Design and evaluation of an eHealth application that aims to support bariatric patients with lifestyle changes after bariatric surgery

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Abstract

Background: There is a general consensus that bariatric surgery is the most effective intervention to achieve significant weight loss. Nevertheless, a large group of bariatric patients who underwent the surgery do not achieve or maintain successful weight loss during the first two years after the surgery. In order for patients to achieve and maintain weight loss after bariatric surgery, it is crucial for them to change to a healthier lifestyle after the surgery and maintain this lifestyle. eHealth could be beneficial in supporting patients with changing their lifestyle. However, little is known about the needs of post-bariatric patients regarding lifestyle change support and how this can be translated to an eHealth intervention. Therefore, the aim of this study was to design and evaluate an low-fidelity prototype of an eHealth application that aims to support postoperative bariatric patients into making lifestyle changes which fits the needs of post-bariatric patients.

Methods: First, a literature search was conducted to gain insight into the state-of-art in eHealth interventions for post-bariatric patients that with the aim to promote lifestyle changes with the publication date of 2011 to 2021. Second, semi-structured interviews with healthcare professionals (n=6) and post-bariatric patients (n=7) were conducted to gain insight into the their opinions and experiences of the current post-operative care. Third, requirements for a possible eHealth application for post-bariatric patients were made using the outcomes of the literature search and interviews. Next, a low-fidelity clickable prototype was created using the 'must have' requirements that were made. With this prototype, usability tests were conducted by post-bariatric patients (n=5). Finally, the prototype was evaluated with the same patients using of the System Usability Scale (SUS) and follow-up questions in the form of a small survey and interview.

Results: Ten studies with eHealth interventions were included to the literature search. Functions of the interventions mainly consisted of components regarding self-monitoring, education, tele-support from healthcare professionals and reminders. The study outcomes of the studies were mostly positive. From the semi-structured interviews it became clear that most of the patients valued the group support from other bariatric patients, the support from healthcare professionals and the education that was given during the postoperative care. Overall improvements for the current postoperative care that were mentioned, were for the care to be more personalized to the patients and for the commitment and adherence of the appointments to be improved. A total of 31 requirements were created for the possible eHealth application, which could be divided into the following themes: weight loss behavioural skills support, support from others, planning and appointments, and motivational support and reminders. The resulting prototype consisted of self-monitoring components, educational components, features for healthcare professionals and other bariatric patients to support the patient and the ability to attend appointments remotely. The usability tests and evaluation of the prototype suggested the overall usability, experience and satisfaction of the components to be positive.

Conclusion: The resulting low-fidelity prototype was received positively by post-bariatric patients. However, it is recommended in future studies to let post-bariatric patients test a more functional version of the prototype for a period of time to ensure more valid outcomes on their experiences and opinions of the prototype. Furthermore, the prototype should continue to be improved and evaluated by stakeholders to ensure that the application is in line with their wants and needs.

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1. Introduction

Over the past 45 years, the worldwide prevalence of obesity has nearly tripled (5). With more than 650 million adults being obese in 2016, obesity has become one of the top health concerns globally (5, 6). In the Netherlands, 14,7% of the population from the age of 18 years were obese in 2019 (7). Obesity has been defined by the World Health Organization (WHO) (5) as: "abnormal or excessive fat accumulation that may impair health". The Body Mass Index (BMI) is used to classify obesity: obesity class I (BMI from 30 kg/m^2 to 34.9 kg/m^2), obesity class II (BMI from 35 kg/m^2 to 39.9 kg/m^2) and obesity class III (BMI greater than or equal to 40 kg/m^2). Class II with obesity-related comorbidities and class III classified as severe or morbid obesity (8). An increase of BMI starting from 25 kg/m^2 is associated with a higher chance of (co)morbidity, such as type 2 diabetes, cardiovascular diseases and cancer, which increases the chance of mortality. Furthermore, an increase of BMI starting from 23 kg/m^2 is associated with a higher risk of death (8, 9).

Obesity is mainly the result of excess energy consumption with respect to the energy expenditure for a prolonged period. In other words, the body is gaining more energy through food intake than it is losing it through metabolic and physical activity, which ultimately results in weight gain. However, obesity can also be caused by different factors, such as genetic, metabolic, behavioural and environmental influences (9-11). Given the rapid growth of the prevalence of obesity, it can be suggested that behavioural and environmental influences may play a bigger role in the current prevalence of obesity than biological influences does (9, 12). Nowadays, an increasing amount of food is created that are high in calories, fat and/or sugar which has become more affordable and easily accessible for the public, for instance fast food, food in vending machines and microwavable food. The level and amount of physical activity has also drastically decreased compared to decades ago, while the amount of sedentary behaviour is increasing, e.g. more time is spend watching tv, playing videogames, and life has become easier due to technology/machines, like going to work by car instead of by bike (9-11). These influences can also be called by the term 'obesogenic environment', where the environment promotes obesity (13).

Management and treatment of obesity consists of (I) lifestyle interventions, e.g., dietary-, exercise and behavioural therapy and (II) pharmacological treatment (14). When it has been proven that these interventions do not result in sufficient and long-term weight loss to the patient, the patient is eligible for (III) surgical interventions (bariatric surgery) as a last resort (15). To be qualified for the surgery, the patient -among other things- also has to be classified in obesity class III (severe or morbid obesity) or in class II with obesity-related comorbidities (14). Currently, there is a general consensus that bariatric surgery is the most effective intervention to achieve significant weight loss and to manage or reduce comorbidities (16, 17). There are different types of bariatric surgery, of which the Roux-en-Y Gastric Bypass, Sleeve Gastrectomy and Mini Gastric Bypass are the most frequently performed bariatric surgery procedures (18). These procedures are shown in figure 1.

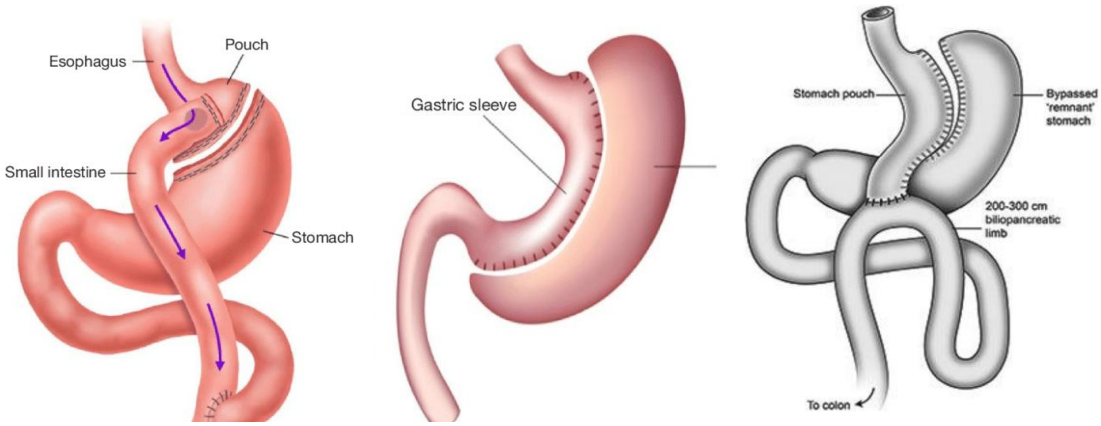

Figure 1. Roux-en-Y Gastric bypass, Sleeve Gastrectomy and Mini Gastric bypass (3) (4)

Postoperative care

Successful weight loss after the surgery is defined as losing 50% of the excess weight or 20% of the total weight (19). However, several studies (16, 20, 21) have reported that approximately 15-35% of the patients who undergo bariatric surgery, do not achieve or maintain successful weight loss during the first two years after the surgery. Poor eating behaviour, poor diet, and lack of physical activity has shown to be the most important lifestyle predictors of weight regain (regain of weight after initial successful weight loss) and unsuccessful weight loss after bariatric surgery (22-26) (27). Therefore, lifestyle and behavioural changes after the surgery are crucial in achieving and maintaining weight loss. During the postoperative care, patients are -among other things- supported and guided by healthcare professionals to go through this process of lifestyle and behavioural changes. This consists -among other things- of multiple group meetings with different health professionals, such as dietitians and physiotherapists, who will guide and support patients during the first few years to live a healthy lifestyle. These healthcare professionals help patients, for example, to get insight into their eating and physical behaviour and guide them on how this behaviour can be changed to achieve and maintain weight loss.

However, it has been reported that a significant amount of patients are not adherent to the current postoperative care, which results to patients not attending to (group) meetings (after a period of time) (28-30). This is a problem, since a low adherence and attendance rate of postoperative (group) meetings has also been shown to be also an important predictor of unsuccessful weight loss and weight regain after bariatric surgery (25, 26, 28, 30). The lack of adherence and the percentage of unsuccessful weight loss can indicate that the current post-operative care process might not sufficient enough or not in line with the needs for a part of the patients for them to achieve and/or maintain weight loss.

eHealth and post-bariatric patients

According to Eysenback (31), eHealth can be defined as:

"an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology."

eHealth interventions can be used for multiple purposes in the healthcare: e.g. with the use of eHealth, prevention, education, therapy and care can be delivered through the digital technology. Also, eHealth is not limited by being one type of technology: eHealth can be seen a an umbrella term that consists of multiple types of technology. For example, telemonitoring, telemedicine and mobile health (mHealth). Furthermore, eHealth can give the opportunity for the conventional healthcare with the healthcare professional to be merged with digital interventions. This can also be referred as blended care (32).

The use of eHealth interventions following bariatric surgery is suggested to be beneficial to promote lifestyle change by several studies (33) (34) (35) (36) (37) (38). For example by self-monitoring the physical activity, diet and weight (33) (34), by receiving education (35) (38), and by receiving support and care remotely from healthcare professionals through the intervention (36) (37). The results of these interventions were found to be promising to promote lifestyle change following bariatric surgery. For example, it was found that patients experienced more weight loss when using self-monitoring components through a mHealth application (33) or received education through online modules (38) than patients who did not used an intervention.

However, most of the studied interventions consisted of features that was targeted on only one or two purpose(s). For example, only focussing on self-monitoring features or only on educational features.

Furthermore, a few of the studied interventions consisted of already existing lifestyle applications (e.g. MyFitnessPall) that are aimed at the general population (37), instead of post-bariatric patients.

Most importantly, there is limited known about the actual needs of bariatric patients regarding lifestyle change support after surgery. It is crucial to make sure that the developed eHealth technology fits the needs of its end-users -in this case the bariatric patients- since this can increase the chances of successful adoption and long-term use of the technology. Adoption refers to the decision of the patient to start using the technology (1).

Therefore, it would valuable get insight into the needs of post-bariatric patients regarding the lifestyle change support after surgery, and design an 'all-in-one' eHealth application that fits on these needs.

Aim, research questions and approach

The aim of this study was to design and evaluate an low-fidelity prototype of an eHealth application that aims to support postoperative bariatric patients into making lifestyle changes. This was done with a holistic approach where the application is designed based on the context, the experiences and opinions of healthcare professionals and bariatric patients, and existing literature. To achieve the research aim, research questions were developed. These research questions were divided into three phases. The phases, research questions and approach of this study can be found in table 1.

Phase	Research questions	Method	Outcome
Phase 1.1: Contextual inquiry	1. What is the state-of-art in eHealth interventions for bariatric postoperative care to support lifestyle changes?	Literature search	Table with the state-of-art of eHealth interventions for post-bariatric patients

Phase 1.2: Contextual inquiry	2. What does the current postoperative care look like for bariatric patients, and what are strong points and points of improvements?	Semi-structured Interview	The opinions, experiences and wishes of the current postoperative care of bariatric patients and healthcare professionals
Phase 2: Value specification	3. What are the needs and values of an eHealth application for bariatric patients in the postoperative care?	Eliciting requirements	Requirements for the eHealth application
Phase 3: Design	4. How is the resulting prototype of the eHealth application received in terms of usability?	Digital prototyping Usability test and evaluation	Low-fidelity prototype of an eHealth application Usability of the eHealth application and patient's opinion on the prototype

Table 1. Phases, research questions and approach of the study

Overview of approach

The study was divided in three phases, in which several methods were conducted within these phases.

