (Berner et al., 2023). These digital barriers could be a critical factor in why eHealth interventions have lower adherence rates among individuals with a low SEP despite similar acceptance levels.

In Chapter 3, our research supported our initial hypothesis, suggesting that participatory design’s inherent strengths supported the participation of our target group. Admittedly, objectively evaluating the impact of participatory design on engagement levels and project outcomes presents severe challenges. The need for more literature in this area complicates comparing our findings with those of other studies. Despite these challenges, our research offers a compelling demonstration of participatory design’s potential to develop interventions that align with the target group. This underscores the necessity for more detailed guidance on using participatory design in various contexts (Vandekerckhove et al., 2020). This need is particularly acute when involving people with a low SEP in participatory design processes.

7.2 Part B – Knowledge tool: The development of the Inclusive eHealth Guide

7.2.1 Main findings

In Chapter 4, we synthesized insights from Part A and Isra Al-Dhahir's contributions to develop the Inclusive eHealth Guide (IeG), a comprehensive knowledge tool designed to support equitable eHealth interventions. The development process of the IeG led to the identification of 16 requirements across system, content, and service levels deemed essential by professionals for such a resource. For the system level, it was crucial to establish an open navigation strategy that accommodates the varied demands of different professional roles, project types, stages, and user groups, alongside presenting information in a concise, visually engaging format. Regarding content, the emphasis was on providing practical, helpful, easily understandable, and scientifically valid information. At the service level, a key requirement was ensuring the guide's long-term sustainability. These requirements guided the development of the IeG, marking a significant step toward fostering equitable access to eHealth services.

7.2.2 Discussion

Through the participatory development of the IeG, we built upon existing resources by filling in some of their gaps. Some existing resources rely on comprehensive textual descriptions to establish credibility, yet this approach can complicate practical application (CEPHIR, 2022; NHS, 2023; WHO, 2019). The IeG builds upon this by presenting information in a visually appealing, easy-to-navigate format. While checklists are commonly used for evaluative benefits (Pharos, 2022), they frequently fall short in providing actionable guidance. The IeG adds to this by providing concrete examples, actionable tips, and practical methods to bridge this gap. While certain resources delve into specific aspects of eHealth development – such as digital comprehension (Pharos, 2022), literacy barriers (Vosloo, 2018), or focusing on particular subgroups like those with low eHealth literacy (Roessingh Research and Development, 2023), – they might be too narrow for broad application. The IeG takes a more comprehensive approach, making it versatile enough for use by a wide range of professionals across various settings, contexts, and stages of project development.

The guide's participatory development process aligns its content and design with the user, thereby improving its relevance and practical applicability. While the number of guidelines *for* participatory design is growing, the number of guides created *through* participatory design remains limited (Goundar et al., 2022). As highlighted earlier

(Cronholm, 2009), considerations such as usability extend beyond just the product or intervention; they are equally crucial when developing guidelines. Guideline developers must have a deep understanding of potential designers' needs, barriers, skills, and knowledge. Similarly, the process of creating guidelines mirrors that of developing interventions in many ways as both require a nuanced approach that prioritizes user needs and usability to ensure effectiveness.

7.3 Part C – Application cycle: Applying the Inclusive Health Guide in cardiac rehabilitation.

7.3.1 Main findings

After developing the IeG, we proceeded to apply this tool in a real-world context, as detailed in Chapter 5. Specifically, we engaged in a design process to develop a tailored eHealth intervention for people with a low SEP in the context of cardiac rehabilitation (CR). The resulting eHealth intervention aims to provide tailored support to the target group during their waiting period preceding CR by providing three types of communication: introductory videos from rehabilitation experts to inform and guide patients, audio narratives from previous patients to offer relatable experiences and emotional support, and practical advice to encourage safe health-promoting activities during the waiting period. Applying the IeG in this case study uncovered several key lessons learned. These insights offer practical considerations for effectively implementing the guide's recommendations. Regarding the design process, we discovered the importance of resource management and participatory methods to facilitate many of the IeG's other recommendations. Regarding the intervention design, personalization and simplicity were identified as crucial factors.

In the subsequent feasibility study, as presented in Chapter 6, we evaluated the adherence and acceptance of the eHealth intervention and explored its effect on feelings of certainty and guidance and drop-out rates. The study showed encouraging adherence and acceptance of the intervention. While the quantitative analysis revealed no effects on feelings of certainty and guidance and dropout rates, qualitative feedback suggested that the intervention provided certainty during the waiting period and clarity about the upcoming CR. A commonly cited area for improvement was the demand for more personalized and extensive content. While this was only the initial iteration of our eHealth intervention, its successful adoption and acceptance among our target demographic underscores its potential.

7.3.2 Discussion

The lessons learned emerging from applying the IeG should be discussed in relation to existing literature. The challenge of managing resources in eHealth for low-SEP projects is also confirmed by recent studies (Al-Dhahir et al., 2022). The significance of participatory design in involving populations with a low SEP still needs to be explored. A limited number of studies have documented this process, yielding promising outcomes in engagement (Gordon et al., 2016) and self-management (Salim et al., 2021). Therefore, it will be necessary to study the potential of this area further. Although there is a broad consensus in the literature regarding the importance of good usability for engaging low-SEP groups (Lee et al., 2022), simplicity receives less emphasis. Researchers frequently advocate incorporating more BCTs rather than fewer (Michie et al., 2013). While integrating multiple BCTs has the potential to enhance the effectiveness of an intervention, its success ultimately hinges on whether it is utilized as intended. Regarding personalization, while the body of literature highlighting its value in eHealth design is growing (Car et al., 2017; Conway et al., 2017), there appears to be a need for more research explicitly addressing its importance for low-SEP groups. Personalization in eHealth interventions may be particularly valuable for these groups, as it ensures that the content, delivery methods, and BCTs are tailored to their unique circumstances and needs.

In our feasibility study described in Chapter 6, we hypothesized that, facilitated by the recommendations of the IeG, we would be able to develop an intervention that was both adhered to and accepted by the target group. The results indicate that our intervention met these expectations. The finding about favorable adherence stands in contrast to the prevailing trends, which document generally low adherence rates to eHealth interventions among people with a low SEP (Arsenijevic et al., 2020; Reiners et al., 2019). This contrast could be attributed to applying the recommendations in the IeG. Our findings on acceptance do align with existing literature, which indicates that acceptance rates might be similar for individuals with low and high SEP (Beuningen, 2019; Patel et al., 2011). Regardless of SEP, it is important to acknowledge the inherent risk that any eHealth intervention may not be accepted by its target audience (Barello et al., 2015). However, by engaging in a participatory design process and following the recommendations in the IeG, we developed an intervention that was well-accepted by our target group.

7.4 Implications

In this section, we transition from theoretical discussions to practical implications based on the findings presented in this dissertation. We discuss the implications based on the three parts of this dissertation: addressing diversity in needs (Chapter 2), reconsidering knowledge sharing (Chapter 4), and considerations for the design and design processes (Chapters 5 and 6). We conclude by presenting an overview of the main themes distilled from these implications that could guide and inspire future research and practice endeavors in design for eHealth equity.

7.4.1 Implications for addressing the diversity in needs

In this dissertation, we discussed that the low-SEP demographic is not homogenous; it consists of various subgroups, each with distinct attitudes and needs. For instance, a well-educated migrant may have the necessary health literacy but struggles to navigate the healthcare system due to language barriers. In addition, a person can live in generally good conditions yet exhibit a disinterest in health matters, thus demonstrating low health literacy. While a health gap linked to education and income levels is evident, we should focus on a more nuanced understanding of diverse subgroup needs. Based on the findings in this dissertation, I propose three low-SEP attitude subgroups that hold different implications for eHealth design. In chapter 2, we delved into two of these subgroups, characterized as the “Optimistically Engaged” and the “Doubtfully Disadvantaged.” The third subgroup, the “Complexly Challenged”, could be connected to the remaining “Detached” and “Indifferent” attitude profiles.

7.4.1.1 Optimistically Engaged

The “Optimistically Engaged” subgroup already demonstrates awareness of the health behavior’s benefits. Despite the lower education and working in below-average paying jobs, their resilience and access to supportive resources (e.g., social networks) afford them to engage actively with health and eHealth initiatives. A standout value for this group is maintaining dependent, personal, and meaningful relationships with their healthcare providers. Although eHealth interventions largely meet their needs, these interventions could be further aligned by implementing a blended system that maintains the essential personal connection with healthcare providers.

7.4.1.2 Doubtfully Disadvantaged

According to our findings, the “Doubtfully Disadvantaged” subgroup is open to making use of eHealth interventions. They recognize the value of healthy behavior and eHealth interventions but struggle with consistent engagement due to difficulties in comprehending health advice or using demanding and complex eHealth interventions. I argue that efforts for design for eHealth equity can best be directed toward this group, for whom eHealth has the potential to bridge the health gap. This could be done, for example, by simplifying medical content, using plain language, incorporating visual aids, or improving the usability and user experience of eHealth systems (Chan & Kaufman, 2011). Another strategy could be to foster a sense of achievement and control to improve self-efficacy. This can be achieved through setting realistic health goals, providing positive reinforcement, and enabling users to track their progress (Kok et al., 2016; Michie et al., 2009). Finally, this group could be supported through community and support networks. Social support is a significant motivator and can aid in adherence to health interventions for this group (Teuscher et al., 2015). Community features such as peer support groups or integration with existing social networks can provide the necessary emotional and motivational support.

Beyond aiding this group, addressing these needs could also benefit a wider audience facing challenges with self-efficacy and literacy, beyond those defined by low-SEP criteria. Designs targeting specific needs and inclusivity have proven to benefit a wider audience (Sutherland, 2019). Subtitles, for instance, help not only people who are deaf or hard of hearing but also those in noisy environments. Ramps help not only those in wheelchairs but also those with heavy luggage. This applies to eHealth design too. People's needs fluctuate; someone might fit one profile today and another tomorrow. Designing for diverse groups does not just include specific societal groups; it also accommodates the changing needs of individuals, making eHealth solutions more inclusive overall.

7.4.1.3 Complexly Challenged

The "Complexly Challenged" subgroup warrants specific attention in our discussion because it represents the stereotype often associated with the low-SEP demographic. These individuals are often entangled in a complex web of personal, social, economic, and environmental challenges, such as persistent debt, intricate family dynamics, neighborhood influence, or the impact of adverse life events (Heutink et al., 2010; Pampel et al., 2010). It is crucial to clarify that the "Complexly Challenged" subgroup represents a suggestive subgroup based on the remaining more negative attitude profiles from Chapter 2. Although the attitude profiles indicate that this group does not encompass the entirety of the low-SEP demographic, their unique perspective necessitates a further examination of the implications of eHealth intervention development for this subgroup. This group, presumably most affected by challenging life circumstances, finds their ability and willingness to prioritize and manage health-related behavior and use eHealth interventions compromised. This group might, therefore, benefit more from programs aimed at debt relief, stable housing, social welfare, and community support systems. A good example is an initiative currently in place to improve the habitability of a disadvantaged area in Rotterdam by addressing education, labor, living, security, and culture (NPRZ, 2024). Such an integral approach seems necessary to reach the conditions for this group to start thinking about improving their health and using eHealth interventions (Heutink et al., 2010). Health interventions that take this integral approach, such as integrated lifestyle interventions, could be valuable for this group to make their first steps toward improving their life. The role of eHealth for this group appears to be relatively minor. Due to the complex life situation of this group, we could aim, with eHealth interventions, to make the desired behavior as effortless and enjoyable as possible, for example, through gamification. The goal should not be to *push* them into adopting a healthier lifestyle top-down; instead, we should aim to gently, from the bottom-up, *pull* them by creating an environment that fits their specific challenges and naturally encourages positive health behavior.