First, a literature search was conducted for the first phase to gain insight into the state-of-art of previous studies on eHealth interventions for post-bariatric patients (chapter 3). In particular, eHealth interventions that were focused on promoting behavioural and/or lifestyle changes. This was done by searching electronic databases with search terms and screening the resulting articles with specified inclusion criteria. After data regarding the researched interventions were extracted from the included articles.

Second, semi-structured interviews with post-bariatric patients and healthcare professionals were conducted (chapter 4). This was to gain insight into, and to explore points of improvement of the current post-operative care for post-bariatric patients. Questions were also asked about the experiences and opinions on eHealth (applications). Pre-determined open-ended questions are asked to the participants during this method. It is however also possible to deviate from the questions when deemed relevant or to ask follow-up questions on certain answers of the participant to gain deeper understanding (39). This allows the researcher to explore the thoughts, feelings and beliefs of the participants on a certain topic (40), in this case: the post-operative care and the use of eHealth (applications). A literature review was also conducted to gain insight on the state-of-art of previous studies on eHealth for post-bariatric patients (chapter 3). This method explores existing knowledge through previous studies about a certain topic, and explores which researched components 'worked' or 'did not work' (41). In this study that would for example mean: which functions of an eHealth technology generated favourable outcomes, such as more weight loss or more chance of long-term use, and which functions did not.

Third, requirements for the first version of the eHealth application were drawn up in the second phase of this study (chapter 5). These requirements were based on the needs and values that were obtained from the outcomes of the first phase.

Lastly, using the requirements, it was possible to design the first version of the prototype of the eHealth application in the third and last phase (chapter 6). This prototype was then evaluated by patients to assess the good points and points of improvements of the eHealth application (chapter

7). This was done through usability testing, where patients tested the prototype by performing tasks scenarios while thinking-aloud. For example, entering the amount of calories in the prototype of the application. This gave insight into the usability of the prototype and possible points of improvements to improve the prototype. Afterwards, participants were asked about their opinions and experiences of the application.

2. Theoretical framework

As mentioned before, applying a holistic approach during the development process of eHealth technology can increase the chances of successful adoption and long-term use of that technology. The CeHRes roadmap is a framework that can be used during this process. This framework serves as guidance for a holistic approach for eHealth development, implementation and evaluation (1). Before developing an eHealth technology however, it is also important to have a proper understanding of the patients experience during the healthcare process and where technology can be of added value during this process (42). Patient journey mapping can be used to identify and visualize this. The CeHRes roadmap and patient journey mapping will be explained in further detail during this chapter.

2.1. CeHRes Roadmap

Stakeholder participation during the development process of an eHealth technology is one of the main fundamentals of the CeHRes roadmap. It is important to ensure that the to-be-developed technology fits the context of where it is going to be used, and the wishes and needs of the stakeholders. This can be achieved by involving relevant stakeholders during the entire developing process. This is also called co-creation, where the technology is developed *with* the stakeholder rather than *for* the stakeholders (1, 43).

The framework consists of six principles, which are depicted in figure 2 The five blue blocks represent the development phases of developing eHealth technology and the grey circles represent the formative evaluations during these phases. The framework acknowledges that the development process is an iterative process. Meaning that the blue phases do not have to be conducted consecutively (1, 43). So, one phase has not to be finished in order to move on to the next phase and it is possible to go back to a certain phase, which makes the process flexible and dynamic (1). Each phase can also be evaluated during the formative evaluation with, for example, the stakeholders. After an evaluation of a phase, it is possible to revise and improve that phase according to the outcomes of the evaluation. This ensures that possible problems and misunderstandings during the development process can be dealt with in the early stages, and that the technology fits with the context and the stakeholders (1).

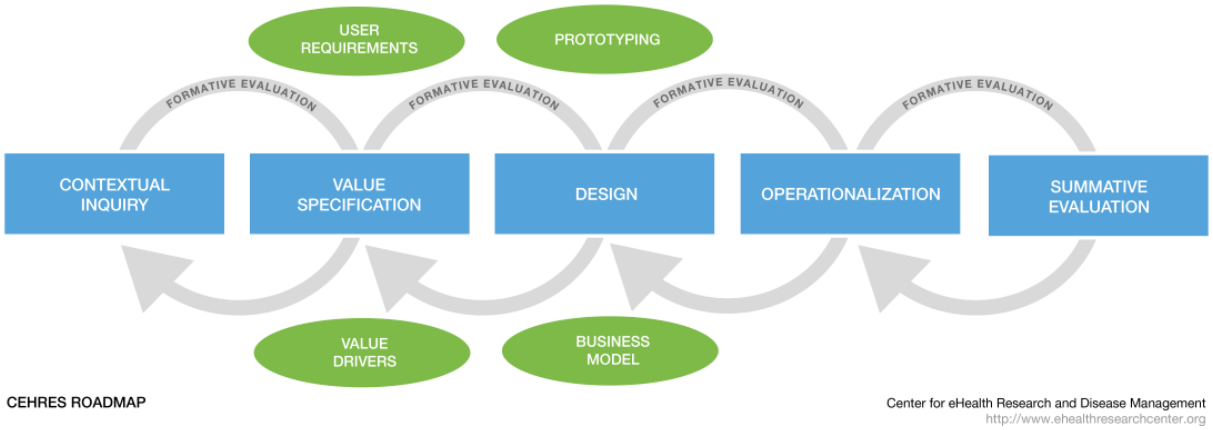

Figure 2. CeHRes Roadmap (1)

The first three phases of the CeHRes Roadmap were used as guidance during this study, since the aim of this study was to design and evaluate an eHealth application for post-bariatric patients. The five phases and the formative evaluation are explained below (1, 43):

Contextual inquiry
The goal of the contextual inquiry is to obtain insight into stakeholders, and the environment of where the eHealth technology is meant to be used in. This is firstly done by identifying relevant stakeholders, these are people who are affected by or affect the technology. Then information about the current situation, and the experiences and opinions of the stakeholders on this situation are collected. This results into weak and strong points of the current situation, which then gives an idea of where eHealth technology can be of value in this context.

Value specification
Results of the contextual inquiry are used as input of the value specification. In this phase it is made clear what the values from the stakeholders are according to them and in what way a technology can be of added value for them. Specific requirements for the design and the functions of the possible eHealth technology can then be drafted using these values.

Design
Next, the requirements are translated into a design for the eHealth technology. Prototypes, mock-ups or storyboards can be created to visualize the requirements and the functions. This can then be used to be tested with the stakeholders to evaluate if the technology fits with their wants and needs, and the context. The initial prototype, mock-up or storyboard can then be adjusted and improved accordingly.

Operationalization
In the fourth phase of ceHRes roadmap, plans are made for the introduction, implementation and to ensure long-term use of the eHealth technology.

Summative evaluation
During the last phase, the impact of the eHealth technology on the stakeholders and the environment are evaluated. This can be done by measuring the effects and/or behavioural changes at a given time. Uptake of the technology is also evaluated: is the technology used as intended and is it being used in the long-term.

Formative evaluation
This principle is connected to each phase of the CeHRes roadmap. It can be used between each phase where at the end of the phase it is evaluated if the outcomes of the last phase have been incorporated in this phase and vice versa. For example if the requirements are incorporated in the design of the technology and vice versa. This principle can also be used within the phases by conducting activities that evaluate if the development process is still in line with the wants and needs of the stakeholders and the context.

2.2. Patient journey mapping

The patient experience, along with patient safety and clinical effectiveness, is one of the key pillars for the quality of healthcare (44, 45). Therefore, providing good patient experience is crucial in order to provide high quality healthcare (44-46). The patient experience can be defined as all the patient interactions with the healthcare system where the experience of the patient is shaped (44, 47).

Patient journey mapping is a method to visualize the perspective and experiences of patients during their journey of receiving healthcare service (42, 44). 'Touchpoints' between the patient and the healthcare service are firstly identified (44). These are moments when the patient comes in contact with the service provided by the healthcare, such as having an appointment with the doctor in the hospital. These touchpoints can be identified for a certain period. For example, from receiving pre-operative care to receiving post-operative care, or from being admitted to the hospital for surgery to being discharged from the hospital. The patient experience and opinions are then identified for each of the touchpoints. This can give insight into points of improvement during a specific point of the care process when looking from the perspective of the patient. Improving these points can increase the quality of the given care for patients (42, 44).

Patient journey mapping can also play an important role in the eHealth development process. The first step of designing, developing or implementing a technology is having proper insight and a good understanding of the patients' journey during the setting where the technology is designed for. Patient journey mapping can be valuable during this phase, since it can be used to identify where technology can play a role to improve care or where it can be a solution for a problem during the patient journey (42). Because of this reason, principles from this method were used for this study.

2.3. Guidelines postoperative care bariatric surgery

The Nederlandse Vereniging voor Heelkunde (NVvH) was one of first to develop a guideline (2011) for the Netherlands regarding postoperative care for patients that underwent bariatric surgery. At the initiative of NVhH, the Federatie Medisch specialisten renewed the guideline (2020) with newly acquired knowledge regarding care for bariatric patients.

The renewed guideline states that one month after the surgery, there should be a follow-up at least every three months in the first year. After this, annual follow-up should be held by a multidisciplinary team. Points of attention during these follow-up sessions should be to educate patients about and to assess adequate nutrition, exercise and behavioural change.

Compliance with nutritional and physical activity guidelines is important for successful and long term weight loss. That is why it is necessary to educate the patients on what the guidelines are, on importance of following these guidelines and on how to change behaviour to reach those guidelines. Furthermore, patients should be able to periodically consult a bariatric dietician to discuss and asses their nutrition intake. Regarding the physical activity, it is advisable to involve a physiotherapist to guide patients to how to slowly increase physical activity and to prevent injuries. It is also advised to have patients attending to (group) meetings after the surgery, as these patients have shown to have better weight loss than who did not attend.

In addition, the guideline of NVvH mentioned the importance of psychological care and guidance after the surgery. It is stated that psychologists should primarily focus on teaching patients to set realistic goals and teaching on how to change behaviour. It is also recommended to monitor the postoperative process (e.g. therapy adherence, mood and social support), and the outcome measures (e.g. weight and quality of life). This way it can be detected earlier when patients need additional psychological care.

The guideline recommends to refer the patient to a psychologist when there is deviant progression of one or more of the following indicators

- weight;
- quality of life;
- psychological functioning (e.g. mood, disturbed eating behaviour, addiction, compulsion);
- limited compliance with agreements, and dietary and exercise recommendations.

Finally, it is recommended to facilitate contact with other bariatric patients during the postoperative care. This way patients are able to help and support each other. Which ultimately can lead to positive weight and psychological outcomes.

3. Phase 1.1: Contextual inquiry – Overview eHealth interventions

During this chapter a literature search was conducted. The obtained literature was used to get insight on the state-of-art in eHealth interventions for post-bariatric patients. In particular, eHealth interventions that were focused on promoting behavioural and/or lifestyle changes. The effect of these interventions on the patients, and the experiences of the interventions were also explored.

3.1. Method

Search strategy

The literature search was conducted in August 2021 using electronic databases PubMed, SCOPUS, and Web of Science. The publication date of the search was limited from 2011 to 2021. Two search strategies were executed, where MeSH terms and synonyms were used as search terms. The search terms of the first strategy were specified based on the PICO (Patient, Intervention, Comparator and Outcome) model. The comparator (C) and outcome (O) were not included in the search terms, since it was aimed to find as many relevant articles as possible. The following terms were used: P = (patients who underwent) *''bariatric surgery''*, I = *''eHealth intervention''* (that is used during the) *"postoperative care"*. The second search strategy used the same terms as the first strategy. Except, the terms that were specified on the postoperative care were left out to find possible eligible articles that might were excluded due to these terms. Both search strategies can be found in table 2.

Search strategy	Database	Search terms	Amount of hits
1	Pubmed	("Bariatric surgery" [MeSH] OR "Post-bariatric") AND ("Postoperative care" [MeSH] OR "Aftercare" [MeSH] OR "Follow-up") AND ("Telemedicine" [MeSH] OR "eHealth" OR "mHealth")	
	SCOPUS	(TITLE-ABS-KEY ("Bariatric surgery") OR TITLE-ABS-KEY ("Post-bariatric") AND TITLE-ABS-KEY ("Postoperative care") OR TITLE-ABS-KEY ("Aftercare") OR TITLE-ABS-KEY ("Follow-up") AND TITLE-ABS-KEY ("Telemedicine") OR TITLE-ABS-KEY ("eHealth") OR TITLE-ABS-KEY ("mHealth"))	
	Web of Science	(ALL=("Bariatric surgery") OR ALL=(“Post-bariatric”)) AND (ALL=(“Aftercare”) OR ALL=(“Follow-up”) OR ALL=(“Postoperative care”)) AND(ALL=(“Telemedicine”) OR ALL=(“eHealth”) OR ALL=(“mHealth”))	
2	Pubmed	("Bariatric surgery" [MeSH] OR "Post-bariatric") AND ("Postoperative care" [MeSH] OR "Aftercare" [MeSH] OR "Follow-up") AND ("Telemedicine" [MeSH] OR "eHealth" OR "mHealth")	
	SCOPUS	(TITLE-ABS-KEY ("Bariatric surgery") AND TITLE-ABS-KEY ("Telemedicine") OR TITLE-ABS-KEY ("eHealth") OR TITLE-ABS-KEY ("mHealth"))	
	Web of Science	ALL=("Bariatric surgery") AND (ALL=(“Telemedicine”) OR ALL=(“eHealth”) OR ALL=(“mHealth”))	

Table 2. Search strategy

Screening and inclusion criteria

Duplicates within each search strategy were removed. After that, duplicates between the two strategies were removed. The title and abstract of the unique articles were screened using the inclusion and exclusion criteria listed in table 3. The criteria was based on the PICOS (Patient, Intervention, Comparator, outcome and Study design) model. Articles were removed based on these criteria. After that, the full text of the remaining articles were assessed for eligibility using the same inclusion and exclusion criteria. The full text articles were independently assessed by two researchers (T.V. and S.A). Next, the two researchers presented to each other and compared which articles they viewed as eligible or not. If there was a disagreement, the two researchers would discuss until consensus was reached. When there was uncertainty about the eligibility of an article, they would also discuss until consensus was reached.

PICOS	Inclusion criteria	Exclusion criteria
Patients	- Patients who underwent *bariatric surgery*	
Intervention	- *eHealth interventions* that are used during the *postoperative care* of patients - Intervention stimulates behavioural/lifestyle change	- Interventions that are solely focused on medical variables. E.g. blood pressure, blood sugar and complications after the surgery
Comparator	- Control group is not required	
Outcome	- The *effect* of the intervention on patients and/or the *experiences* of patients on the intervention in terms of weight loss, intervention satisfaction and behavioural change	- Effects that are solely focused on medical variables. E.g. blood pressure, blood sugar and complications after the surgery
Study design	- Experimental, observational and qualitative studies	- Systematic reviews and study protocols

Table 3. Inclusion and exclusion criteria for literature search

Data extraction

The following information was extracted from the eligible articles by one researcher (T.V.): study design, type of eHealth intervention that was being researched, the functions of the intervention, how long the intervention was being used, how long after the surgery the intervention was being used and what the key findings were after using the intervention.

3.2. Results

Study selection

The two search strategies resulted in a total of 267 studies, of which 111 studies were unique. After screening the title and abstract of these unique studies, 87 articles were excluded. After this, the remaining 24 articles were fully screened for eligibility, of which 14 articles were excluded. Consequently, ten articles were included in this study. Excluded articles had no eHealth intervention that was being studied, had the wrong target group or study design, had no full text, or reported nonrelevant outcomes, such as the effect of the intervention on complications after bariatric surgery. A visualization of the study selection process can be found in figure 3.

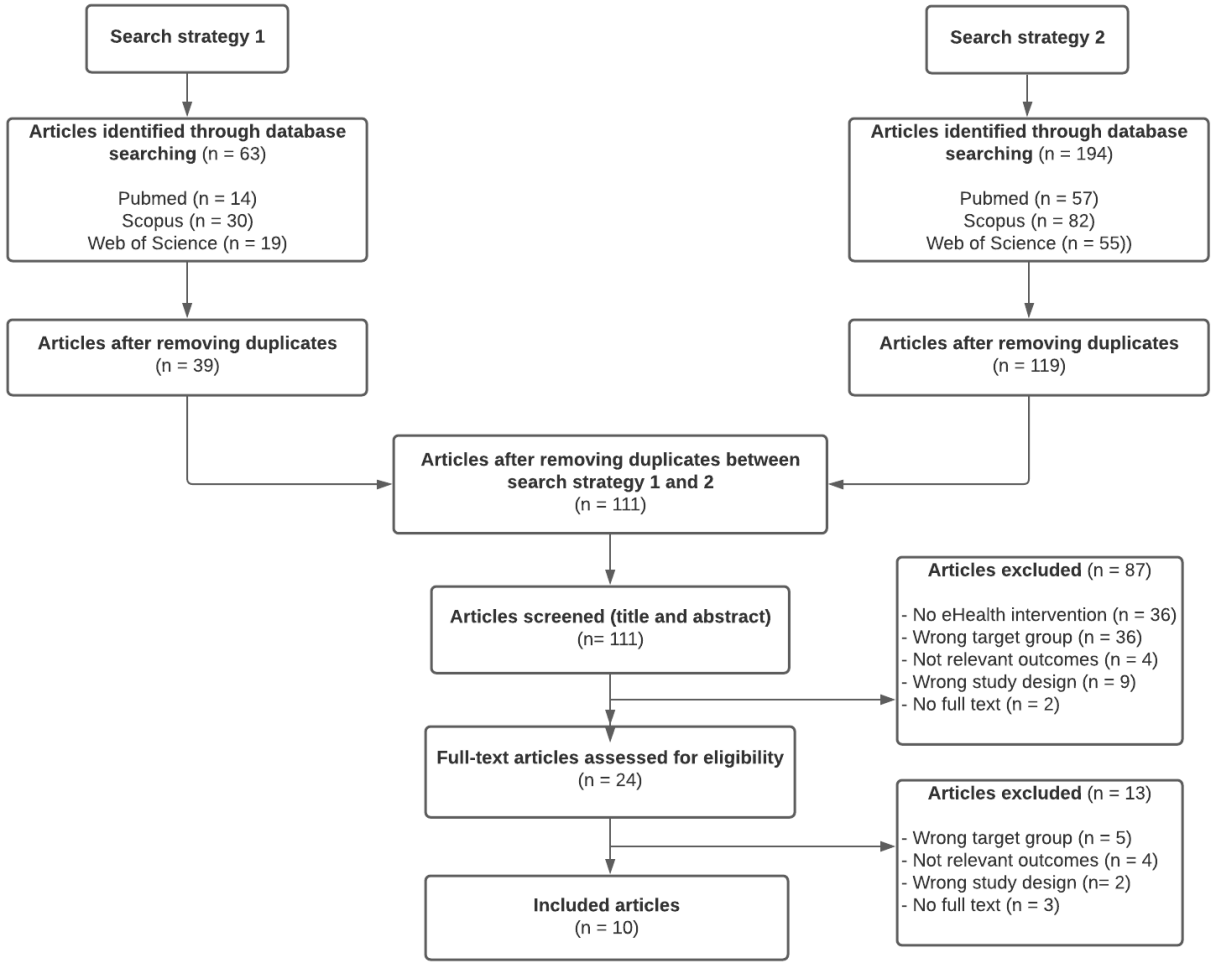

Figure 3. Study selection process

Data extraction

The extracted information of the final ten articles, was divided into the different types of mode of intervention delivery: the interventions were delivered through the telephone, mobile phone, a website, or through multiple platforms. The summary of the extracted information can be found in table 4. The patient characteristics and sample size of the ten articles can be found in appendix A

Study			eHealth intervention		
First author, year	**Design**	**Outcome measures**	**Type, duration and time**	**Components**	**Key findings**
A. Arnaert (2021) **(48)**	Qualitative study	- Exploring experiences participants receiving intervention	**Type**: Telemonitoring platform **Time:** 1 month **Duration**: During the first 6 weeks after surgery	Focused on medical complications: - Videoconferencing - Remote physiological monitoring - Keeping track of daily food record - Weekly entries of body weight - Tailored patient education material - Telenurse calls when clinical data was outside of expected patient-specific parameters Focused on stimulating behavioural change: - 14 days after questionnaire about to support the patient to adhere to healthy nutrition and exercise guidelines (and follow up on psychological	- Some patients felt more stimulated to comply to recommended lifestyle behaviours due to daily questionnaire
L. E. Bradley (2016) **(38)**	Open trial design	- Weight change - Intervention acceptability and feasibility - Eating-related and physical activity variables - Acceptance-Based process variables	**Type**: Remotely delivered intervention **Time:** At least 1.5 years after surgery **Duration**: 10 weeks	10 weekly online modules consisting of: - E-learnings - Interactive exercises - Examples on how other patients utilize acceptance-based treatment (ABT) skills - Quizzes aimed to support patients' understanding of the material - Assignments to be completed throughout the week	- Weight loss was maintained 3 months after intervention use - High mean rating of acceptability (4.7 out of 5) -70% retention (completed treatment) - Participants had significant weight loss after completing treatment - No differences in other eating-related and physical activity variables

				Brief check-in telephone call with a member of the study team: - to ensure understanding and utilization of ABT skills - To get feedback on weight losses and food records - Tracking daily food intake using mobile application: MyFitnessPal	
S. Cassin (2020) **(49)**	Randomized controlled trial	Modified Yale Food Addiction Scale Version 2.0 (mYEAS 2.0) (to assess food addiction symptoms)	**Type**: Telephone-based intervention (Tele-CBT) **Time:** 1 year after surgery **Duration**: 10 weeks	- Six 1-hour sessions conducted weekly over the telephone: introduction to behaviour change strategies, homework and practicing skills obtained from sessions - 1-hour 'booster' session, 4 weeks after the sixth session over the telephone: check-in to review skills learned, troubleshoot issues and developing relapse prevention plan	- mYEAS 2.0 scores were lower in the intervention group compared to control group after 3 months - mYEAS 2.0 scores were lower within intervention group after using intervention after 3 months - No differences within control group after 3 months - No differences between the two groups after 6 months
V. A. Santiago (2020) **(37)**	Qualitative study	Patients' experiences of the intervention: - Personal changes attributed to the intervention - Optimal timing of intervention - Intervention delivery format	**Type**: Telephone-based intervention (Tele-CBT) **Time:** 1 year after surgery **Duration**:10 weeks	- Six 1-hour sessions conducted weekly over the telephone: introduction to behaviour change strategies, homework and practicing skills obtained from sessions - 1-hour 'booster' session, 4 weeks after the sixth session over the telephone: check-in to review skills	Behavioural changes: - Weighing less excessively - Exercising more often - More conscious of nutrition due to tracking food intake - The intervention would be most helpful 12 months after surgery according to most participants

				learned, troubleshoot issues and developing relapse prevention plan	- Mixed opinions on treatment preference in-person or through the telephone
M. Lauti (2018) **(50)**	Parallel randomised trial	- Change in percent excess weight (%EWL) - Other wight parameters (initial mean BMI, change in BMI and percent of total weight loss) - Change in Bariatric Analysis Reporting Outcome System (BAROS) -satisfaction survey regarding intervention	**Type**: Mobile phone-based intervention **Time:** 14 – 24 months after surgery **Duration**: 1 year	(Daily) Text message support	- No differences in %EWL and other weight parameters - Intervention group tended to have less weight regain - Better BAROS score after 12 months - Almost all participants were satisfied with the intervention
C. W. Mangieri (2018) **(33)**	Prospective randomized control trial	- Percent of excess body weight loss (%EWL) - Percent of excess BMI loss (%EBL) - Quality of Live (QoL) via RAND-36 survey	**Type**: Mobile application (MyFitnessPal) **Time:** 150 – 210 days after surgery **Duration**: 24 months	- Exercise diary - Calorie intake diary - Weight tracker	- Better %EWL and %EBL compared to the non-intervention group - Improvement in weight loss results and maintenance - No differences in QoL parameters
D. P. A. Versteegden (2021) **(35)**	Retrospective review	- %TWL - User data traffic - QoL using RAND-39 survey	**Type**: eHealth platform **Time:** When referred to surgery to 3 years after surgery **Duration**: Unknown	- Information in phases (pre- and post operative content) - Weekly tips, question of the week and fact or false - Frequently asked questions - Patient experiences - Recipes by dietician - Instruction videos of exercises by physiotherapist	- No differences in %TWL between low-active, medium-active and high-active users - Participants who accessed postoperative content had higher %TWL 1 and 2 year(s) after surgery compared to who did not - No differences in QoL parameters