7.4.2 Implications for knowledge sharing

During our participatory development sessions with professionals, it became clear that there is a gap between their needs regarding equitable eHealth development and current information and resources. The standard approach of using academic publications and detailed reports does not align with the practical needs of most professionals. While policymakers favor this traditional format for its emphasis on robust data for evidence-based decisions, practitioners like developers and healthcare providers seek more directly applicable information. This situation underscores a misalignment between academic knowledge outputs and the practical needs of professionals working with eHealth interventions and low-SEP groups. Recognizing the complexity of such endeavors highlights the necessity for a “translational step” to connect theory with practice. As introduced by (Höök & Löwgren, 2012), the concept of intermediary knowledge presents tools like guides, prototypes, and annotated portfolios that can act as a bridge to make knowledge more practical and accessible. While the traditional approach remains most suitable for fundamental research, more is needed to effectively meet the demands of applied research aimed at designing eHealth interventions for and with low-SEP groups. We should consider shifting our output and knowledge sharing toward practical outcomes to address this imbalance. Funding institutions could prioritize projects that demonstrate the practical application of equitable eHealth interventions, while academic journals could place greater emphasis on the translation of knowledge into practical and feasible solutions. The situated knowledge from these applied endeavors can become the fundament for practical, applicable, and usable knowledge tools.

7.4.3 Implications for intervention design and design process

Applying the IeG in the design process yielded results that brought forth several implications for designing equitable eHealth interventions for both the design of the intervention itself and the overall design process that need to be discussed.

7.4.3.1 Resources

Regarding the design process, a central challenge in designing eHealth solutions for low-SEP groups, as posed by this dissertation, is the insufficient resource allocation dedicated to the involvement of these groups. This has several implications for the future of design for eHealth equity. One possible future pathway is for projects to allocate sufficient resources to work on inclusivity from the outset of a project. This can, for example, involve creating specific work packages dedicated to participatory design and research, emphasizing end-user and stakeholder input to tailor interventions to diverse user needs. Another pathway could be reconsidering the traditional resource distribution model, which often emphasizes assessing effectiveness using large-scale randomized controlled trials and overlooks the crucial initial phase of participatory, bottom-up research. Early user involvement in the development of digital interventions ensures the usability and real-world relevance of the intervention (van Gemert-Pijnen et al., 2011). Given their smaller scale, participatory approaches could concentrate resources on inclusivity and aligning interventions to meet diverse user needs. This then sets a solid foundation for future, more extensive trials, balancing scientific rigor and user-centric design.

7.4.3.2 Participatory design

One of the main themes throughout this dissertation has been the role of participatory design in designing eHealth with and for people with a low SEP. Traditionally, the design of these interventions relied on methods that typically involve top-down approaches, with a focus on evidence development, standardized research procedures, and limited end-user engagement. These traditional methods have predominantly been oriented toward higher SEP groups, resulting in a misalignment with the needs of low-SEP populations. This misalignment stems from several limitations in conventional approaches. For example, these approaches often have limited flexibility to adjust research activities to the unique needs and constraints of participants with a low SEP, such as lower digital and health literacy levels. Additionally, traditional methods often face recruitment challenges, relying on passive strategies that attract a self-selecting group of motivated and available participants. Furthermore, traditional approaches prioritize effectiveness, frequently overlooking factors such as usability and engagement, which are especially important for individuals with limited digital skills and motivation.

Participatory design presents valuable qualities that could be effective in overcoming these barriers. Its flexible, visual, and hands-on nature allows for adapting research methodologies to meet the specific needs of different target groups. For instance, as detailed in Chapter 3, to engage individuals facing literacy challenges, visual storyboards can be employed in a co-constructing stories session. Additionally, the interaction with experience prototypes, as presented in Chapter 3, makes future technologies more tangible and concrete for individuals who struggle with understanding abstract concepts. Participatory design also prioritizes understanding and designing for the user's needs by understanding the complex interplay of emotional, cognitive, and environmental factors within a person's context that risk being isolated in more traditional approaches. Finally, the iterative and bottom-up nature of participatory design helps establish a trust-based relationship with participants, potentially increasing the willingness to engage among those who would normally be reluctant to get involved.

However, it should be acknowledged that participatory design is not without its limitations. Its bottom-up, situational nature can limit the generalizability of its findings to other contexts, necessitating caution in their interpretation. Furthermore, while participatory design can be implemented on a smaller scale to reduce resource demands, its methods typically still require considerable time and resources. This can pose challenges, particularly when designing eHealth solutions for populations with a low SEP, which already demands additional resources. Moreover, participatory design may not be entirely feasible for certain low-SEP subgroups. The "Complexly Challenged" group for example, may face too many constraints in time, energy, or resources to fully commit to a participatory design process. This group might be better engaged with research activities like those borrowed from anthropology, such as interviews or participant observation. These methods allow researchers to immerse themselves in the lived experiences of this group without requiring the same level of commitment from participants. This approach also respects the time and resource limitations faced by participants, as it does not demand active involvement or extensive contributions from them.

Furthermore, participatory design can pose significant cognitive challenges, particularly for certain groups with lower self-confidence, such as the "Doubtfully Disadvantaged" subgroup. Within participatory design, participants are sometimes expected to work on activities independently at home without direct support from researchers. They can also be expected to engage in co-creation sessions that require them to imagine future scenarios or conceptualize potential product features, which can be demanding for some individuals.

To better address this group, participatory design can be complemented with supportive strategies aimed at boosting self-efficacy and providing a more inclusive environment. This could include offering preparatory sessions that equip participants with the necessary skills and knowledge to contribute effectively, and creating a supportive network where participants can seek help and share ideas outside of formal sessions.

While participatory design holds promise for creating more equitable eHealth interventions, it is not the holy grail. Its implementation requires careful consideration of different user groups and should be complemented with other strategies where needed. For example, insights gained from participatory design can be validated and generalized in larger trials. Therefore, achieving meaningful and inclusive eHealth interventions necessitates a multidisciplinary approach that involves collaboration between designers, researchers, healthcare professionals, and, most importantly, individuals these interventions aim to serve.

7.4.3.3 User engagement

Regarding the design of the intervention itself, we discovered the importance of user engagement through simplicity. A well-designed and simple user experience, even if it means compromising some functionality, is crucial for engaging users with a low SEP. An example is the Ommetje app (Hersenstichting, 2024) which promotes 20-minute walks with a simple interface. Its minimalistic design aids in maintaining user engagement. The “less is more” principle may also be relevant for designing equitable eHealth interventions. Integrating numerous BCTs without considering usability and aesthetic appeal can complicate the user experience and discourage engagement, especially for users with limited digital skills. Given the typically constrained resources in intervention development, the resource-intensive nature of integrating multiple components often compromises user experience. For users with a low SEP, the benefits of adding more behavioral components hinge on the quality of their integration. Therefore, a streamlined intervention with a few well-integrated principles might be more effective for these groups than a theoretically comprehensive but practically cumbersome intervention.

7.4.3.4 Personalization

Another salient finding regarding intervention design indicated a strong preference among participants for more personalized content. Personalization in eHealth interventions is crucial for low-SEP groups because it ensures the content, delivery, and BCTs are directly relevant to their specific circumstances and needs. I propose two possible avenues to make personalization feasible in eHealth interventions for low-SEP groups.

The first way, the machine way, entails leveraging advancements in artificial intelligence (AI), using big data and sophisticated algorithms to provide personalized behavior change mechanisms or lifestyle recommendations. This method has been utilized effectively in entertainment and social media, as seen with platforms like Netflix and TikTok. Although AI has made considerable advances in healthcare, we are still grappling with severe issues around safety and privacy that must be resolved before this can become a widespread practice (Jiang et al., 2017). These issues and the already existing challenges in designing equitable interventions suggest that, while AI holds potential, its implementation for personalized eHealth solutions requires careful consideration.

The second way, the human way, offers a more immediate and practical solution. By using eHealth platforms with human interaction, we can combine the best of both worlds. This "blended care" approach could offer the flexibility and constant availability of digital platforms and the healthcare professionals' personal touch and human interaction. Within this model, barriers that would typically be present when people with a low SEP interact with either healthcare or eHealth systems could be mitigated. For example, interpreting data from eHealth systems could be challenging for some patients with low health literacy. Healthcare providers could help patients understand the data and make informed decisions about their health or select the desired behavior change techniques. Alternatively, eHealth systems could offer online advice, providing patients with information they can review at their own pace. This empowers them to understand their health information better, communicate more effectively with their healthcare providers, and play a more active role in their health decision making process. One of the promises of eHealth solutions is to ease the burden on healthcare professionals, offering to complement their efforts if integrated effectively into their workflows, potentially reducing their workload (Howard et al., 2013). Yet, the investment in research, development, implementation, training, and maintenance must be justified by long-term benefits. Developing a sound business and implementation strategy alongside the intervention can help manage these costs (van Limburg et al., 2011). Considering these factors, a blended approach emerges as the most practical route for developing personalized equitable eHealth interventions in the foreseeable future.

7.4.4. Implications for design for eHealth equity

Reflecting on the discussed implications, it is important to underscore the key themes that played a vital role in this dissertation. Future research should explore the applicability of these themes in various contexts, which could pave the way for identifying universally relevant and validated core principles for designing equitable eHealth interventions. To take the first step, I will summarize the key themes emerging from this thesis.

Addressing the diversity in needs

- **Optimistically Engaged**

  Reach through eHealth by implementing a blended system that maintains and emphasizes the personal connection with healthcare providers to support existing healthy behavior.

- **Doubtfully Disadvantaged**

  Support through eHealth by simplifying medical content, having good usability, fostering a sense of achievement and control, and involve community networks to provide emotional and motivational support.

- **Complexly Challenged**

  Integrate socio-economic and community support programs, easy access to professional advice, and gamification to encourage enjoyment.

Sharing knowledge

- **Bridge theory and practice**

  Develop and disseminate accessible knowledge tools like guides, prototypes, and annotated portfolios to make academic research applicable to practitioners.

- **Practical outcomes**

  Encourage funding institutions and academic journals to prioritize projects and publications demonstrating the practical application of research in equitable eHealth interventions.

Design and process

- **Resources**

  Allocate sufficient resources for inclusivity and participatory design from the start, prioritizing early user involvement to tailor interventions to diverse needs.

- **Participatory design**

  Enhance interventions through participatory design to ensure alignment with user needs, providing a flexible approach to behavior change tailored to specific group needs.

- **User engagement**

Prioritize user engagement through a well-designed and simple user experience, focusing on well-integrated behavior change components to maintain engagement.

- **Personalization**

Achieve personalization through a blended care approach, combining digital platforms with human interaction to address barriers faced by individuals with a low SEP effectively.

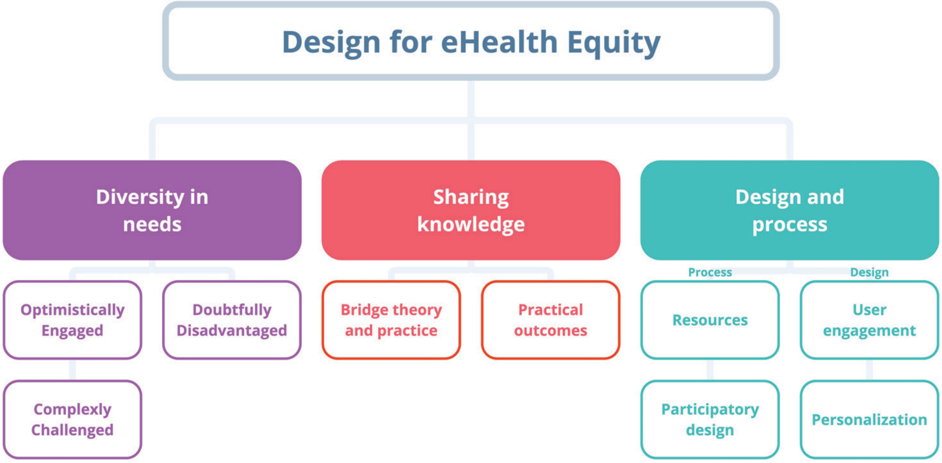


Figure 7.1 Implications for design for eHealth equity.