					- Content that was pushed to the front of the page of the platform were most viewed
C. D. Wang (2019) **(51)**	Matched case control study	- Adherence to treatment (through percentage of attendance and rate of dropout) - Physical and psychological factors - Weight change - BMI change - Rurality Index of Ontario (RIO)	**Type**: Telemedicine **Time:** Up to 5 years after surgery (mean = 2.59 years after surgery) **Duration**: Unknown	- Videoconferencing	- No differences in appointment attendance, BMI and physical and psychosocial outcomes - Mean RIO scores were lower for the non-intervention group
P. Klasnja (2020) **(34)**	Pre-post study	- Adherence to wearing the Fitbit, and to track calorie intake and weight - Difference average daily steps over 1 week between baseline and end of study (using activPAL device) - Effects on sedentary behaviour (sitting time, standing time and sit-to-stand transitions) - Difference in average daily step count between first and last 2 weeks of intervention use (using Fitbit)	**Type**: Mobile application and telemonitoring (BariFit) **Time:** 2 months after surgery **Duration**: 16 weeks	- Fitbit watch and application - Digital scale - Up to 5 text messages from the application to (1) encourage participant to be active and (2) weekly reminders to weigh themselves and to track their food intake	- 96% of the participants who connected their Fitbit accounts to the BariFit still wore the Fitbit on the last 4 days the study - Adherence to tracking calorie intake and weight decreased over time - Increased average daily step count from baseline to final week of the study - Trend towards improvement of sitting time - No differences in standing time and sit-to-stand transitions - Increased stepping time - No difference in average daily step count between the first

					and last 2 weeks of the intervention
C. I. Voils (2020) **(36)**	Single group pre-post study with qualitative interviews	- Intervention adherence - Effect size - Acceptability of intervention - Daily dietary intake - Daily physical activity	**Type**: Telephone-based intervention **Time**: 1 year after surgery **Duration**: 16 weeks	30-45 minutes telephone calls: - 4-weekly addressing behaviour change strategies for diet, physical activity and nutrition supplement adherence - 5-biweekly addressing weight loss maintenance constructs	- 93% retention (completed the intervention) - Positive adherence (mean 7.8 calls out of 9 calls received) - Small to medium effect on increased walking, moderate and vigorous intensity and total physical activity (Cohens d = 0.23-0.52)

Table 4. Characteristics of included studies

Telephone-based interventions

Study characteristics

Three studies (36, 37, 49) evaluated interventions that were telephone-based, meaning that treatment was conducted through the telephone. Two of the three studies (37, 49) evaluated the same intervention (tele-cognitive behavioural therapy). For the two interventions, treatment was divided into multiple telephone call sessions ranging from 7 (37, 49) to 14 (36) sessions per week (36, 37, 49) or biweekly (36). The telephone call lasted 30 (1,2) to 60 (3) minutes and the duration of intervention ranged from 10 (37, 49) to 14 (36) weeks. Both interventions were tested on patients that underwent surgery one year prior to their studies. Furthermore, the studies were experimental and/or qualitative studies, where the effect and experiences of the interventions were evaluated.

Intervention contents

Contents of both interventions primarily focused on teaching *weight loss behavioural skills* to the patients, such as creation goals (36, 37, 49), action plans (36, 37, 49) and how to self-monitor their weight (36, 37, 49), food intake (36, 37, 49),and physical activity (36). Problem-solving skills (36) were also taught to handle and overcome challenging (food) situations. For example, by "identifying counterproductive thoughts that lead to maladaptive behaviour, and to change these counterproductive thoughts into more adaptive ones"(36).

Furthermore, both interventions paid great attention on *educating* and bringing *awareness* to the patients on the lifestyle changes after the surgery. For example, by educating patients about the food intake (36), exercising and physical activity guidelines. Also, by identifying the places, people, and foods that make it challenging to eat healthy (37, 49), and by helping patients to understand eating behaviour (1,2) (e.g. why it is pleasurable to eat) and the importance of a regular eating pattern (37, 49).

In addition, *weight loss maintenance support* was given and *check-ups* were held during the last few telephone sessions. During these sessions the goals and behaviour change skills were reviewed (37, 49), social support was given (36), and a relapse prevention plan was formulated with the patient (36, 37, 49).

Study outcomes

After three months of starting with the telephone based-intervention, patients showed less food addiction symptoms in comparison with patients who received standard post-operative care. However, no differences were seen after six months, indicating that the intervention is at least helpful in reducing food addiction symptoms in the short term (49).

Furthermore, all -expect for one patient- experienced several behavioural changes after completing the intervention. For example, not weighting themselves everyday anymore, less mental barriers to start exercising which results to exercising more often and being more conscious of their nutrition due to tracking their food intake which results to eating in moderation (37). The increase in physical activity was also supported by a small to medium effect size on increased walking (D = 0.38), moderate intensity physical activity (D = 0.52), vigorous intensity physical activity (D = 0.52) and total physical activity (D = 0.49) (36).

In addition, most patients felt that approximately 12 months post-surgery was the most appropriate moment to since that was the weight loss started to slow down and the struggle with maintaining the weight loss began. Other patients suggested 3-4 months and 7-8 months after surgery. While another patient thinks that the timing of the intervention does not matter, but that reaching their goal mattered. This indicates that the most appropriate moment for the intervention differs per person (37).

Lastly, the telephone-based intervention (36) showed positive retention rate; 93% of the patients completed the intervention. Adherence for the intervention was also positive; average of 7.8 calls of 9 calls were received by the patients.

Mobile phone-based interventions

Study characteristics

Three studies (33, 34, 50) evaluated interventions that were mobile phone-based, meaning that the intervention conducted through the mobile phone. The duration of the intervention use variated from 16 weeks (34), 12 months (50) and 24 months (33). The interventions were tested on patients that underwent surgery between 2 and 24 months prior to the study. Furthermore, all three studies were experimental studies, where the effect of the intervention was evaluated.

Intervention contents

The mobile phone-based interventions consisted of existing mobile applications (Fitbit and MyFitnessPall) with *self-monitoring function* (33, 34), such as tracking weight ((33, 34)), calorie intake (33, 34) and exercises (34). For these functions it was necessary for the patient manually enter the data in the application (33). It was however also possible for the patient to monitor the physical activity passively using a activity tracker (Fitbit) (34), which synchronizes the activity data to the Fitbit application. A digital scale was also given to the patient (34). This scale automatically sent the data to the application after weighing themselves.

Furthermore, the mobile phone-based interventions consisted of *daily text messages* to reach behaviour change in bariatric patients (33, 50). These messages were sent once a day (50) or up to five times a day (34). The text messages contained suggestions on how patients could be active (33, 50). For example the suggestion to take a short walk, or the suggestion to stand up and briefly move around after being sedentary for an period. The messages were tailored to the time of the day, the day of the week, and current weather.

In addition, content of the text messages were based on the experienced needs of bariatric patients who had weight regain (50). These texts could, for example, contain supportive, educational messages, or messages with tips.

Lastly, text messages were used as daily reminders for the patient to track their food intake and as weekly reminders to weigh themselves (34).

Study outcomes

The mobile phone-intervention that only consisted of self-monitoring functions (33) showed the intervention group had better percentage average weight loss (%EWL) and percentage average BMI loss (%EWL) after 12 and 24 months compared to the non-intervention group ($p = 0.007 – 0.0479$). The intervention group also showed to have a more stable weight loss after using the intervention for 12 and 24 months ($p = 0.0003$). However, no differences were seen in the Quality of Life (QoL) parameters

The intervention that only consisted of daily text messages (50) showed no differences in %EWL between the intervention and non-intervention group. It was however found that the intervention group tended to have less weight regain compared to the other group. After 12 months of using the intervention, it was also seen that patients had a better Bariatric Analysis and Reporting Outcome System (BAROS) score. This system evaluates the results of obesity treatments by analysing the weight loss, changes in co-morbidities and quality of life (52). Other than that, most of the patients who received the intervention found it to be beneficial. They felt supported and more

motivated while using the intervention. In addition, they felt that the frequency and timing of the text were just right, and would like to continue receiving the text.

For the intervention that consisted of both self-monitoring functions and daily text messages (34), it was found that the average daily step count and stepping time was increased after using the intervention for two weeks, and that there was a trend towards reduction of sitting time. However, there was no differences found in the standing time and the amount of sit-to-stand transitions after using the intervention. Regarding the adherence, it was found that adherence to track calorie intake and weight was decreasing over time. Adherence for wearing the activity tracker (Fitbit) was positive, as 96% of the patients were still wearing it until the last four days of the study -so for more than 15 weeks-.

Web-based based and multi-platform based interventions

Study characteristics

Two studies (35, 51) evaluated interventions that were web-based, meaning that the intervention was delivered through the internet using a web browser. The duration of the intervention use were unknown for both studies. The interventions were tested on patients that underwent surgery up to 3 (35) and 5 (51) years prior to the studies. Furthermore, the studies were a matched case control (51) study and a retrospective review (35), where intervention users were compared with non-intervention users and where existing data of the intervention was reviewed.

Two other studies (38, 48) were web-based interventions combined with additional platforms, such the telephone for telephone calls and the mobile phone for the use of existing applications. However, the intervention of one of these studies (48) had functions that were mainly focused on medical variables, such as complications after surgery. These functions were left out from the current study since they were irrelevant for the study. The duration of the interventions use ranged from 4 (48) weeks to 10 weeks (38). The interventions were tested on patients that underwent surgery 1 month (48) prior to the study, or at least 1.5 years prior to the study (38). Furthermore, the studies were qualitative (48) and experimental (38).

Intervention contents

Contents of the web-based interventions primarily focused on giving information to the patients regarding on how to change the lifestyle after surgery and *educating* them. The given information was conveyed in various forms. For example, in the form of online modules with e-learnings (38), interactive exercises (38), quizzes (38) and assignments (38), or in the form of weekly tips (35), frequently asked questions (35), recipes by the dietician and exercise instructions by the physiotherapist. The presentation of the given information varied from the use of images (35, 38), text (35, 38), videos (35, 38) or fact sheets (35). Patients also had the ability to review the information more than once and review it again when desired to (35, 38). Patients also had the ability to attend to their follow-up appointments with the healthcare professional through videoconferencing (10). Furthermore, patients were asked to fill out questionnaires that were formulated in a way to support patients to adhere to healthy nutrition and exercise guidelines (48).

In addition to the web-based content, patients were asked to *track* their daily food intake using an already existing mobile application (MyFitnessPal) (38). Patients were also *checked-up* on through a telephone call to ensure the understanding of the given information (38), and to get feedback on their weight loss and food records (38).

Study outcomes

The web-based interventions showed no differences in %TWL between low-active, medium-active and high-active users and no differences in QoL parameters (35). The study did show that patients who accessed content that contained postoperative information had higher %TWL after 1 ($p = 0.006$) and 2 ($p = 0.034$) year(s) compared to patients who did not. However, after 3 years no difference %TWL was found. It is also notable that the amount active users of the intervention in after 2 and 3 years dropped from 1,087 users to 483 users. Content that were shown on the frontpage of the website were also viewed the most (35).

Furthermore, is was shown that videoconferencing resulted in no differences in the appointment attendance, BMI change, and physical and psychosocial outcomes (51). It did however show that the mean Rurality Index of Ontario (RIO) score to be lower for the non-videoconferencing group (RIO = 2.39) compared tot the videoconferencing group (RIO = 24.54) ($p < 0.001$). The RIO shows the level of rurality for the individual in the province, where the score of 0 to 39 is considered urban and 40 and above is considered urban. The RIO score outcomes suggest that patients that live in rural areas are more inclined to use videoconferencing than those who live in urban areas.

For the multi-platform-based intervention (38), patients showed weight loss after using the intervention ($p = 0.01$) which was maintained for at least 3 months after the use of the intervention. However, no differences were seen in other eating-related and physical activity variables, such as emotional eating, grazing behaviour and the expenditure of physical activity. Furthermore, the intervention showed to have a high mean rating of acceptably (4.7 of 5). It was, among other things, rated on the overall satisfaction of the program and the confidence in recommending the program to others. Also, the intervention showed a retention rate of 70%.

Lastly, patients expressed that they felt more motivated to comply tot the recommended lifestyle behaviours when to filling out the daily questionnaire (48). This is because patients found that the questionnaire served as a reminder and also because of the knowledge that the health professional could see the results of the questionnaire.

Summary of contents and functions

The interventions of the ten included studies displayed similar contents and functions. These contents and functions could be categorized into four different themes. Table 5 represents which themes were included in the interventions of the different studies. The contents and functions were divided into the following themes:

1. *Self-monitoring*: e.g. monitoring the physical activity, food intake and weight.
2. *Educational component*: e.g. information weight loss behavioural skills, information on lifestyle guidelines after the surgery, suggestions on how patients can be active, e-learnings and relevant tips for post-bariatric patients.
3. *Tele-support from healthcare professional*s: e.g. check-ups to ensure understanding of given information, social support and appointments in the form of videoconferences.
4. *Reminders*: e.g. reminders to enter the data for self-monitoring, and (daily) text messages and questionnaires to remind patients on behaviour change and lifestyle guidelines

Study	Self-monitoring	Educational component	Tele-support from HCP	Reminder
A. Arnaert (2021)	X (medical)	X (medical)	X (medical)	X
L. E. Bradley (2016)	X	x	X	
S. Cassin (2020)		X	X	
V. A. Santiago (2020)		X	X	
M. Lauti (2018)		X		X
C. W. Mangieri (2018)	X			
D. P. A. Versteegden (2021)		X		
C. D. Wang (2019)			X	
P. Klasnja (2020)	X	X		X
C. I. Voils (2020)		X	X	

Table 5. eHealth intervention contents and functions

3.3. Conclusion

Limited studies are conducted on eHealth interventions that are specifically made for post-bariatric patients that promotes behavioural and/or lifestyle changes. The mode of intervention delivery could be divided into: telephone-based, mobile phone-based, web-based and multi-platform-based interventions. The functions and content of the interventions could be divided into the following themes: self-monitoring, educational components, tele-support from healthcare professionals and reminders. Most of the interventions mainly focused on one or two of these themes, of which educational components were mostly included into the interventions.

The ten studies showed various -but mostly positive- study outcomes. Most of the studies showed that the interventions had positive effects on weight loss, weight maintenance and behavioural changes, such as exercising more often. The interventions also showed an overall good retention rate, acceptability rate and experiences.

4. Phase 1.2: Contextual inquiry - Semi-structured interview

4.1. Method

Design

This part of the contextual inquiry used a qualitative design involving individual semi-structured interviews with post-bariatric patients and healthcare professionals. Qualitative research is interested in collecting and analysing non-numerical data that gives the researcher insight into the attitudes, experiences, opinions and behaviour of people (53, 54). Therefore, the interviews were used to get insight on how the current postoperative care looks like. It was also used to explore the thoughts, feelings and beliefs of the stakeholders on the given postoperative care and the use of eHealth (applications) in the postoperative care.

The number of interviews for a study depends on when the thematic saturation is reached. This happens when further interviews result in no new themes (55, 56). A study (57) has shown that six to seven interviews are enough to reach the majority of the themes in a homogeneous sample. Six interviews are needed to reach 80% of the saturation. Therefore, six interviews with patients were used as a baseline for the number of interviews for this study. There are no six healthcare professionals per relevant discipline for this postoperative care. Therefore, at least one interview was held with professionals that were available per discipline.

Setting and participants

Both post-bariatric patients and health professionals were included for the interviews since they are directly involved in delivering or receiving the postoperative care, and since they are important stakeholders for the development of the eHealth application.

Patients

Post-bariatric patients were recruited during the period of March 2021 to June 2021 in Ziekenhuisgroep Twente (ZGT) Hengelo. The recruitment took place during their last mandatory group meeting -approximately six months after surgery- which was conducted by the dietician. Patients were recruited in a total of six group meetings, where every time a different group of patients were present. First, patients were recruited for the study of a PhD-candidate (E.K.), where patients were asked to wear a Fitbit smartwatch over the span of two weeks. The patients who consented to participate in the Fitbit study could indicate whether they also consented to participate in an interview. Patients who consented for the interview were eligible for this study.

Healthcare professionals

Healthcare professionals who guide and support the post-bariatric patients with the lifestyle changes after the surgery, and who are directly involved with delivering the post-operative care to the patients in ZGT were asked to participate in a interview. These health professionals were identified as the dietician, psychologist, nurse and physiotherapist. They were contacted from March 2021 to June 2021.

Interview guide

A semi-structured interview guide was created for both the health professionals and the patients. Both interview schemes were based on the principles of the Contextual Inquiry phase of the CeHRes Roadmap, where experiences and opinions of the stakeholders are collected on the current situation. This will give an idea of where and how eHealth technology can be of added value. The interview

scheme for the healthcare professionals can be found in appendix B, and the scheme for the patients can be found in appendix C.

Healthcare professionals
The interview guide for healthcare professionals contained questions to gain knowledge about what the current postoperative care looks like to identify the touchpoints between the patient and healthcare professional. This was based on the principles of patient journey mapping. Furthermore, their opinions about the good points and points of improvement for the current postoperative care, and the opinions on the use of eHealth (applications) for post-bariatric patients asked.

Patients
The interview guide for patients contained questions to gain knowledge about their experiences of the received post-operative care and their opinions on the good points and points of improvement. Principles from the patient journey mapping were used to bring structure to these questions by focusing on the touchpoints between the patients and the healthcare professionals. The answers from the interviews of the healthcare professionals on the current postoperative care were used as guideline for the interview guide. Therefore, questions about the experiences of the post-operative care were split up per health professional they came in contact with: the dietician, nurse, psychologist and physiotherapist. Next, questions were asked to gain knowledge about their experiences on changing their lifestyle. Finally, questions about their opinions on eHealth (applications) for post-bariatric patients were asked.

Procedure
Included healthcare professionals were emailed and patients were called included to set a date for the interview. During this moment of setting a date, healthcare professionals and patients were also made aware about recording the interviews to transcribe it afterwards. They were also told that the recordings would be deleted after the study was finished. Written consent was given by the professionals in an email and written consent was given by the patients through the phone. The interviews with the healthcare professionals were held through Microsoft Teams, and with the patients through the phone

First, the healthcare professionals were interviewed since information gained on what the current postoperative care looks like, could prepare the researcher on the interviews with the patients by being more knowledgeable about their received care. The interviews with the healthcare professionals lasted between 50 to 60 minutes. The interviews with the patients lasted between 25 to 35 minutes.

Data analysis
The recorded interviews were transcribed verbatim using the programme Sonix.ai. The transcripts were analysed using a qualitative data analysis software named Atlas.ti 9.0. Two researchers (T.V and E.H) coded one transcript of the patient independently from each other. First, the transcript was read by the researchers to get familiarized with the contents. Second, the transcript was broken up into sections based on the topics that can be seen in the interview scheme. Third, the broken up sections where analysed through inductive coding, in which codes were created based on the content of the data (58, 59). The following fragments were coded: those that were relevant to the research question -the strong points and points of improvement of the postoperative care- and the desired functions of the eHealth application. At last, the two researchers compared the codes of the transcript. Which fragments and how the fragments should be coded was discussed until both

researchers reached consensus. The previous four steps were repeated for two more transcripts: one of a patient and one of a health professional. The remaining transcripts where coded by one researcher. Codes with similar characteristics where combined into a category, which also can be called a main code.

4.2. Results

Participants

Patients

Nineteen post-bariatric patients agreed to participate in the Fitbit study and thirteen patients agreed to participate in the interview. Ten patients were contacted to be interviewed for this study, of which seven patients were actually interviewed, two patients were unreachable and one patient cancelled due to family circumstances. After conducting the seventh interview, it was found that there were little new themes gained. So, no other patients were further contacted to participate to the interviews.

Patient #	**Gender**	**Age**	**eHealth technology use** *(other than the provided Fitbit watch of the study by E.K)*
1	Female	67 years	Fitbit watch and mobile application to keep track of nutrition
2	Female	53 years	Mobile application to keep track of amount of steps
3	Female	51 years	Mobile application that sends reminders to drink water
4	Female	56 years	Mobile application to keep track of nutrition
5	male	49 years	Fitbit watch and mobile application to keep track of nutrition
6	Female	37 years	Mobile application that sends reminders to drink water and that keeps track of the weight
7	Female	64 years	None

Table 6. Patient characteristics

Healthcare professionals

Seven healthcare professionals were contacted, of which one dietician, one psychologist, one nurse and 2 physical therapists agreed to participate in the interview.

4.2.1. Current postoperative care

Interviews were taken of the healthcare professionals to get insight on the current postoperative care that bariatric patient are receiving from the bariatric centre in Hengelo. The postoperative care that was given during the moment of the interview will be described during this study. This postoperative care can be altered form the usual care because of COVID-19 regulations at the moment op the interviews.

Nurse

Around one week after the surgery the nurse will call the patient. In this call the nurse will assess the state of the patient by asking questions. For example, by asking them how they feel after the surgery and asking how it is going with the nutrition and hydration. Furthermore, the nurse will go through the postoperative appointments with the patient to ensure that all appointments are planned. The nurse explained that *"planning the appointments sometimes can go wrong, so it is always nice to review that with the patient"*. After that, there are no other mandatory contact moments with the nurse. The nurse expressed that *"if patients have complaints or questions, then they can call or mail us and then we will answer them".*

Dietician

In the course of one month to six months after the surgery, patients receive four mandatory group meetings with the dietician. During these meetings, several subjects and points of attention will be covered. For example, educating the patients about what proteins, carbohydrates and calories are, the importance of keeping track of these nutrients and guidelines on how much the daily intake should be. At the third group meeting an interactive game will be played with the patients, called 'the fat game'. This was to create awareness of that when you have a good foundation regarding nutrition and make conscious choices (e.g. choosing low-fat dairy products instead of high-fat diary products), then you have more room for fat from other products (e.g. a birthday cake).

The last meeting is focused on behaviour. During this meeting the changes in the lives of the patients after the surgery, will be discussed. Physical and mental changes can happen to patients after the weight loss and during the road to weight loss. Changes in the social circle of the patients can also happen where, for example, the patient is being treated differently. Most common scenarios are covered and discussions from and between the patients are encouraged. Lastly, the optional group meetings of the psychologist are brought to the attention of the patients so that patients are reminded of the option to attend to these meetings if necessary.

After the mandatory group meetings, patients are also able to sign up for two optional group meetings of the dietician. For the first optional meeting, patients can review the dates that it is going to be held on the website of the hospital and choose on which date they want attend. During this meeting information will be given about how to read labels of food and how to alter recipes. For the second optional meeting, the patient can schedule themselves when they have the feeling that they are falling back to old patterns after one or a couples year(s) after the surgery.

Psychologist

There are five optional meetings where the patient can attend to. The first four meetings are about (1) breaking eating habits and eating mindfully, (2) dealing with stress and how it relates to unhealthy lifestyle, (3) body perception, self-image and relationships, and (4) motivation and relapse prevention. During these meetings education, guidance, awareness and guidelines regarding these subjects are given to the patient.

The last meeting focuses on communication in relationships with their partner and important relatives, and what the changes after surgery can mean for the patient and their partner of close

relative. During this meeting, the patient is able to bring one important person in their life, such as their partner, child or friend. To attend to the optional meetings, the patient can review the dates that the meetings are going to be held on the website of the hospital and choose on which date they want attend.

Furthermore, patients are able to sign up for individual meetings with the psychologist when the group meetings are not enough. These patients can have a maximum of five to eight meetings with the psychologist

Physiotherapist

Six weeks -if the patient is feeling good enough to physically participate- and six months after the surgery, the patient is able to attend to the optional group meetings of the physiotherapist. For the first half of the two meetings, patients are given advice and educated on the guidelines regarding physical activity. For example, how to gradually built it up and the importance of it. During the second half of the two meetings, patients are instructed to train on some fitness equipment, such as on a treadmill. This is to make patients feel what their limits are and to create awareness of their own capabilities so that they know how they can build it up. This is because the amount of good physical activity differs per person, so it is important for the patient to feel it other than only receiving information on it.