7.5 Strengths and limitations

The participatory nature of our studies, which emphasized direct engagement with individuals in the target group in all project phases, can be considered as one of this dissertation's strengths. This research brings individuals with a low SEP to the forefront as active collaborators, providing a platform for their perspectives to be heard and integrated. This offers insights that might otherwise be overlooked in more traditional research settings. The participatory nature was not only limited to people with a low SEP. We also actively involved different types of professionals working with eHealth to gather their perspectives and requirements first-hand about requirements for a knowledge tool for developing equitable eHealth interventions.

Another key strength of this research lies in the novel methodology of the commencement of the IeG, which was developed by combining top-down professionals' insights with bottom-up experiences from people with a low SEP. This approach aimed to address the common misalignment of eHealth interventions with the needs of low-SEP groups, often seen in traditional top-down only approaches. By integrating the broad expertise of professionals and the contextualized experiences of the target group, the IeG emerges as a comprehensive tool to enhance the equity of eHealth interventions.

The pragmatic output is another strength of this study. We have developed two practical end-products, the IeG and the first version of an eHealth intervention that could be directly implemented in CR. Moreover, by applying the IeG in a case study and conducting a pilot feasibility trial of the eHealth intervention, we gained important insights into the practical value of the guide and tailoring interventions to people with a low SEP. The practical output is important as it provides a crucial step toward delivering concrete benefits and improvements directly to society. In addition, the developed eHealth intervention provides professionals with a clear, context-specific example to inspire the practical application of theoretical knowledge.

Nevertheless, the participatory and pragmatic nature of this dissertation's studies inevitably also raises several issues, specifically toward the broader generalizability of the findings. In Part A, for example, the resulting attitude profiles were derived from a specific subset of individuals situated in community centers in an urban area of the Netherlands. Consequently, the representativeness of these attitudes may not hold for those outside of this context, such as individuals in rural areas or other countries. It should also be noted that attitudes differ spatially and temporarily. Personal (e.g., values, goals, development), social (e.g., relationships), or sociohistorical (e.g., political events, tech revolutions) factors can change. They thereby might directly influence attitudes related to health, healthcare, and eHealth over time (Albarracin & Shavitt, 2018). Therefore, the findings in this dissertation should be interpreted within their emergent context and carefully translated to other contexts, spatial and temporal. For Part B, the development of the guide was informed by these localized findings and insights from professionals in the Dutch context. Although this was supplemented with broader literature, the applicability of the recommendations may predominantly align with the Dutch context, signaling a need for caution in assuming their relevance internationally. Part C's application of the guide within a singular case study provided practical insights; however, it is not indicative that the same results or insights would be observed in different case studies. This specificity underlines a limitation in claiming the broader efficacy of the guide across varied applications.

Another limitation of this dissertation is the interpretability of the findings relating to the IeG. While we showed valuable pragmatic lessons learned and found that the target group accepted and adhered to the resulting intervention, attributing these findings solely to the IeG's influence would overlook other contributing factors. My empathy for the target group developed through earlier community-based and participatory design work likely played an important role in the commencement of the approaches and design decisions. My intrinsic connection with the IeG's development may have also introduced a bias that could influence my evaluation of its utility. Addressing this, less-biased, systematic approaches could be suggested, where the IeG's efficacy is assessed by different designers in diverse contexts through multiple case studies. However, isolating the IeG's efficacy as a singular contributing factor to successful interventions could be inherently challenging considering the complexity and heterogeneity imperative to design cases. One must question whether the objective should be to prove the IeG's efficacy or to continue refining it through action cycles and case studies, thus enriching it with practical knowledge and sustaining its immediate impact on healthcare practice. My inclination is toward the latter, favoring an iterative approach that prioritizes direct contributions to the field over definitive studies about its efficacy.

Finally, a notable limitation of this study is the challenge of conclusively assessing the effects of the developed eHealth intervention. The feasibility design of our study meant that there were several methodological constraints that could affect the validity and generalizability of the results (e.g., single center and small sample size). This means that the results should be considered as suggestive rather than conclusive. This limitation should also be taken into account when considering our claims about the value of the IeG. Nevertheless, we have gathered promising insights regarding the intervention's acceptance and adherence and preliminary indications of its potential effects, which are invaluable for its further development. Notably, the enthusiasm shown by the CR center to proceed with the direct implementation and further refinement of the intervention marks a successful initial phase in its overall development and implementation process. For a designer, establishing such a proof-of-concept is crucial, as it lays the groundwork for more comprehensive and rigorous evaluations of the intervention's (cost) effectiveness in future stages.

7.6 Future directions

This section discusses the future directions to shape the trajectory of eHealth equity research. First, we will discuss the future evolution, implementation, and dissemination of the IeG. Second, we delve into reflections on academic research directions that hold promise for advancing our understanding of eHealth equity.

7.6.1 Future of the Inclusive eHealth Guide

Looking to the future of the IeG, it will be important to address its long-term viability. Academic projects risk falling in disuse after their initial launch, losing relevance and interest over time. Therefore, for the future of the IeG, it will be crucial to focus on its dissemination. This dissemination could be targeted at forming strategic partnerships with organizations focused on eHealth design or low-SEP groups to utilize their networks, resources, and platforms to enhance visibility and impact. Moreover, future research should be dedicated to the IeG's continual development, concentrating on incorporating both practical (e.g., lessons learned, examples) and theoretical (e.g., frameworks, mechanisms) insights from the field. This ensures the guide stays relevant and addresses the evolving challenges and opportunities within eHealth for people with a low SEP. Regular assessments and updates of the guide's design and applicability will be vital to keep it user-friendly and relevant. The application cycle presented in this dissertation yields several recommendations for improving the guide's design applicability.

The first recommendation, predominantly arising from the evaluation with professionals in Chapter 4 and yet to be implemented, is establishing the IeG as a dynamic and evolving tool. Its impact can be enhanced when it is extensively circulated and actively employed. Professionals should, therefore, not only use the guide in their diverse projects but also share their experiences and context-specific challenges. To achieve this, the tool should ideally become a crowd-based platform, where users collaboratively edit and manage content. While this approach raises concerns about the information's credibility, our findings do suggest that most of the required content is practical, such as examples, dos and don'ts, and lessons learned. This type of content may not need strict quality or credibility checks, making it better suited for such an open format.

Another recommendation emerged from the application of the guide in Chapter 5. While the guide's comprehensive nature is its strength, the many recommendations can be overwhelming. To address this, a section could be added that illustrates potential methodologies for applying the guide, such as those applied in Chapter 5. For example, it can be used to check inventory before starting a project or to review afterward what recommendations were and still need to be followed. By proposing these methodologies alongside the guide, we can provide professionals with inspiration that respects the diversity of their projects.

A third improvement identified in Chapter 5 is the addition of a downloadable, coded table of recommendations to the guide, which professionals can use for planning, tracking, and retrospectively evaluating their projects. This tool could facilitate the usage of the guide in various project stages and aid communication among project members.

Finally, Chapters 5 and 6 highlighted specific recommendations within the guide that had a greater impact than others. This suggests that the recommendations may not be equally effective but could benefit from a more hierarchical organization. However, it should be noted that the importance of any given recommendation varies widely, contingent on the project's nature, context, and target audience. Therefore, future development of the guide could be aimed at investigating the importance of the guide's recommendations within different contexts and professional groups.

7.6.2 Future of the CapriXpress

For future intervention versions, we recommend several improvements to increase its effectiveness and impact. First, developing a seamless connection between the intervention and the patient's care pathway will be crucial. Future steps should concentrate on collaborating with referring hospitals to investigate the integration of the intervention with their discharge procedures. Starting the intervention during the patient's hospital visit, rather than at enrollment at the CR center as done in our feasibility study, provides a chance to support the patient throughout their entire journey. This approach could improve the intervention's effectiveness. The connection at the end of the waiting period, as patients transition into the rehabilitation phase, could also be improved by having the intervention facilitate the intake process through compiling patient notes, reflections, and questions beforehand. Such information could serve as valuable prompts during the rehabilitation intake consultations, thereby streamlining the transition into rehabilitation and enhancing the overall effectiveness of the intervention.

Enhancing the effectiveness of the CapriXpress can also be achieved by dynamically personalizing its content to meet patients' diverse needs and preferences. This approach would enable patients to gain knowledge that is more relevant to their interests and personal health goals. Therefore, future research should focus on determining what content patients prefer in the intervention and how these preferences vary across patient profiles. Future development could focus on a blended system or incorporate strategies like initial screening questions or adding a feedback system that lets users indicate their preferred content. Besides adapting content to personal preferences, it will also be important to communicate realistic expectations about the nature of the advice provided. While the intervention offers general advice that can be customized to some extent, it is essential to clarify that most personalized guidance will come from healthcare professionals during the CR phase.

Finally, future steps could be concentrated at expanding the scope of the CapriXpress after its effectiveness has been optimized. This can be done by making the intervention accessible and effective for people from various socio-economic backgrounds. Additionally, its scope could be expanded to multiple hospital-rehabilitation care pathways or other conditions (e.g., stroke).

7.6.3 Future research directions

For participatory design and its role in designing equitable eHealth interventions, several unanswered questions still merit further investigation. First, it will be important to conduct research to validate the effectiveness of participatory design, specifically in the context of eHealth interventions for low-SEP groups. This should include comparative effectiveness studies that compare eHealth interventions developed through participatory design with those interventions developed using conventional methodologies. The focus should be on evaluating the impact of these approaches on key outcomes, including user adherence, acceptance, and health outcomes. Another valuable avenue for future research involves the development of clear frameworks and guidelines for participatory design (Vandekerckhove et al., 2020). These should detail the participatory design methods and tools that are most effective in engaging individuals from low-SEP backgrounds throughout the research process. There should be an emphasis on distinguishing these recommendations between different target sub-groups, project goals, and phases of project development.

Another crucial area in need of further investigation is the long-term maintenance of healthy behavior. This is true for the low-SEP population but notably extends to the entire population as well. For this, it is not only important that an eHealth intervention aligns with the needs of specific populations, but also that they keep being aligned when these needs change over time. Explorative self-experimentation and “behavior crafting” emerge as promising concepts (Fedlmeier et al., 2022). These approaches encourage individuals to actively participate in creating and adjusting their behavior change strategies, fostering a sense of ownership and alignment with personal needs and goals. Yet, it remains to be questioned how such self-directed methods fare among populations with lower levels of self-efficacy, health literacy, or motivation. While these methods offer opportunities to enhance and sustain healthy behavior, they, like eHealth interventions, also risk exacerbating health disparities. Future research could explore how to improve autonomy in the management of health behavior for groups, specifically with low health literacy and self-efficacy.