It was chosen for the second optional meeting to have the same content as the first meeting. This is because the mindset and the life of patients can be different six months after the surgery compared to six weeks after the surgery. So it is possible that patients will look at the meeting with a different point of view during the second meeting. Additionally, the physiotherapist noticed that many patients had forgotten about the information that was given about physical activity, for example because they were more occupied with managing other lifestyle changes after the surgery. So, the second meeting is more to refresh the knowledge of the patients.

Lastly, more general information about the meetings are: that patients have to call to a certain number in order to sign up for the optional meetings and that all the group meetings are held physically. Patients are also always able to mail or call the healthcare professionals to ask questions. Furthermore, patients stay 5 years in treatment after the surgery. So, patient are able to attend to the optional group meetings during that period. Visualizations from the touch points between patients and healthcare professionals can be found in Figure 4 .

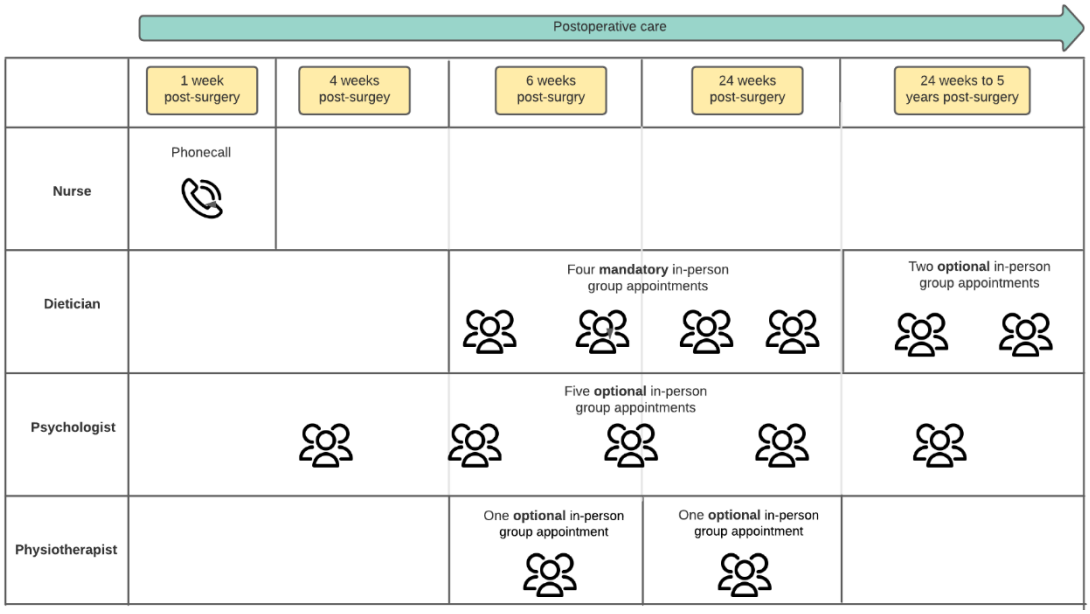

Figure 4. Touch points between post-bariatric patients and healthcare professionals during the postoperative care

4.2.2. Opinions, experiences and wishes of postoperative care

The interview outcomes could be divided into the following main codes: support during treatment, mode of delivery during treatment, treatment commitment and attendance, and features and content of treatment. Each main code consisted of various subcodes, as shown in table 7.

Main and subcodes	Definition of code
Support during treatment	
- Support by HCP	For patients to be able to contact and be supported by HCP
- Remote communication	For patients to be able to communicate remotely with HCP, e.g. through a chat function or video calling.
- Group support	For patients to exchange experiences and support each other
- Insight into progress and needs patients	For the HCP to be able to see if patients require further help and support of the HCP
Mode of delivery during treatment	
- Appointment setting preferences	The various preferences of patients regarding the setting of appointments
- Digital content	Digitally sending content of the given group appointments to the patients so they can review the information afterwards
Treatment commitment and attendance	
- Clarity on scheduled optional appointments	Patients were not aware that additional optional appointments were given by the HCP
- On location appointments	Patients could not make it to the appointments since these were given on location
- Necessity of appointments	Patients did not attend to certain appointments since they deemed it unnecessary for them
Features and content of treatment	
- Education	For patients to receive information on nutritional information and the lifestyle changes regarding food after the surgery
- Various knowledge level	The various needs of patients regarding the content and pace of the appointments due to various level of knowledge
- Awareness of lifestyle	For patients to be aware of their lifestyle through self-monitoring and reminders
- Motivational components	For patients to be motivated to change their lifestyle after surgery, e.g. by creating challenges and achieving goals

Table 7. Themes, main codes and subcodes derived from interviews with post-bariatric patients and healthcare professionals

Support during treatment

The first main code refers to the opinions, experiences and wishes of patients and healthcare professionals regarding the way that patients are supported during the postoperative care.

More than half of the patients stated that they *felt supported by the healthcare professionals*. They mentioned that they could ask questions or ask for help during the (group) appointments, or call or email them when in need of help. As illustrated by patient 3*: ''It was said very clearly: 'You can contact us at any time. If you run into something, you should really just contact us.' That was consistently pointed out. I think that's a very good feeling.''*

Patients also mentioned that they felt listened to and felt comforted to know that they were supported by healthcare professionals when they need help or advice, as illustrated by patient 4: *''They listened to my problems and complaints, which got addressed and advice was given, like: 'try this and that, and please get in touch if it does not work out. That felt really reassuring.''*

The support given by the healthcare professionals were also mentioned as important during the postoperative care by all the healthcare professionals, as illustrated by the psychologist: *''I think the most important thing is that patients can voice their questions and problems ... So that they do not struggle for too long and that it feels accessible. So that they feel heard and understood. So that they are like: I can really go to those care providers for help.''*

Furthermore, it was stated by more than half of the patients that they valued the group setting during appointments, since it created the feeling of *group support*. It was mentioned that they appreciated the fact that they could talk with fellow post-bariatric patients during those group appointments, listen to their experiences and compare these with their own experiences, and that they could exchange tips with each other when facing similar problems. Patient 3 explained the following: *"You could share your experiences, or listen to problems that other persons were experiencing. Then often you think like: Oh yes, I have that as well. And then you also might be able to give tips yourself."* The positive impact of group support during the group appointments was also acknowledged by the dietician: *"There are patients that do not dare to point out that they are struggling with something … At the end of the appointment they suddenly realise that other people also experience those problems, and then they dare to come out with their problems."*

The healthcare professionals also mentioned the wish for the healthcare professionals *to have insight into the progress and needs of patients*. The physiotherapists and dietician for example, mentioned that they valued the face to face setting during (group) appointments. This way it is, for example easier for the healthcare professional to see if the patient *"understands the information that is given"* or if they maybe *"require more help".* This was illustrated by the dietician: *"That expression [of the patients], that already says a lot. If we see doubt, then we immediately ask follow-up questions: 'What do you think about this? And why does it not work?'. Yes, that is the added value [of face to face appointments]."*

Additionally, several patients and healthcare professionals expressed the wish for *remote check-up* during the postoperative care. For example, patient 3 and 6 stated that they wished that there were *"more check-ups"* on their *"wellbeing"* so healthcare professionals can see *"if everything is okay"* with the patient. The patients gave the following examples of check-up questions: *"How are you feeling (mentally)? Do you have any pain complaints? How are the wounds looking?"*

The dietician and psychologist stated similar opinions of remote check-up. They stated that it would be of *"added value"* when the to-be-developed application could *"monitor"* and *"check-up on"* the wellbeing of the patients through *"questionnaires"* that are *"specifically focused on bariatric patients"*. This way healthcare professionals would be *"informed earlier"* when patients need more support or help. Examples of check-up questions for the questionnaires that were mentioned were: *"Do you have a request for help? Do you have any difficulties with the lifestyle changes? Do you have any difficulties with the food changes?"*

The dietician and psychologist also mentioned that these questionnaires should have some *"criteria"* so that healthcare professionals only receive a notification when patients actually need extra support. For example, when a patient surpasses the criteria of a "point scale" of a certain questionnaire. That way they do not need to *"review every single questionnaire"*, which would be *"impossible given the amount of patients"*

The check-up can also be beneficial for patients who are experiencing difficulties with asking for help when having complaints, such as patient 1: they mentioned only seeking help until the complaints *"are too much too bear".* When the patient finally asked for help to ask what they could do about it, the healthcare professional said to them: *"You should have come way earlier to me for help."*

The psychologist stated similar situations where they found it *"regretful"* that patients do not ask for help sooner so the healthcare professionals could help the patient earlier and better. The dietician also mentioned that patients sometimes simply *"do not dare to point out that they are struggling with something''.*

Lastly, the dietician expressed the wish for patients to have the ability to *remotely communicate* with healthcare professionals. For example, *"a chat function were patients can contact us when they have short questions"*. This might be *"easier"* for patients to ask questions or to ask for help when they are feeling unsure about asking for help. Furthermore, it was suggested that it would be convenient if patients could plan an online appointment with the healthcare professionals, such as a videoconference call. This can also decrease the barrier of contacting the healthcare professionals for help or advice, and does not require for the patient to physically to the hospital.

Mode of delivery during treatment

The second main code refers to the opinions, experiences and wishes of patients and healthcare professionals regarding the mode of delivery of treatment during the postoperative care.

First, it became apparent that patients had *various appointment setting preferences* during the postoperative care. The psychologist stated, for example, that a point of improvement could be that there should be a more *"personalized"* approach during the postoperative care. It was illustrated as followed: *"We try to organize the group appointments as time-efficiently and care-efficiently as possible, so that we can help as much as possible at the same time. But I notice every time that people's needs are very different and that it is not always possible to get everyone out of the door satisfied after the group appointments."* After analysing the interviews, it became clear that patients indeed had different preferences for the appointment setting during the postoperative care.

Previously, it was mentioned that several patients valued the group setting during the appointments. However, patient 2 stated to prefer *a "smaller group size"*, since they *"were with too many people, so you could not really go into conversation with the other people"*. The dietician had a similar statement: *"A smaller group size might be more beneficial, so that it becomes more personal and people might feel more like: 'Okay, I can fully open up here'. … People are more closed up now with 30 participants [in contrast to before with 15 participants]."*

There was also a patient that stated to prefer one on one appointments instead of group appointments. Patient 5 mentioned the following: *"You are making yourself very vulnerable when sharing you experiences and complaints in a group. And I think it is very hard to open up to a group and make yourself vulnerable."* The same patient also mentioned that too much time was taken to *"go around to group"* to ask how everybody was doing, while other patients appreciated those moments.

Furthermore, a few patients stated to appreciate that the presentation was sent through the email after the group appointment of the dietician. This made it possible for patients *to "look back and review the information"* in the *digital content*. Patient 2 also mentioned: *" When I look at it [the digital content], it helps me with remembering the information like: oh yes, that was said [during the appointment], oh yes that many blocks of fat and so on. "*

Treatment commitment and attendance
The third main code refers the opinions, experiences and wishes of patients and healthcare professionals regarding the commitment to the treatment and the attendance to optional and mandatory (group) appointments.

All the healthcare professionals mentioned that they do not see every bariatric patient back after the surgery at the (group) appointments and that the attendance to the optional appointments are even less. The nurse and the physiotherapists mentioned that they see less than 50% of the bariatric patients back. The physiotherapist elaborated by stating: *"If you take into account the amount of bariatric patients that are operated on, then we only see a fraction of them back [during the optional group appointment]".* The physiotherapists emphasized the problem by stating that the lack of attendance for their optional appointment is their biggest point of improvement during the postoperative care and wished that they could *"reach more patients to deliver the information that is given during the optional appointment"*.

The lack of attendance for the optional appointments was confirmed by the attendance of the patients: of the seven interviewed patients, none of them attended the optional group meetings. A reason for this, could be the *lack of clarity on the scheduled optional appointment*: several patients mentioned that they were not aware that optional group appointments were given during the postoperative care, as illustrated by patient 2: *"I was not aware [of the optional group appointments]. If I do not know about those appointments, I cannot attend to them".* Patients also pointed out that they did not attend the optional appointments since they had forgotten about them, as mentioned by patient 4: *"I did not look back at it actually. I was planning to attend them at that moment. But now that you mention it… I totally forgot about them ".*

However, some patients who were aware of the optional appointments stated that they chose or could not attend them since *the appointments were on location*. For example, a patient did not attend due to the fact that they had to *"arrange transportation"* to the location. A patient also mentioned that is was hard to combine the optional appointments with work due to the amount of time the appointments takes and the distance to the location, as explained by patient 5:

"It [the optional group meetings] approximately takes away half of your day including the travel time. And it is hard to plan around those appointments since they are during the day, certainly when you work besides that … You already missed a few weeks of work due to the operation itself and the mandatory appointments. And if you also want to attend those optional appointments… Furthermore, I am a lot of the time in the north of The Netherlands. If I attend the optional appointments, then I'm on the road for about one or one and a half hours."