Finally, future research could explore the paradigm shift from top-down healthcare interventions to more nuanced, bottom-up, tailored interventions. The prevailing top-down approach, characterized by one-size-fits-all standardized interventions and eHealth interventions, often has limited room for patient input. This leads to less appropriate care for patients who deviate from the norm, such as those with a low SEP. In addition, this can also inadvertently induce feelings of paternalism and infringe upon an individual's health autonomy, diminishing their motivation to adhere to these interventions (Grunloh et al., 2018). Therefore, it remains crucial to recognize the value of patient input in shaping healthcare interventions. The bottom-up approach to developing eHealth interventions discussed in this dissertation offers promising prospects. It emphasizes the importance of catering to the unique needs of specific groups. By tailoring health interventions to better align with individual needs and circumstances, people can engage with these interventions in a more meaningful way. This empowers them to take control of their own care, enhancing feelings of autonomy and, consequently, their motivation to engage with the intervention and their overall health. Such alignment ensures a better match between the provided and the required care and addresses some of the shortcomings of the one-size-fits-all approach. By focusing on groups for whom standard approaches are less effective, this strategy holds the potential to reduce health disparities. However, the standardization and evidence-based nature inherent in top-down interventions play a crucial role in ensuring improved general public health outcomes and efficient implementation of these interventions (Nys, 2008). Moreover, certain patient groups, such as the "Optimistically Engaged", may prefer delegating health responsibility to healthcare providers. Therefore, a critical consideration is the potential negative impact of transitioning to a more complex and resource-intensive approach on groups that the existing healthcare system adequately serves. Acknowledging the complexity of integrating these bottom-up approaches, future research should investigate the conditions through which bottom-up approaches to intervention design can enhance the healthcare system. It is essential to clarify that the objective should not be to shift to bottom-up approaches completely but to identify areas where they can augment the existing top-down system (Vansteenkiste et al., 2012). Future research should, for instance, assess the practicality of healthcare professionals' adoption and application of these interventions effectively and evaluate the scalability of such tailored interventions.

7.7 General conclusion

This thesis demonstrated an apparent willingness from the participants with a low SEP to engage with their health through eHealth interventions. However, it also uncovered a mismatch between the current design of eHealth interventions and the diverse needs of the low-SEP demographic. We showed that participatory design offers a promising method for involving people with a low SEP, highlighting the necessity for comprehensive, practical, and user-friendly tools and guidelines to assist professionals in these efforts. The IeG represents an important step toward addressing this need. The application of the IeG revealed its value in guiding our design process and decisions. The intervention, as a result, was accepted and adhered to by the target group.

In conclusion, our efforts in developing the IeG and its application in a specific case study represent a promising initial step toward narrowing the health gap. Our findings underscore the importance of tailoring our eHealth interventions to the diverse needs of the target group, thereby promoting healthy behavior. The findings suggest that the IeG could equip professionals with the practical knowledge and tools needed to achieve this. Looking forward, it will be essential to further explore and solidify the role of participatory design in design for eHealth equity while considering resource management, user engagement and personalization. By addressing these factors, we can pave the way for eHealth equity, ultimately contributing to narrowing the health gap through eHealth solutions rather than despite them.

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Appendices

Chapter 2

2A – Concepts characterizing the attitude profiles

2B – Inter-profile relationships based on correlation coefficients between concepts

Chapter 4

4A – Associations between Delphi study and attitude profiles study

4B – Inclusive eHealth Guide final version and references to requirements

Chapter 6

6A – Qualitative themes relating to the adherence, acceptance, content, and impact of the CapriXpress

Appendix 2A – Concepts characterizing the attitude profiles

	M	SD	M	SD	M	SD	$P < 0.05$
	Light-hearted 38%		**Concerned 38%**		**Encumbered 24%**		
Category: Perception							
Balance	4.13	1.03	2.88	1.09	3.10	1.60	1 – (2,3)
Absence of complaints	4.19	1.52	2.69	1.20	2.40	1.71	1 – (2,3)
Working on health	4.13	0.81	4.00	1.16	2.40	0.97	3 – (1,2)
Participation	4.94	0.68	3.50	0.89	3.90	1.29	1 – (2,3)
Life under control	5.13	0.72	4.06	1.06	3.90	1.66	1 – (2,3)
Category: Consciousness							
Consciousness	4.81	0.54	4.94	1.00	3.80	1.32	3 – (1,2)
Concern	3.25	1.00	4.94	1.06	3.90	1.52	2 – (1,3)
Complaints	3.63	1.09	1.88	0.96	3.40	1.43	2 – (1,3)
Interest	4.69	0.87	4.13	1.03	2.20	1.03	3 – (1,2)
Category: Motivation							
Motivation	4.81	0.54	4.63	1.09	3.60	1.17	3 – (1,2)
Perceived barriers	3.19	1.17	2.44	1.26	5.30	1.06	3 – (1,2)
Feeling	4.81	0.83	4.38	0.62	2.60	1.17	3 – (1,2)
Category: Control							
Control	4.31	1.20	3.31	1.35	3.20	1.40	1 – (2,3)
Self-efficacy	5.00	0.73	4.81	1.28	3.20	1.69	3 – (1,2)
Category: Healthcare							
	4) Loyal 60%		**5) Disadvantaged 11%**		**6) Detached 29%**		
Healthcare satisfaction	5.12	0.83	3.00	1.41	3.83	1.03	4 – (5,6)
Personal	5.16	0.69	2.80	1.10	3.70	0.99	4 – (5,6)
Communication	4.96	1.42	2.00	1.00	5.00	0.85	5 – (4,6)
Authority	4.52	1.33	4.00	1.58	3.00	0.95	4 – (5,6)
Autonomy	1.68	0.80	5.00	0.71	2.42	1.24	All
Category: Messages							
Message clarity	5.24	0.60	4.20	1.10	4.75	1.14	4 - 5
Nuance	4.92	1.38	1.60	0.55	5.25	0.87	5 - (4,6)
Doctor info source	5.28	0.74	3.40	1.67	3.33	1.16	4 – (5,6)
Source interpretation	5.28	0.98	2.60	2.07	5.25	1.06	5 - (4,6)
Rules	2.40	1.12	4.40	2.07	1.92	0.90	5 - (4,6)

Appendix 2A – Continued

	M	SD	M	SD	M	SD	*P < 0.05*
	Category: eHealth						
	7) Eager 48%		**8) Hesitating 38%**		**9) Indifferent 14%**		
Usage	4.45	1.87	3.44	1.63	2.50	2.34	7 - 9
Enthusiasm	5.25	0.85	4.13	1.08	1.83	0.75	All
Anxiety	1.15	0.37	3.62	1.08	2.33	1.50	All
Exposure	5.40	1.14	2.87	1.36	5.00	0.90	8 – (7,9)
Trust	5.60	0.50	3.37	1.31	5.33	0.82	8 – (7,9)

Mean scores of and significant relationships ($P < 0.05$) between the nine profiles based on questionnaire concepts. N = 42.

Appendix 2B – Inter-profile relationships based on correlation coefficients between concepts.

		Loyal				**Eager**	
		Satisfaction	**Clarity**	**Doc. Inf. S.***	**Personal**	**Usage**	**Enthusiasm**
Light-hearted	Consciousness	-0.10	0.25	0.07	-0.07	**0.47**	**0.25**
	Motivation	**-0.28**	0.90	-0.20	-0.01	**0.25**	**0.28**
	Feeling	**0.26**	0.00	0.14	**0.31**	**0.28**	**0.44**
	Interest	**0.30**	**0.28**	**0.31**	**0.26**	**0.38**	**0.30**

		Enc.**	**Disadvantaged**			
		Self-efficacy	Source Int.***	Rules	Nuance	Communication
Hesitating	Exposure	**0.50**	**-0.58**	**-0.56**	**-0.48**	0.25
	Anxiety	**-0.39**	**0.69**	**0.39**	**0.36**	**-0.50**
	Trust	**0.33**	**-0.43**	**-0.48**	-0.21	0.06

Correlation coefficients determined using a principal component analysis. Significant correlations (P < 0.05) are highlighted. Sample N = 42.

* Doctor as information source

** Encumbered

*** Source Interpretation

Appendix 4A – Associations between Delphi study and attitude profiles study

Findings from study 1 (Delphi study)	Findings from Study 2 (Attitude profiles study)	Associations between study 1 and study 2
Development		
Knowledge of professionals (refers to the fact that professionals have insufficient knowledge of people with a low SEP) (-)	Encumbered Disadvantaged Hesitating	Encumbered: Having a difficult life situation, therefore, thinking about investments for future health has limited priority. Disadvantaged: Finding written materials too difficult to understand Hesitating: Having limited digital skills and experiencing difficulties in adopting eHealth.
Social environment (refers to the involvement of the social environment of people with a low SEP in the development of eHealth interventions) (+)	Indifferent Hesitating	Indifferent: Has no need for technology but becomes motivated when social networks themselves are enthusiastic about eHealth. Hesitating: Typically involves people from the social environment with more knowledge and skills to assist in using eHealth.
Rewards (refer to rewarding the participants for their thoughts on eHealth interventions) (+)	Indifferent Encumbered	Indifferent: Is not open to nor interested in the development of eHealth. Encumbered: Becomes motivated by eHealth that relieves burdens or is seamlessly integrated into daily life.
Reach		
Communication (refers to the verbal and written communication level that does not match with people with a low SEP and is therefore unable to reach them) (-)	Disadvantaged	Written materials are too difficult to understand
Lack of resources (refers to lack of time and financial resources to reach the target group) (-)	Detached	Has the lack of trust toward healthcare professionals and researchers.
Engagement (refers to current eHealth interventions that do not sufficiently motivate or stimulate the user) (-)	Eager	Becomes motivated by self-monitoring and feedback
Everyday life (refers to eHealth interventions that do not align with the everyday lives of people with a low SEP) (-)	Encumbered	Has a difficult life situation and, therefore, thinking about investments for future health has limited priority
Modes of delivery (refers to materials and technology that do not fit the skill levels of people with a low SEP) (-)	Disadvantaged Encumbered	Disadvantaged: Values a healthcare provider that understands communication barriers, listens well, and can explain things clearly. Encumbered: Values a healthcare provider who understands and considers their life situation.

Appendix 4A – Continued

Findings from study 1 (Delphi study)	Findings from Study 2 (Attitude profiles study)	Associations between study 1 and study 2
Usability (refers to the barriers that affect the user-friendliness of eHealth interventions, thus hindering reach to the low-SEP group)	Hesitating Indifferent	Hesitating: Has limited digital skills and, therefore, experiences difficulties adopting eHealth. Indifferent: Does not see why eHealth is better than traditional approaches and, therefore, considers it not worth the effort.
Reward (refers to rewarding people with a low SEP to encourage participants)	Encumbered Indifferent	Encumbered: Becomes motivated by eHealth that deburdens or is seamlessly integrated into daily life. Indifferent: Does not see why eHealth is better than traditional approaches and therefore considers it not worth the effort.
Communication (refers to different forms of communication) (+)	Disadvantaged Loyal Eager Hesitating	Disadvantaged: 1. Written materials are too difficult to understand. 2. Becomes motivated by visual information that attracts attention. Loyal: Values a personal, face-to-face approach with (healthcare) professionals. Hesitant: Is not sufficiently aware of eHealth and what it adds and therefore finds it hard to understand the added benefit of using eHealth. Eager: Is open toward and enthusiastic about eHealth.
Knowledge of professionals (refers to professionals having the necessary communication skills to reach people with a low SEP) (+)	Disadvantaged	Values a healthcare provider that understands communication barriers, listens well, and can explain things clearly.
Everyday life (refers to understanding the everyday lives of people with a low SEP to devise a suitable intervention) (+)	Light-hearted/Concerned Encumbered	Light-hearted: Is positive and feels good about personal health. Concerned: Faces one or several health-related limitations. Encumbered: Becomes motivated by eHealth that deburdens or is seamlessly integrated into daily life.
Motivation (refers to motivating people with a low SEP about the relevance of eHealth interventions to enhance reach) (+)	Hesitating Indifferent	Hesitating: Is not sufficiently aware of eHealth and what it adds, and therefore finds it hard to understand the added benefits of using eHealth. Indifferent: Is not open to nor interested in eHealth.
Reach Strategies (refers to strategies that can be used to reach people with a low SEP) (+)	Indifferent Hesitating	Indifferent: Is not open to nor interested in eHealth. Hesitating: Is not sufficiently aware of eHealth and what it adds, and therefore finds it hard to understand the added benefits of using eHealth.

Appendix 4A – Continued

Findings from study 1 (Delphi study)	**Findings from Study 2 (Attitude profiles study)**	**Associations between study 1 and study 2**
Social environment (refers to the social environment of people with a low SEP) (+)	Concerned Indifferent Hesitating Encumbered Detached	Concerned: 1. Has a low perceived control 2. Benefits from social interaction. Indifferent: Does not see why eHealth is better than traditional approaches and therefore considers it not worth the effort. Hesitating: In this profile, family members or friends have more knowledge about technology compared to people with low SES. Encumbered: Benefits from social interaction.
Technology Support (refers to helping people with a low SEP in the use of eHealth interventions to enhance reach) (+)	Hesitating	Hesitating: Has limited digital skills and therefore experiences difficulties adopting eHealth.
Usability (refers to the factors that promote the user-friendliness of eHealth interventions) (+)	Disadvantaged Eager Disadvantaged Hesitating	Disadvantaged: Becomes motivated by visual information that attracts attention. Disadvantaged: Written materials are too difficult to understand. Eager: Becomes motivated by self-monitoring and feedback. Hesitating: Is not sufficiently aware of eHealth and what it adds, and therefore finds it hard to understand the added benefits of using eHealth.
Adherence		
Knowledge (refers to the understanding that individuals with low (SEP) have about their health) (-)	Encumbered	Has a difficult life situation, and therefore, thinking about investments for future health has limited priority.
Motivation (refers to the level of motivation that individuals with a low SEP have to continue utilizing interventions) (-)	Indifferent	Does not see why eHealth is better than traditional approaches and therefore considers it not worth the effort.
Not involving people with a low SEP (refer to the expectations that individuals of a low SEP have toward eHealth interventions and the needs they have in return) (-)	Encumbered	Has a difficult life situation, and therefore, thinking about investments for future health has limited priority.
Usability (refers to the barriers that prevent individuals with low digital skills and low literacy from effectively using eHealth interventions) (-)	Hesitating	Has limited digital skills and therefore experiences difficulties adopting eHealth.

Appendix 4A – Continued

Findings from study 1 (Delphi study)	Findings from Study 2 (Attitude profiles study)	Associations between study 1 and study 2
Communication (refers to the means of communicating with individuals with a low SEP) (+)	Encumbered Loyal Concerned	Encumbered: Has a difficult life situation, and therefore, thinking about investments for future health has limited priority. Loyal: Values a personal, face-to-face approach with healthcare professionals. Concerned: Has a low perceived control.
Social environment (refers to involving friends, family, and community support in the utilization of eHealth interventions) (+)	Concerned Encumbered Hesitating	Concerned: Benefits from social interaction. Hesitating: Typically involves people from the social environment with more knowledge and skills to assist using e-health.
Engagement eHealth (refers to the level of involvement and active participation of users in utilizing eHealth technologies) (+)	Indifferent/Encumbered Hesitating/Eager/Indifferent Encumbered/Concerned/Indifferent Concerned Loyal	Encumbered: Has a difficult life situation, and therefore, thinking about investments for future health has limited priority. Indifferent: Is not open to nor interested in eHealth. Hesitating/Eager/Indifferent Hesitating: Is not sufficiently aware of eHealth and what it adds, and therefore finds it hard to understand the added benefit of using eHealth. Eager: Becomes motivated by self-monitoring and feedback. Indifferent: Does not see why eHealth is better than traditional approaches and therefore considers it not worth the effort. Concerned: 1. Has a low perceived control. 2. Becomes motivated by setting and achieving goals. Loyal: Values a personal, face-to-face approach with healthcare professionals.
Usability (refers to enabling individuals with a low SEP, low digital skills, and low literacy to access and use eHealth interventions effectively) (+)	Hesitating	Has limited digital skills and therefore experiences difficulties adopting eHealth.
Evaluation		
Evaluation methods and timing (refers to the evaluation methods used during evaluation research that do not fit the low-SEP group) (-)	Disadvantaged	Disadvantaged: Written materials are too difficult to understand.
Everyday life (refers to people with a low SEP who have other problems that prevent them from participating in evaluation research) (-)	Encumbered Concerned	Concerned: Faces one or several health-related limitations. Encumbered: Has a difficult life situation and, therefore, thinking about investments for (future) health has limited priority.

Appendix 4A – Continued

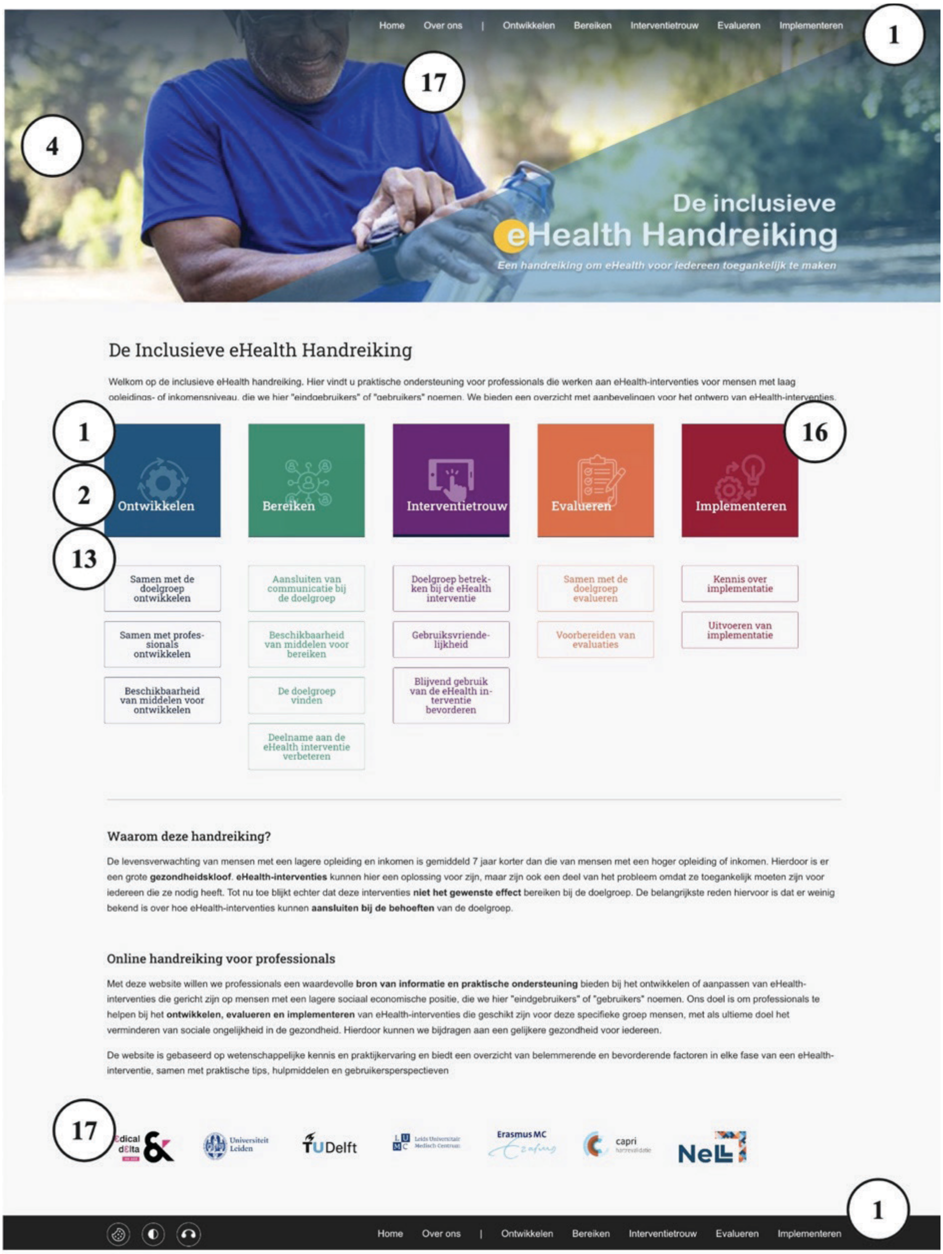
Findings from study 1 (Delphi study)	Findings from Study 2 (Attitude profiles study)	Associations between study 1 and study 2
Engagement (Refers to methods or strategies that encourage people with a low SEP to participate in evaluation studies) (-)	Encumbered Concerned Indifferent Detached /Loyal	Encumbered: 1. Has a difficult life situation and, therefore, is not eager to participate in evaluation studies. 2. Has a difficult life situation and, therefore, thinking about investments for (future) health has limited priority. Concerned: Becomes motivated by setting and achieving goals. Indifferent: Does not see why eHealth is better than traditional approaches and, therefore, considers it not worth the effort. Detached: Has a lack of trust toward healthcare professionals and researchers. Loyal: Values a personal, face-to-face approach with (healthcare) professionals.
Evaluation methods (refers to the evaluation methods used to evaluate the eHealth intervention) (+)	Disadvantaged	Disadvantaged: Written materials are too difficult to understand.
Implementation		
Motivation (refers to persuading professionals to implement an eHealth intervention in practice) (+)	Hesitating	Hesitating: If professionals themselves are competent and enthusiastic about eHealth, it can be effective in hesitant groups

(+) = facilitator, (-) = barrier

The conception of this table involved two authors independently examining the interplay between barriers and facilitators from the Delphi study and profiles from the attitude profile study. Discrepancies and alignments were discussed, categorized, and ultimately synthesized into this final table.

Appendix 4B – Inclusive eHealth Guide final version and references to requirements

Home page



De Inclusieve eHealth Handreiking

Welkom op de inclusieve eHealth handreiking. Hier vindt u praktische ondersteuning voor professionals die werken aan eHealth-interventies voor mensen met laag opleidings- of inkomensniveau, die we hier "eindgebruikers" of "gebruikers" noemen. We bieden een overzicht met aanbevelingen voor het ontwerp van eHealth-interventies.

Waarom deze handreiking?

De levensverwachting van mensen met een lagere opleiding en inkomen is gemiddeld 7 jaar korter dan die van mensen met een hoger opleiding of inkomen. Hierdoor is er een grote **gezondheidskloof**. **eHealth-interventies** kunnen hier een oplossing voor zijn, maar zijn ook een deel van het probleem omdat ze toegankelijk moeten zijn voor iedereen die ze nodig heeft. Tot nu toe blijkt echter dat deze interventies **niet het gewenste effect** bereiken bij de doelgroep. De belangrijkste reden hiervoor is dat er weinig bekend is over hoe eHealth-interventies kunnen **aansluiten bij de behoeften** van de doelgroep.