Furthermore, several patients mentioned that they were not able to attend to some appointments because they were hindered due to personal circumstances.

Lastly, several patients stated that they did not attend to the optional group meetings since they found it to be *"unnecessary"*. Patient 3, 5 and 7 explained that this was mainly because *"it is going well"* with them at the moment and because they *"have no further complaints"*.

Features and content of treatment
The last main code refers to the opinions, experiences and wishes of patients and healthcare professionals regarding the features and content of the treatment during the postoperative care.

First, more than half of the patients mentioned that valued the *education*, such as the information that was given about nutrition during the mandatory group appointment of the dietician. Examples that were given were: information on how to deal with the lifestyle changes of food after the surgery, what is exactly in the food and guidelines on nutritional intake. Patient 4 mentioned that the given information during these appointments created *"insight and awareness on nutrition"* for them. Patient 7 also mentioned the given information to be an *"eye opener".*

For the to-be-developed application, several patients shared the desire for the to have educational components with *"information and guidelines"* regarding *"nutrition"* and *"physical activity".* Receiving *"tips and tricks" was* also mentioned by multiple patients. For example, *"if this does not work, try this"* and *"suggestions"* on how you could change the lifestyle after surgery.
The psychologist also shared similar thoughts. However, they also mentioned that it was desirable that the to-be-developed application contains *"advice"* on certain topics for when patients are have certain problems after the surgery.

Second, it became clear that there was a *various level of knowledge and education* between the patients, which resulted in different needs. Most of the patients found that the amount of information given and pace of the mandatory group appointments to be good. However, patient 5 stated: *"It [the pace during the group appointment] was too slow for me. … I preferred the given information to be more general instead of in a detailed level."* Patient 2 mentioned: *"I already knew a lot [about nutrition] … So for me it was not very valuable [the dietician group meetings]"*. While another patient thought that they had not enough information about certain topics.

The dietician had similar experiences and stated the following: *"We have had people who can remember a lot of information very quickly, who have indicated that they wished that the pace of the information that was given during the group appointments was quicker. However, the social class of this target group are sometimes lower. For these people it can be too much information at once and then they will not remember it anymore."*

Third, it became apparent that all patients wished to have an increased *awareness of their lifestyle*. For example, by keeping track and monitoring their *"food intake", "physical activity"* and *"weight"*. Other than monitoring, patient 2 mentioned they wished to receive feedback on the progress of their goals, for instance, *"you only need 2,000 more steps to reach your step goal of 10,000"*.

The psychologist and nurse also mentioned that *"occasional reminders"* could be of added value to increase *"awareness"* and *"behavioural change"* in patients. Examples given of the reminders were: *"Did you relax enough today? How many activities did you do today? How did it go with your food intake today?"* The reminders could also contain *"essential information"* , for example, to remind them of guidelines.

Lastly, patients shared their *motivations* for lifestyle change after the surgery. Most of the patients stated that seeing their body change and being able to fit into smaller size of clothes felt *"rewarding".* The rewarding feeling and the thought of *"not wanting to be the old version of me"* encouraged them to comply to a healthier lifestyle. Furthermore, a few patients stated that *"taking challenges"* and *"achieving goals"* motivated them to change their lifestyle. This was also suggested by a few patient to include in the to-be-developed application.

4.3. Conclusion

The experiences and opinions of healthcare professionals and post-bariatric patients could be divided into the following themes: support during treatment, mode of delivery during treatment, treatment commitment and attendance, and features and content of treatment. Within these themes, the healthcare professionals and patients expressed valuable points, points of improvements and wishes of and for the postoperative care.

Valuable points

From the interviews it became clear that patients appreciated and valued the support that they received form the healthcare professionals during the postoperative care. Support of the professionals could be received during the (group) appointments, through email or through the phone.

Patients also valued the feeling of group support during the group appointments with fellow post-bariatric patients. This way patient were able to share their own and listen to each others experiences, and share tips with each other.

Furthermore, patients mentioned to value the education and information that was given during the postoperative care. The given information was said to create insight and awareness to the patients. Additionally, patients expressed the appreciation the fact that they received digital content after the group appointments so that they were able to look at the contents again in their own time.

Points of improvement

A point of improvement for the current postoperative care could be for the care to be more personalized to the patients. The reason for this is the different preferences that patients had regarding the appointment setting during the postoperative care, for example the preference of group size during group appointments.

Due to various level of knowledge and education it also became apparent that patients had different preferences regarding the approaches during the group appointments. For example, the preference of the amount of information given during an group appointments, and the pace and content of the appointments.

Another point of improvement could be improve the commitment and attendance of patients to (group) appointments that are given by healthcare professionals, with the emphasis on the optional appointments. The lack of attendance to these appointments could be explained due to the lack of clarity on the scheduled optional appointment, since some patients were not aware that these appointments were given.

Some patients also mentioned that they had forgotten about the optional appointments or explained that they did not found it necessary to attend them. However, some patients explained that they were not able to attend to the mandatory and optional appointments due to the fact that they were not able to physically attend them. Reasons that were given were, for example: because they had transportation issues, because the distance was too far or because they were hindered by personal circumstances.

Wishes

Healthcare professionals wished to have insight into the progress and needs of the patients during the postoperative care. This way it would easier for the professionals to see if patients require help from them, and then the professionals would be able to help the patients earlier on. A way to facilitate this wish would be for professionals to remotely check-up on the patients, which was also expressed as a wish

For the to-be-developed application, patients wished that it would contain educational components with relevant information and suggestions on how to change their lifestyle. Patients also wished to have an increased awareness of their lifestyle and to receive feedback on the progress of their health goals while using the application.

Lastly, patients mentioned motivations for them to change their lifestyle after the surgery were: the feeling of being rewarded after the weight loss, taking challenges to change their lifestyle and to achieve goals. These motivations were also wished to be translated into the to-be-developed application.

5. Phase 2: Value specification – Requirement elicitation

5.1. Method

Procedure

Outcomes from phase 1 were translated into requirements for the eHealth application during the second phase: the value specification. This was done by filling out a requirement template based on the translation table and requirement notation template by Van Velsen et al. (2013). The requirement template used for this study is shown in table 7. The table consisted of the requirement attribute, value, description, rationale, type, priority, source and conflicts, which will be explained below in further detail. The following steps were undertaken to fill out the requirement template:

1. Requirement attribute, value, description and rationale

Outcomes from the literature search and interviews that contained important needs and values in relation to the overall goal of the eHealth technology were summarized and listed as 'attribute' in the requirement template. Per attribute, one or more requirements were developed. These are technical translations of the attribute, which were listed as 'description' in the template. The value of the requirement was also determined. Furthermore, the reason for the need of every requirement was explained in the 'rationale'

3. Requirement type

The requirements were categorized according to their type. This was done using the Function and events, Interactions and usability, Content and structure, and Style and aesthetics (FICS) framework (60, 61). The name of the framework represents the four types the requirements could be categorized in.

4. Requirement priority

Prioritization of the requirements was executed according to the MoSCoW method. This method has four prioritization classifications (62, 63): (I) *Must have*. These requirements must be included in the technology, otherwise it would result in failure of the technology. (II) *Should have*. These are high-priority requirements which are important for stakeholders or have a high value for them. They are, however, not critical for the launch of the technology. (III) *Could have.* These are desirable, but not necessary, requirements. The requirements from this group are less important than the 'should have' group. (IV) *Won't have*. These are requirements that will not be developed and implemented during the current version of the technology, but may be included in future versions. Requirements that were derived from both the literature search and the interviews, were given the priority of "must have". Other requirements were prioritized as a first suggestion from the researcher.

5. Requirement source and conflicts

Lastly, possible conflicts of the requirements to take into account -when applicable- and the source of the requirement were listed in the template.

Requirement #:	**Requirement type:**
Value:	**Attribute:**
Description:	
Rationale:	
Source:	
Priority:	**Conflicts:**

Table 7. Requirement template

5.2. Results

A total of 31 requirements were created for the eHealth application to must have, should have or could have (table 8). The requirements in the table were divided into the following themes: weight loss behavioural skills support, support from others, planning and appointments, and motivational support and reminders. Furthermore, the requirements were categorized based on the FICS framework: functions and events (F&E), interaction and usability issues (I&U), content and structure (C&S) and style and aesthetics (S&A). The full requirement templates can be found in appendix D. The full requirement templates can be found in appendix D.

ID	Requirement	MoSCow	FICS
Weight loss behavioural skills support			
Self-monitoring			
1.	The application is able to retrieve step data from the mobile phone of the patient, when the patients consents to it	Must have	F&E
2.	The application is compatible with other mobile health devices and is able to retrieve the data from these devices (e.g. an activity tracker and digital scale)	Could have	F&E
3.	The application contains an overview with of the daily progression and daily personalized goals (e.g. amount of steps, calorie count and weight	Must have	C&S
4.	The patient is able to enter their weight, food intake and exercise values in the application	Must have	I&U
5.	The application shows visualizations of the progress (e.g. the amount of steps, the weight and caloric intake)	Must have	S&E
Educational components			
6.	Patients have different level of knowledge and education. So it is important to make terminology and words in the application as easy as possible. To make it understandable for most of the patients	Must have	C&S
7.	The application contains (general) information, examples and exercises on behavioural changes after the surgery and problem solving skills (e.g. guidelines and e-learnings on food intake and physical activity)	Must have	C&S
8.	The given information is able to be conveyed through images, text, videos or fact sheets	Must have	S&E
9.	The application contains a section for frequently asked questions (FAQ)	Could have	C&S
10.	The application contains suggestions on what patients can execute to increase or maintain weight loss (e.g. exercise and recipe suggestions)	Must have	C&S
Support from others			
Health care professionals			
11.	The patient is able to remotely communicate with the healthcare professional through the application (e.g. through a chat function)	Must have	I&U
12.	The patient is able to attend to (group) appointments with the healthcare professional remotely using the application (e.g. video calling and conferencing)	Must have	I&U
13.	The patient has to be invited to the videoconference to be able to attend to the group appointments	Must have	I&U

14.	The patients is able to view the group appointments again using the application	Must have	F&E
15.	The patient is able to use the chat and microphone during the videoconference of the group appointment (e.g. for questions)	Must have	I&U
16.	The patient is able to make an online appointment with the healthcare professional through the application	Should have	I&U
17.	The application contains a periodic questionnaire to check-up on the patient (e.g. questions on the current wellbeing and problems regarding the lifestyle change)	Must have	F&E
18.	The questionnaire contains specific questions relevant to the different healthcare professional (e.g. dietician, physical therapist, nurse and psychologist)	Must have	C&S
19	The corresponding healthcare professional receives a notification when certain answers to the questionnaire are out of the determined norm	Must have	I&U
Other bariatric patients			
20.	The patients are able to support each other through the applications (e.g. forums where patients can ask post experiences, tips and questions)	Must have	F&E
Planning and appointments			
21.	The application contains an agenda where patients can view the scheduled (group) appointments with the healthcare professional	Should have	C&S
22.	The patient is able to view the scheduled dates for the optional group appointments and is able to sign up for the appointments they wish to attend	Should have	I&U
23.	The patient is able to read were the optional group appointment is about before signing up to the optional group appointments	Should have	C&S
Motivational support and reminders			
24.	The application sends reminders to track their lifestyle (e.g. their food intake, weight and exercises)	Should have	I&U
25.	The application sends reminders of the scheduled appointments when it is close to the scheduled date	Should have	I&U
26.	The application sends motivational notifications or notifications with suggestions to encourage behavioural change (e.g. suggestions to start exercising or the encouragement to keep it up with the food intake)	Could have	I&U
27.	The notifications are tailored to the time of the day, the day of the week, the weather and the recorded lifestyle values of the patients (e.g. the amount of steps, food intake and weight)	Could have	F&E
28.	The patient receives feedback from the application regarding the progress (e.g. of the food intake and physical activity) (e.g. you still have X steps to go to reach your goal!)	Should have	I&U
29.	The application has a reward system (e.g. getting achievements when reaching the goals for a certain amount of time)	Should have	F&E
30.	The patients receives a notification when a goal has not been reached for a certain amount of time to increase awareness (e.g. the step or food intake goal)	Should have	I&U

31.	The patient is able to set personalized goals in the application (e.g. step and weight goal)	Must have	I&U

Table 8. List of requirements for the eHealth application

5.3. Conclusion

31 requirements were created for the eHealth application. The requirements categorized into their type, prioritization and could be divided into the following themes: weight loss behavioural skills support, support from others, planning and appointments, and motivational support and reminders. However, some requirements also had some conflicts to take into account when implementing these requirements. Most notably conflicts are the fact that some requirements require the cooperation and time of the healthcare professionals and/or other experts. For example, to generate the information, the check-up questionnaire and the Most Asked Questions (FAQ).