Online handreiking voor professionals

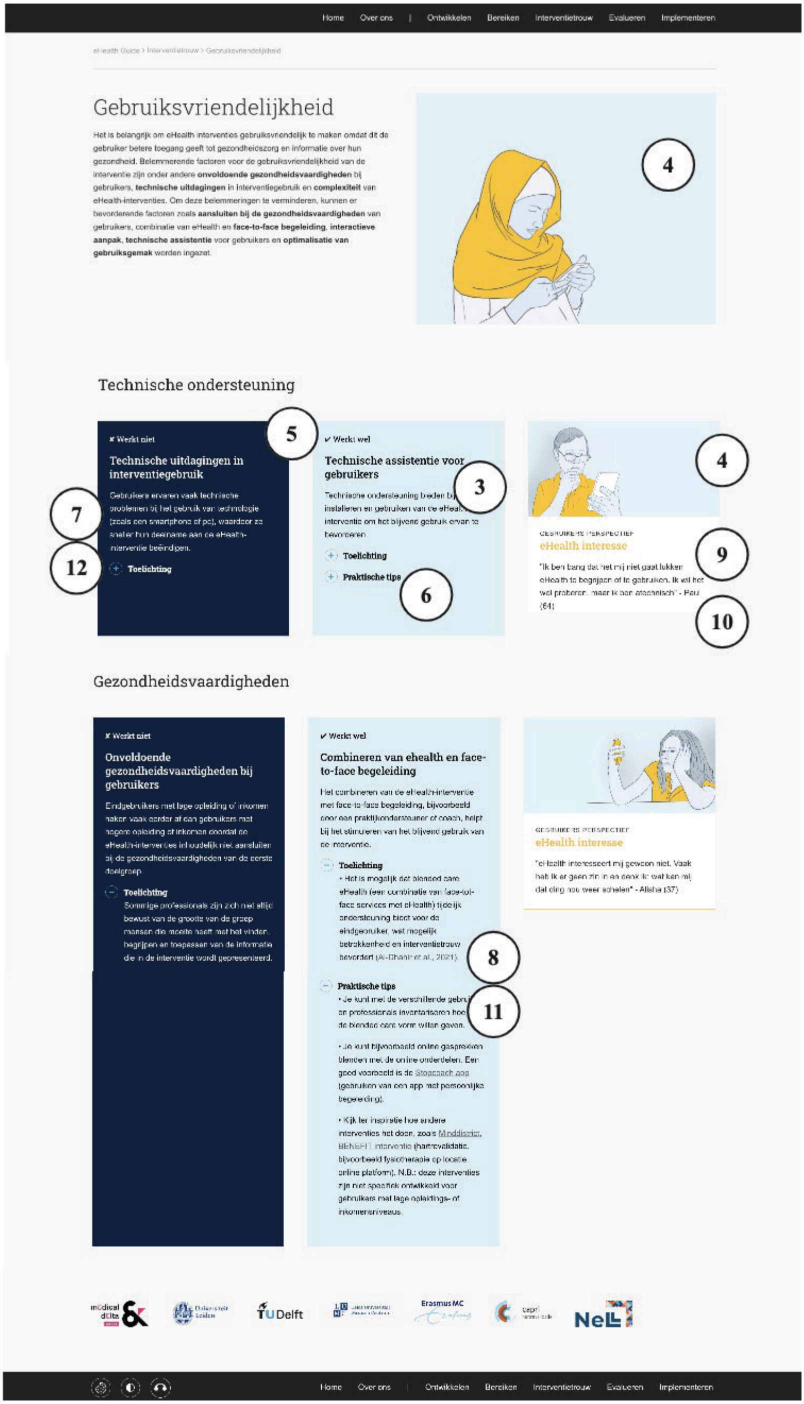
Met deze website willen we professionals een waardevolle **bron van informatie en praktische ondersteuning** bieden bij het ontwikkelen of aanpassen van eHealth-interventies die gericht zijn op mensen met een lagere sociaal economische positie, die we hier "eindgebruikers" of "gebruikers" noemen. Ons doel is om professionals te helpen bij het **ontwikkelen, evalueren en implementeren** van eHealth-interventies die geschikt zijn voor deze specifieke groep mensen, met als ultieme doel het verminderen van sociale ongelijkheid in de gezondheid. Hierdoor kunnen we bijdragen aan een gelijkere gezondheid voor iedereen.

De website is gebaseerd op wetenschappelijke kennis en praktijkervaring en biedt een overzicht van belemmerende en bevorderende factoren in elke fase van een eHealth-interventie, samen met praktische tips, hulpmiddelen en gebruikersperspectieven

The numbers 1, 2, etc. indicate the requirements that have been integrated into the final version.

(1) Open Navigation - The website's navigation provides a starting point for users to explore the different phases of eHealth development. The navigation patterns are open, and users can find the phases at the top and bottom of the website, allowing them to explore other content directly.
(2) Starting scheme - Upon landing on the website, users are presented with a starting scheme that provides an overview of the content and helps them determine what content is most useful for them.
(4) Visual elements - A visual banner on the home page improves the appeal of the website and invites users to explore further.
(13) Suitability for different professionals - The comprehensive overview of the entire process of eHealth development makes the guide suitable for different types of professionals at various stages of eHealth development.
(16) Focus on implementation - The implementation section is dedicated entirely to addressing the needs of professionals looking for this type of information
(17) Enhance credibility –A dedicated 'About Us' page that includes information about the guide's background and the team behind it, as well as logos of the parties involved. This will help to improve the guide's credibility.

Theme page



Gebruiksvriendelijkheid

Het is belangrijk om eHealth interventies gebruiksvriendelijk te maken omdat dit de gebruiker betere toegang geeft tot gezondheidszorg en informatie over hun gezondheid. Belemmerende factoren voor de gebruiksvriendelijkheid van de interventie zijn onder andere **onvoldoende gezondheidsvaardigheden** bij gebruikers, **technische uitdagingen** in interventiegebruik en **complexiteit** van eHealth-interventies. Om deze belemmeringen te verminderen, kunnen er bevorderende factoren zoals **aansluiten bij de gezondheidsvaardigheden** van gebruikers, combinatie van eHealth en **face-to-face begeleiding**, **interactieve aanpak**, **technische assistentie** voor gebruikers en **optimalisatie van gebruiksgemak** worden ingezet.

Technische ondersteuning

✘ Werkt niet

Technische uitdagingen in interventiegebruik

Gebruikers ervaren vaak technische problemen bij het gebruik van technologie (zoals een smartphone of pc), waardoor ze sneller hun deelname aan de eHealth-interventie beëindigen.

＋ **Toelichting**

✔ Werkt wel

Technische assistentie voor gebruikers

Technische ondersteuning bieden bi installeren en gebruiken van de eHeal interventie om het blijvend gebruik ervan te bevorderen.

＋ **Toelichting**

＋ **Praktische tips**

GEBRUIKERS PERSPECTIEF

eHealth interesse

"Ik ben bang dat het mij niet gaat lukken eHealth te begrijpen of te gebruiken. Ik wil het wel proberen, maar ik ben atechnisch" - Paul (64)

Gezondheidsvaardigheden

✘ Werkt niet

Onvoldoende gezondheidsvaardigheden bij gebruikers

Eindgebruikers met lage opleiding of inkomen haken vaak eerder af dan gebruikers met hogere opleiding of inkomen doordat de eHealth-interventies inhoudelijk niet aansluiten bij de gezondheidsvaardigheden van de eerste doelgroep.

− **Toelichting**

Sommige professionals zijn zich niet altijd bewust van de grootte van de groep mensen die moeite heeft met het vinden, begrijpen en toepassen van de informatie die in de interventie wordt gepresenteerd.

✔ Werkt wel

Combineren van ehealth en face-to-face begeleiding

Het combineren van de eHealth-interventie met face-to-face begeleiding, bijvoorbeeld door een praktijkondersteuner of coach, helpt bij het stimuleren van het blijvend gebruik van de interventie.

− **Toelichting**

- Het is mogelijk dat blended care eHealth (een combinatie van face-to-face services met eHealth) tijdelijk ondersteuning biedt voor de eindgebruiker, wat mogelijk betrokkenheid en interventietrouw bevordert (Al-Dhahir et al., 2021).

− **Praktische tips**

- Je kunt met de verschillende gebru en professionals inventariseren hoe de blended care vorm willen geven.
- Je kunt bijvoorbeeld online gesprekken blenden met de online onderdelen. Een goed voorbeeld is de Stopcoach app (gebruiken van een app met persoonlijke begeleiding).
- Kijk ter inspiratie hoe andere interventies het doen, zoals Minddistrict, BENEFIT interventie (hartrevalidatie, bijvoorbeeld fysiotherapie op locatie, online platform). N.B.: deze interventies zijn niet specifiek ontwikkeld voor gebruikers met lage opleidings- of inkomensniveaus.

GEBRUIKERS PERSPECTIEF

eHealth interesse

"eHealth interesseert mij gewoon niet. Vaak heb ik er geen zin in en denk ik: wat kan mij dat ding nou weer schelen" - Alisha (37)

(3) Specific information - The starting scheme directs users to theme pages that offer specific information on barriers, facilitators, and user perspectives related to that theme.
(4) Visual elements - Illustrations of users in relevant contexts enhance the page's appeal.
(5) Concurrent presentation - Presenting both barriers and facilitators maintains a neutral tone and provides a comprehensive understanding of the information.
(6) Shorter pages - The use of "accordion" elements allows users to expand information selectively, keeping the page length shorter.
(7) Comprehensible information - The content is developed in collaboration with a communication expert to ensure it is easy to understand.
(8) Scientific evidence - The website cites scientific sources to back up information presented throughout.
(9) Realistic user representation - Using real quotes from previous user research provides a sense of realism.
(10) Abstract user information - User theme titles communicate the user's attitude in a clear way.
(11) Practical application - The website provides practical tips and references to external tools and resources to improve the practical applicability of the information.
(12) Informal tone-of-voice - An informal tone-of-voice is used throughout the guide, making it more approachable and engaging.

Appendix 6A – Qualitative themes relating to the adherence, acceptance, content, and impact of the CapriXpress.

Theme	F*	P, N (%)**	Description	Quote
Intervention adherence				
Fit in daily routine	24	13 (72)	Intervention use fitted in daily schedules and became a routine	*"We used to sit in the morning for coffee. Yeah, we would sit down for a while, and I received them, and then I had my phone in my hand. Well, I went through it, I even turned it on so that the lady could listen along and that way. Yeah, it's also at a fixed time. You have to be careful not to let it sit for a whole week and then review it after a week. Because that will not work, I think. If you throw everything together, it is just a matter of sifting through it and fulfilling a duty."*
Curiosity	17	11 (61)	Curiosity about new messages	*"I was curious about it every day. I also opened it every day. I went through the entire program. I was, well, actually, looking forward to seeing what news they had to say today. Yeah, it was actually more curiosity."*
Usability and satisfaction				
Easy to use	23	18 (100)	Finds the intervention easy to use	*"Yes, I find it quite easy, actually. You take the train, and then you grab that other thing, the suitcase, and then you just move it back and forth a bit. And that went well. That all went smoothly."*
Appreciates playfulness	13	13 (72)	Appreciates the playful design of the interface	*"Well, you know, I found it enjoyable. More enjoyable than just a boring list or something, you know. Yeah, it's funny that they thought of it like, oh yeah, let's pretend it's a journey. With your stories in a suitcase, very amusing. You're on a journey to your rehabilitation."*
Appreciates peer stories	9	7 (39)	Appreciates the integration of peer stories functionality	*"Yes, and stories from others, right? People naturally relate to that. Because there's always a story like, oh, I've experienced that too. And then I don't have to worry about it, so to speak."*
Reward system unclear	7	7 (39)	Did not understand the travel bag upgrade system	*"Those numbers that were next to it, at one point, it was on fourteen, then it went back to seven or something, just to give you an idea. Oh, why is that then?"*
Content and Language				
Lack of depth and detail	26	10 (56)	Finds information too superficial and needs an additional layer of depth.	*"Look, we're talking about the dietitian. And the dietitian gave a very brief explanation of what she does. Very brief, I can't remember exactly how it was explained. But she didn't really delve into the topic. For example, what can you tell about your sugar or salt levels being too high? What are the consequences of that? Could you get paralysis? Could you have a heart attack? So, the information was lacking, in my opinion. More substance is needed."*

Appendix 6A – Continued

Theme	F*	P, N (%)**	Description	Quote
Clear communication	21	16 (89)	Found the information easy to comprehend	*"At least, for me, it was easy to follow, not too difficult. No, let's say, it wasn't overly technical language. Also, not overly simplified, but simply clear in terms of what was said and expected, yes."*
Need for personalized information	17	11 (61)	Needs information that is personalized to individual disease situations and preferences	*"All those social workers and such... For me, I think, it's not interesting. I only do it to become physically well. That's my goal. I don't think I have any other issues. And then, yes... I think the app is limited in that aspect."*
Need for personalized advice	11	6 (33)	Needs advice that is personalized to individual disease situations and preferences	*"See, one piece of advice was to go for a walk. For example, walk to the supermarket. Well, I can walk a bit further as well."*
Impact and Relevance				
Rehabilitation roadmap	22	12 (67)	Felt the intervention provided a clear understanding of what can be expected during CR	*"You know, when all those people introduced themselves and told stories about different participants. Yeah, that was nice because you get an idea in advance of what to expect when you start the rehabilitation. So, that was quite pleasant."*
Certainty during transition	12	5 (28)	Felt the intervention brought a sense of certainty during the waiting period	*"Well, in terms of reducing uncertainties, the app did help me because if you didn't have that app, you would fall into a void between being discharged from the hospital and starting rehabilitation. So, in that sense, the app was able to provide assistance in filling that void at some point."*
Health Status Understanding	10	7 (39)	Felt the intervention Provided comprehensive information about the patient's current situation.	*"I received a lot of information that I wouldn't normally get. If you haven't had a heart attack, you don't even think about all the information you've received. So, for me, it was a kind of recognition. And, actually, it was very good. So, as I said, it made me wiser."*
Managing emotions	5	4 (22)	Felt the intervention Helped to improve emotional wellbeing	*"Yeah, as I mentioned. The first time for me, last Monday, entering that room and getting back into motion. That was scary. And that had already been told in a story. Something I had heard. And it did sound familiar. In the story, I also heard that once you take that first step, it gets better. And that was absolutely true."*
Pre-rehabilitation guidance	5	4 (22)	Felt the intervention provided guidance in activities that can already be done while waiting for rehabilitation to begin.	*"Well, yeah, at least that I have to pay attention, that I have to balance my diet a bit, and also that I have to start exercising, and yes, everything helped."*

Appendix 6A – Continued

Theme	F*	P, N (%)**	Description	Quote
Movement Confidence	1	1 (6)	Felt the intervention helped to feel less fear of medical incidents when moving or undertaking activities.	*"I thought, well, I'll go along on the bike for once. And, yeah, we happened to have a headwind, and then, well, you start to feel a bit uneasy on that bike. And, yeah, then you also think back to those videos where it was said, for example, one starts too fast and the other starts too slow, thinking they can't do it anymore, and so on. And then you think about... that. And it actually helps with cycling because the next day I got back on the bike. And, yeah, that's how you overcome some of the fear you have about, well, doing the activities you need to do."*
Hope	0	0 (0)	Felt the intervention provided a clear understanding of a positive outlook in the future health journey	
Integration in care journey				
Transition missing	11	7 (39)	Transition from end-of-use of the intervention toward rehabilitation is missing	*"Yeah, what I missed, of course, is that at some point, it stops. And then you only see the conductor, I believe. And he says, well, it's going well like this. And then I think to myself, well, what's going so well, that the train isn't running, but you don't get advice. And that's actually when the therapy is in sight, then the train keeps going. You miss the point where the advice stops. And in a few days, you get therapy. And then we continue with the physical part."*
Technical issues				
No new messages issue	7	5 (28)	Mentioning of a technical issue in which participant didn't receive new messages	*"At some point, nothing was coming through to me, so I thought, is this all there is? I didn't find it very helpful, what exactly is the intention? But then it turned out okay after all."*

* Frequency of occurrence of the theme
** Percentage of participants mentioning the theme
Themes resulting from the semi-structure interviews performed with participants in the intervention group of the study. N = 18

Summary

The impact of socioeconomic position (SEP) —encompassing income, education level, and occupation—on health is clear. Chronic illnesses such as heart disease, diabetes, and obesity disproportionately affect those in lower socioeconomic groups, leading to prolonged healthcare needs that burden both individuals and society.

Although healthy lifestyle behaviors like regular physical activity and a balanced diet are crucial for disease prevention, research consistently shows that these behaviors are less prevalent among lower socioeconomic groups. As the costs of managing chronic illnesses rise, eHealth interventions have emerged as a potential solution. However, these interventions often require digital skills and proactive health attitudes that are not universally available across all socioeconomic levels. Too often, eHealth solutions are developed with a one-size-fits-all approach, catering primarily to the high health-literate and motivated, inadvertently widening the health gap instead of narrowing it.

Bottom-up, participatory approaches offer a transformative outlook on tailoring eHealth interventions to the unique needs, skills, and preferences of individuals with a low SEP by involving them directly in the design process. Yet, professionals often encounter hurdles such as low health literacy and cultural disparities when engaging these groups. While the scientific community is gaining insights into these barriers, actionable guidance remains scarce. Thus, there is an urgent call for a comprehensive tool integrating known barriers and facilitators to steer the equitable design of eHealth interventions for individuals with a low SEP. This dissertation presents the development of such a tool for professionals. It unfolds across three key sections: Part A delves into knowledge inquiry, Part B focuses on tool development, and Part C illustrates its application in a real-world setting.

Part A: Knowledge Inquiry

In this part of the dissertation, we delve into the critical knowledge gaps: why eHealth interventions often fall short for individuals with a low SEP, and how participatory design could be leveraged to engage this group in the design process.

In Chapter 2, we delve into the attitudes of individuals with a low SEP toward health, healthcare, and eHealth, to better understand their reasons for (not) engaging in health-promoting activities and eHealth interventions. Rather than observing from a distance, we embraced a community-based participatory research approach, actively involving the target group in the process. Through this collaborative effort, we uncovered nine distinct profiles representing different attitudes towards health, healthcare, and eHealth. These profiles converge into two overarching attitudes: the "Optimistically Engaged," who are generally positive about health, healthcare, and eHealth, and the "Doubtfully Disadvantaged," who struggle with barriers and have low confidence in managing health and navigating the healthcare system. Our findings challenge the assumption that individuals with lower SEP are uniformly unwilling to adopt healthy behavior and engage with eHealth interventions. Instead, we found a rich diversity of attitudes within this group, with the majority displaying a genuine willingness to embrace health-promoting activities and eHealth interventions. This suggests that the issue may lie less in the unwillingness of the target demographic and more in the design of eHealth interventions themselves.

Chapter 3 builds upon our earlier findings regarding the importance of designing eHealth solutions to diverse needs, by exploring how to reach this through participatory design. We present a case study where participatory design methods were specifically applied to develop an eHealth intervention: a smart inhaler to improve medication adherence among asthma patients. This study paid particular attention to individuals with low health literacy, a characteristic often associated with a low SEP, which can be a significant barrier to participation in research and design processes. We focused on three participatory design methods: co-constructing stories, experience prototype exhibition, and video prototype evaluation. We found participatory design activities effectively engaged participants, deepening the understanding of motivations and preferences. The chapter presents the potential and implications of these methods in effectively engaging and designing for and with the target group.

Part B: Development of the Knowledge Tool

In this part, in Chapter 4, the dissertation delves into the development of our knowledge tool, merging insights from the studies in Part A and the research of Isra Al-Dhahir, a fellow PhD candidate. Our approach, thus far mainly bottom-up, involved direct collaboration with the target group and a hands-on case study. However, to ensure comprehensive understanding, Isra's work offered a top-down perspective based on existing literature and common barriers and facilitators identified by professionals. This chapter focuses on merging both perspectives to create the Inclusive eHealth Guide (IeG): a practical tool for professionals to design for eHealth equity. Through a participatory approach, we identified 16 requirements for the tool's design and integrated them into the first version of the IeG.

Part C: Application Cycle

During the application cycle, we delved into the practical application of the IeG within a specific real-world scenario: The development of a tailored eHealth intervention for people with a low SEP in the context of cardiac rehabilitation (CR). Chapter 5 presents the design process of this intervention in which we identified the need of patients with a low SEP to feel more certain and guided during their waiting period preceding CR. In response, we developed a tailored eHealth intervention, together with the target group, to address this need. Implementing the guide during this project yielded four key lessons learned that could guide future designers in similar case-specific applications of the IeG: the need for resource management, the value of participatory methods, and the importance of personalization and simplicity in eHealth design.

In Chapter 6, we evaluated the feasibility and effects on certainty and guidance of the developed intervention among people with a low SEP. Results show the potential of the intervention and the IeG. The intervention demonstrated good adherence and acceptance among participants. Despite the quantitative data showing no improvements in certainty and guidance, qualitative insights suggest that the intervention may offer benefits in these areas. The results show that the application of the IeG could lead to the development of interventions that are both adhered to and accepted by people with a low SEP, posing it as a valuable resource for professionals designing equitable eHealth interventions.

Conclusion

This dissertation contributes to narrowing the health gap by developing and applying the IeG, a practical tool for designing equitable eHealth interventions. We identified diverse subgroups within low SEP, each with specific needs. There are the optimistically engaged who could benefit most from a blended system that maintains and emphasizes the personal connection with healthcare providers. The doubtfully disadvantaged have a lot to gain from eHealth and can be supported through simplifying medical content, ensuring good usability, and fostering a sense of achievement and control. Additionally, there is the complexly challenged group, which is the most difficult to reach through eHealth, and could benefit more from the integration of socio-economic and community support programs. Furthermore, our findings underscore the importance of bridging theoretical knowledge with practical application, exemplified by the IeG and our practical case study. Finally, this dissertation has shed light on some important implications for design and design processes. Regarding the design process, we can confirm that participatory design is a valuable approach to developing equitable eHealth interventions, but we should be mindful of allocating sufficient resources. Concerning the design itself, we found there needs to be more emphasis on personalized and engaging interventions. By addressing these factors, we can pave the way for eHealth equity, ultimately contributing to narrowing the health gap through eHealth solutions rather than despite them.

Samenvatting

De invloed van sociaaleconomische positie (SEP) —waarbij inkomen, opleidingsniveau en beroep worden meegenomen— op gezondheid is evident. We zien dat chronische ziekten zoals hartziekten, diabetes en obesitas onevenredig vaak voorkomen bij mensen in lagere sociaaleconomische groepen. Dit leidt tot langdurige zorgbehoeften die niet alleen voor individuen, maar ook voor de samenleving als geheel een grote last vormen.

Hoewel een gezonde leefstijl, zoals regelmatige lichaamsbeweging en een gebalanceerd dieet, cruciaal is voor het voorkomen van ziekten, toont onderzoek consequent aan dat deze gezonde gewoonten minder voorkomen bij mensen met een lagere SEP. Nu de kosten voor het behandelen van chronische ziekten stijgen, worden eHealth-interventies (digitale gezondheidsoplossingen) steeds vaker gezien als een mogelijke oplossing. Deze interventies vereisen echter vaak digitale vaardigheden en een proactieve houding ten opzichte van gezondheid, iets wat niet voor iedereen vanzelfsprekend is. Te vaak worden eHealth-oplossingen ontworpen met een "one-size-fits-all"-benadering, die vooral gericht is op mensen die al goed geïnformeerd en gemotiveerd zijn. Hierdoor kan de gezondheidskloof onbedoeld groter worden in plaats van kleiner.

Een belangrijke oplossing ligt in een "bottom-up" benadering: eHealth-interventies aanpassen aan de unieke behoeften, vaardigheden en voorkeuren van mensen met een lage SEP door hen direct bij het ontwerpproces te betrekken. Dit biedt een veelbelovend perspectief, maar professionals lopen vaak tegen belemmeringen aan, zoals lage gezondheidsvaardigheden en culturele verschillen. Hoewel de wetenschappelijke gemeenschap steeds meer inzicht krijgt in deze obstakels, is er nog steeds een gebrek aan concrete handvatten voor professionals om hiermee om te gaan. Daarom is er een dringende behoefte aan een uitgebreide tool die bekende belemmerende en bevorderende factoren samenbrengt om het ontwerp van inclusieve eHealth-interventies voor mensen met een lage SEP te ondersteunen. Dit proefschrift beschrijft de ontwikkeling van zo'n tool voor professionals, bestaande uit drie delen: Deel A richt zich op kennisvergaring, Deel B op de ontwikkeling van de tool, en Deel C laat zien hoe deze tool in de praktijk kan worden toegepast.

Deel A: Kennisvergaring

In het eerste deel van het proefschrift onderzoeken we waarom eHealth-interventies vaak tekortschieten voor mensen met een lage SEP, en hoe participatief ontwerp kan worden ingezet om deze groep beter bij het ontwerpproces te betrekken. Hoofdstuk 2 richt zich op de houdingen van mensen met een lage SEP ten opzichte van gezondheid, gezondheidszorg en eHealth, om beter te begrijpen waarom zij wel of niet deelnemen aan gezondheidsbevorderende activiteiten en eHealth-interventies. In plaats van deze mensen van een afstand te observeren, kozen we voor een community-based participatory research benadering, waarbij de doelgroep actief betrokken werd bij het onderzoek. Door deze samenwerking ontdekten we negen verschillende profielen die uiteenlopende houdingen ten opzichte van gezondheid, gezondheidszorg en eHealth weerspiegelen. Deze profielen zijn te verdelen in twee overkoepelende houdingen: de “Optimistisch Betrokkenen”, die over het algemeen positief zijn over gezondheid, gezondheidszorg en eHealth, en de “Twijfelend Achtergestelden”, die geconfronteerd worden met obstakels en weinig vertrouwen hebben in hun vermogen om hun gezondheid te beheersen en door het zorgsysteem te navigeren. Onze bevindingen gaan in tegen de veronderstelling dat mensen met een lagere SEP niet gemotiveerd zouden zijn om gezond gedrag aan te nemen en deel te nemen aan eHealth-interventies. Integendeel, we vonden een rijke diversiteit aan houdingen binnen deze groep, waarbij de meerderheid juist een oprechte bereidheid toont om gezondheidsbevorderende activiteiten en eHealth-interventies te omarmen. Dit suggereert dat het probleem minder ligt in de onwil van de doelgroep, en meer in het ontwerp van de eHealth-oplossingen zelf.

Hoofdstuk 3 bouwt voort op onze eerdere bevindingen over het belang van het ontwerpen van eHealth-oplossingen die aansluiten bij verschillende behoeften, door te onderzoeken hoe dit bereikt kan worden via participatief ontwerp. We presenteren een case study waarin participatieve ontwerpmethoden specifiek werden toegepast om een eHealth-interventie te ontwikkelen: een slimme inhalator die bedoeld is om de therapietrouw onder astmapatiënten te verbeteren. Bij deze studie werd aandacht besteed aan mensen met lage gezondheidsvaardigheden, een kenmerk dat vaak geassocieerd wordt met een lage SEP, wat een aanzienlijk obstakel kan vormen voor deelname aan onderzoeks- en ontwerpprocessen. We richtten ons op drie participatieve ontwerpmethoden: Co-constructing stories, Experience prototype exhibition, en Video-prototype evaluatie. We ontdekten dat participatieve ontwerpactiviteiten de deelnemers succesvol wisten te betrekken, waardoor we ook een beter beeld kregen van hun motivaties en voorkeuren. Dit hoofdstuk laat zien dat er potentie is voor deze methoden tijdens het ontwerpen voor en met deze doelgroep.

Deel B: Ontwikkeling van de IeG

Het tweede deel van het proefschrift gaat in op de ontwikkeling van de tool die we de Inclusieve eHealth Guide (IeG) hebben genoemd. Dit hoofdstuk combineert inzichten uit de studies in Deel A met het onderzoek van een collega-promovenda, Isra Al-Dhahir. Onze aanpak was tot nu toe vooral “bottom-up”, met directe samenwerking met de doelgroep en een hands-on case study. Om echter een volledig beeld te scheppen, hebben we ook gebruik gemaakt van Isra’s “top-down” perspectief, gebaseerd op bestaande literatuur en vaak voorkomende belemmerende en bevorderende factoren die door professionals zijn geïdentificeerd. In dit hoofdstuk ligt de focus op het samenvoegen van beide perspectieven om de IeG te ontwikkelen: een praktische tool voor professionals om inclusieve eHealth-interventies te ontwerpen. Door een participatieve aanpak hebben we 16 eisen voor het ontwerp van de tool geïdentificeerd en deze geïntegreerd in de eerste versie van de IeG.

Deel C: Toepassing van de IeG

Het laatste deel van het proefschrift gaat in op de praktische toepassing van de IeG in een specifieke situatie: de ontwikkeling van een eHealth-interventie specifiek voor mensen met een lage SEP in de context van hartrevalidatie (HR). Hoofdstuk 5 beschrijft het ontwerpproces van deze interventie, waarbij we de behoefte van patiënten met een lage SEP in kaart brachten. We leerden dat patiënten de behoefte hadden om zich zekerder en beter begeleid te voelen tijdens hun wachttijd voorafgaand aan HR. Samen met de doelgroep hebben we eHealth-interventie ontwikkeld die aan deze behoefte voldoet. Het implementeren van de IeG tijdens dit proces leverde vier belangrijke lessen op die toekomstige ontwerpers kunnen helpen bij vergelijkbare case-specifieke toepassingen van de IeG: het belang van het beheren van middelen, de waarde van participatieve methoden, en de noodzaak van personalisatie en eenvoud in het ontwerp van eHealth-interventies.

Hoofdstuk 6 beschrijft de evaluatie van de haalbaarheid en effecten van de ontwikkelde interventie op het gevoel van zekerheid en begeleiding bij patiënten met een lage SEP. De resultaten laten zien dat er potentie is voor de interventie en de IeG. De interventie werd goed gebruikt en geaccepteerd door de deelnemers. Hoewel de kwantitatieve data geen significante verbeteringen in zekerheid en begeleiding lieten zien, suggereren kwalitatieve inzichten dat de interventie wel voordelen kan bieden op deze gebieden. De resultaten tonen aan dat de toepassing van de IeG kan leiden tot de ontwikkeling van interventies die zowel worden gebruikt als geaccepteerd door mensen met een lage SEP. De IeG kan een waardevol hulpmiddel zijn voor professionals die inclusieve eHealth-interventies willen ontwerpen.

Conclusie

Dit proefschrift draagt bij aan het verkleinen van de gezondheidskloof door de ontwikkeling en toepassing van de IeG, een praktische tool voor het ontwerpen van inclusieve eHealth-interventies. We hebben diverse subgroepen binnen lage SEP geïdentificeerd, elk met specifieke behoeften. De optimistisch betrokkenen, bijvoorbeeld, kunnen het meeste baat hebben bij een hybride systeem dat de persoonlijke connectie met zorgverleners behoudt en benadrukt. Bij de twijfelend achtergestelden is veel te winnen met eHealth. Deze groep kan ondersteund worden door medische informatie eenvoudiger te maken, gebruiksvriendelijke interventies te maken en een gevoel van zowel succes als controle te bevorderen. Daarnaast is er de complex uitgedaagde groep, die het moeilijkst te bereiken is via eHealth-interventies, en meer baat zou kunnen hebben bij de integratie van wijkgerichte programma's en initiatieven. Verder belichten onze bevindingen het belang van het overbruggen van theoretische kennis en praktische toepassing, zoals gedemonstreerd door de IeG en onze case study. Ten slotte belicht dit proefschrift belangrijke handvatten voor het ontwerp en de ontwerpprocessen van eHealth-interventies. Participatief ontwerp blijkt een waardevolle aanpak voor het ontwikkelen van inclusieve eHealth-interventies, mits er voldoende middelen worden toegewezen. Wat betreft het ontwerp zelf, benadrukken we dat er meer focus moet liggen op gepersonaliseerde en stimulerende interventies. Door deze aspecten aan te pakken, kunnen we bijdragen aan het verkleinen van de gezondheidskloof.

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About the author

Jasper was born on July 24, 1994, in Bloemendaal. He completed his pre-university education at Lyceum Sancta Maria in Haarlem, graduating in May 2012. He then pursued a bachelor's degree in industrial design at the Technical University of Eindhoven and graduated in March 2017.

Jasper continued his academic journey by obtaining a master's degree in Integrated Product Design with a Medisign specialization, graduating Cum Laude from the Delft University of Technology in July 2019. Jasper's graduation project was conducted at the LUMC and National eHealth Living Lab in collaboration with AstraZeneca. He developed a smart asthma inhaler designed for patients with low health literacy, leading to his subsequent PhD research.

Starting in September 2019, Jasper started his PhD project as part of the Medical Delta program: "eHealth and self-management". His research was conducted at both TU Delft and Erasmus MC, in collaboration with Capri Cardiac Rehabilitation. Throughout his PhD, Jasper conducted various types of research, including ethnographic community-based research with vulnerable groups, the development of an online tool for knowledge distribution, and the development of an eHealth intervention in the context of cardiac rehabilitation.

In addition to his research, Jasper was actively involved in teaching and student supervision at TU Delft and Erasmus MC. He published several first-author papers in peer-reviewed scientific journals and presented his work at various national and international scientific conferences. Jasper also served as president of the Young Medical Delta board, where he facilitated connections between young professionals passionate about medical technology and organized events such as symposia, hackathons, and award ceremonies.

Currently, since March 2024, Jasper has begun a postdoctoral position at the Delft University of Technology. As part of the Healthbox consortium, he is developing user profiles through codesign with end-users. This new chapter in his academic career highlights his passion and commitment to advancing inclusive, human-centered health technology through design.

List of publications

Journal publications, accepted

Faber, J. S., Al-Dhahir, I., Reijnders, T., Chavannes, N. H., Evers, A. W. M., Kraal, J. J., van den Berg-Emons, H. J. G, & Visch, V. T (2021). Attitudes Toward Health, Healthcare, and eHealth of People with a Low Socioeconomic Status: A Community-Based Participatory Approach. Frontiers in Digital Health, 3. doi: 10.3389/fdgth.2021.690182

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Al-Dhahir, I., Breeman, L. B., **Faber, J. S.**, Wentzel, J., Kraal, J. J., van den Berg-Emons, H. J. G., Janssen, V. R., Kraaijenhagen, R. A., Visch, V. T., Chavannes, N. H., & Evers, A. W. (Submitted for review). Content evaluation of the inclusive eHealth guide: How to develop interventions for people with a lower socioeconomic position? Patient Education and Counselling.

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Faber, J. S., Al-Dhahir, I., Reijnders, T., Kraal, J. J., Evers, A. W. M., Chavannes, N. H., van den Berg-Emons, H. J. G., & Visch, V. T. (2021). Attitudes towards health, healthcare and eHealth in a disadvantaged neighbourhood – A community-based participatory approach. Oral presentationat EHPS, Online Conference, 2021.

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Workshops

Houtman, T. & **Faber, J. S.** (2023) Improving the science/society loop by design: how can we strengthen the impact of behavioral science? Dare2Share session at ISBNPA, Uppsala, 2023

Houtman, T. & **Faber, J.S.**, (2023) Gedragsinzichten toepassen met design thinking. Workshop at Congres Gedragsinzichten voor een Gezonde Samenleving, Mechelen, 2023.