Furthermore, most of the requirements depends on the willingness to use of the patients. For instance, it up to the patient whether they are going to use the self-monitoring functions, the educational components and the support components. Therefore, it is valuable to test (a prototype of) the application with the patients to research the usage behaviour of patients of the application and their opinions on it. This way the need for the different requirements becomes clear, after which the requirements can also be revised accordingly.

6. Phase 3: Design – Digital prototyping

Following the value specification phase, we have now reached the last phase of this study: the design phase. The aim of this phase was to design a clickable low-fidelity (lo-fi) prototype of the eHealth intervention using the outcomes of the contextual inquiry and value specification. Furthermore, the prototype was tested on the usability and evaluated by the patients, which will be further specified in the next chapter. This chapter will focus on the process of creating the clickable prototype.

6.1. method

Based on the results of the contextual inquiry and value specification (phase 1 and 2), a lo-fi prototype was created. It was decided to create a lo-fi prototype since the aim of this phase is to have insight into the initial opinion of the design and features. Low-fidelity prototypes do not necessarily have to resemble the final product and are less focused on the visual appearances and aesthetics of the product. They however do contain the most important features to reach its goals in order for stakeholders to test and evaluate the prototype on its functionality and content (1). In addition, lo-fi prototypes are easy and quick to iterate, which is important in the early stages of designing a product (64).

The requirements of the last chapter that were prioritized with “must have” were used as input for the design of the prototype, provided that the requirement it was able to be visualized. The programme Proto.io was used to create a clickable prototype of the eHealth application.

Procedure

First, the layout of the prototype and which requirements should be implemented where, was decided. Second, multiple existing lifestyle applications were looked up to gain knowledge on currently used designs and to gain inspiration for the design of this prototype. For example, Fitbit, Google Fit and Flo. Lastly, visualization of the initial prototype was created based on the requirements. This was done by creating several different screens based on the requirements. The prototype was made clickable and interactive by “connecting” a certain place on a screen with another screen. Meaning, when that certain place on the first screen is clicked on, the prototype automatically changes to the next screen since it is linked to the place of the first screen that has been clicked on.

6.2. Results

Of the 31 requirements that were created in the last phase, there were 18 “must have” requirements. Requirements such as “The patient has to be invited to the videoconference to be able to attend to the group appointments” and “The application is able to retrieve step data from the mobile phone of the patient, when the patients consents to it”, were not possible to be visualized since these requirements could not be interacted with through the prototype. Eventually, 13 requirements were implemented in the prototype.

The resulting prototype was divided into four main sections: the today (self-monitoring), education, support and appointments/meetings section. The prototype was divided based on the themes that were created in the requirement table of the last chapter (table X). Except for requirement 10 regarding behaviour change suggestions. This requirements was implemented in both the today (self-monitoring) and education section, since it was fitting for both sections. So the four main sections contained the following requirements:

- Today section = requirement 3, 4, 5, 10 and 31.
- Education section = requirement 7, 8 and 10.
- Support section = Requirement 11, 17 and 20
- Appointments/meetings section= requirement 12 and 14.

Appendix F shows which requirements are implemented in the prototype and in which section of the prototype. The content of each section, will be discussed in further detail below. Furthermore, screenshots of the prototype are also included below for visualization.

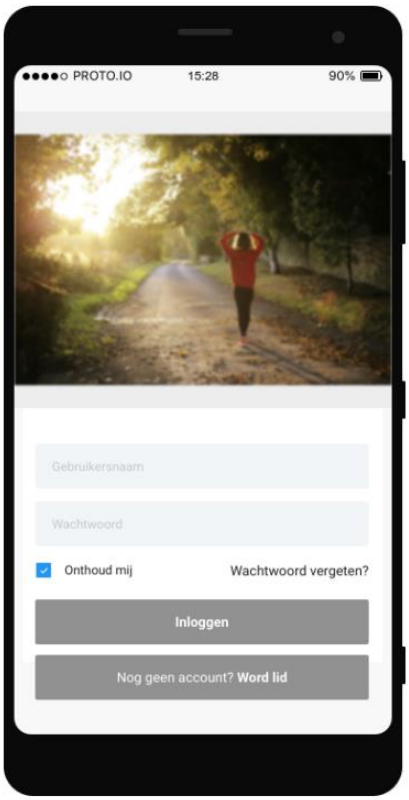

Figure 5. Log-in screen

Logging in

For security and privacy reasons, the patient needs to log-in with their personal username (or e-mail) and password to have access into the application (figure 6). This screen was not based on a requirement of the last chapter. However, it was still implemented in this prototype since all of the already existed lifestyle applications that were viewed, included a log-in screen as “starting/begin” screen. This screen was also implemented to serve as an example for the patient on how to perform a task for the usability test in the next chapter.

Today

When logged into the application, the first section of the application will appear, which is the "today" section with self-monitoring components (figure 7). This sections contains an overview (req. 3) of how the amount of steps taken, calories burned and the weight has progressed. The progress of their personalized goals of the day are also shown in this overview. With this overview, the patient is able to see their progress and goals of the day at a glance. Additionally, a tip of the day with daily suggestions are included to give the patient behaviour change suggestions and inspiration for that day (req. 10).

Figure 6. "Today" screen with self-monitoring components

Figure 7a. (Visualization of) amount of steps

Figure 8b. (Visualization of) weight

Figure 8c. Entering new weight data

Visualizations and adding new data

When clicking on one of the grey bars in the overview shown in figure 7, the patient is sent to the next screen, where they can see a visualization of their progress in the form of graphs (req. 5). For example, their progress on the amount of steps taken and the weight (loss) (figure 8a and 8b). Here they can also see their progress per day, week and month. Additionally, the personal goal (of the day) can be seen and edited by the patient (req. 31). The patient is also able to enter new health data (req. 4), e.g. their new weight and nutrition data, in the application (figure 8c) by clicking on the "+" on the right top of the screen (figure 7a and 7b). Entering the new data can also be done by clicking on the "+" on the overview screen (figure 6) on the right side of the grey bars.

Education

On the tab bar on the bottom of the screen, the patient is able to navigate to the “education” screen (figure 9). This screen contains educational components for the patient (req. 7, 8 and 10). First, there is a section that contains information on, for example, guidelines, physical activity, nutrition and mental health. It also contains suggestions and examples for physical exercises and recipes to inspire the patient. These topics can be seen by scrolling down the screen of figure 9. Second, the patient is able to navigate through the “education” screen by using the grey bubbles on the top of the screen. So, other than seeing information, the patients is able to save e.g. articles, recipes or exercises that seems relevant for themselves and want easy access to. The patient is also able to make e-learnings to test and refresh their knowledge. Lastly, the patient is able to search for specific information using keywords in the “search” bar on the top of the screen.

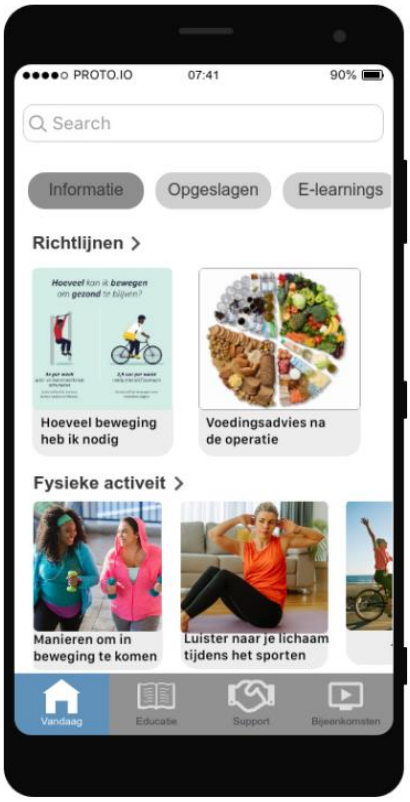

Figure 9. Educational components

Support

Chat function (req. 11)

Using the tab bar on the bottom of the screen, the patient is able to navigate to the “support” screen (figure 10a). This will show an overview of the chats that the patient had with healthcare professionals. When clicking on the chat, the whole chat history will appear (figure 10b).

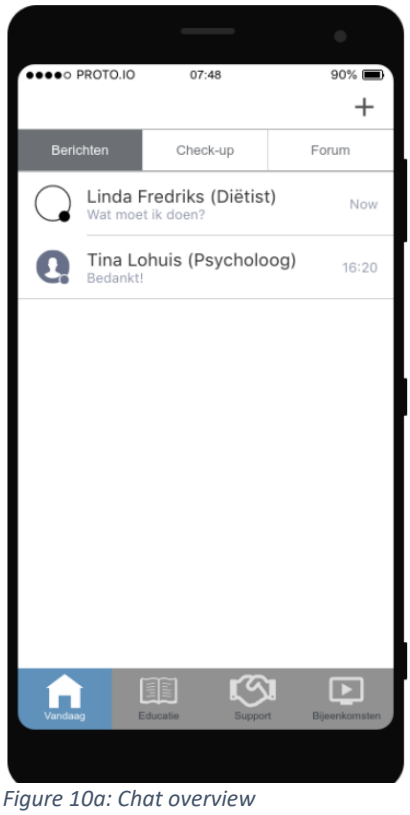

Figure 10a: Chat overview

Figure 10b: Example of chat (history)

The patient is able to send a new message to the healthcare professionals at the bottom the screen of figure 10b. This way healthcare professionals can support the patient remotely when the patient has certain questions or requires extra support.

To start a new chat with a healthcare professional that they have not chat with before, the patient can click on the “+” on the top right of figure 9a to chat with selected relevant professionals.

Check-up questionnaire (req. 17)
Using the bar in the top of the screen that is shown in figure 11a, the patient is able to navigate to the “check-up” questionnaires. Here the patient is able to see an overview of previous filled out questionnaires. New questionnaires that can be filled out will also appear on this screen and can be recognized by the grey bubble with “1” in it. When clicking on the new questionnaire, the screen that is shown in figure 11b will appear. In this screen, the patient is able to fill out the questionnaire.

Using the check-up questionnaire, healthcare professionals are able to reach out to the patient and support them when certain questions are out of the determined norm.

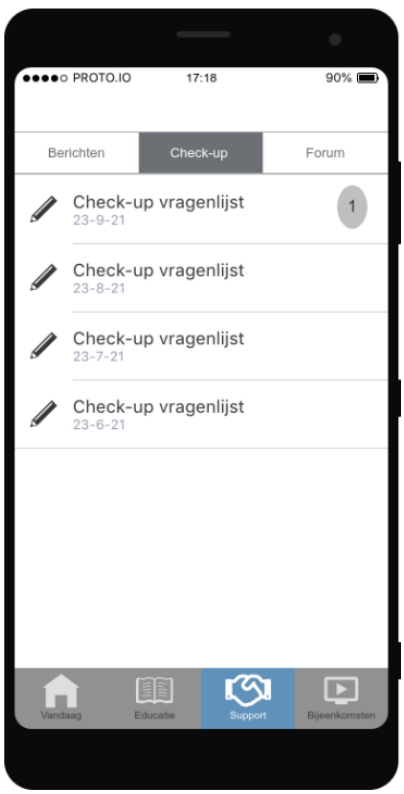

Figure 11a: Questionnaire overview

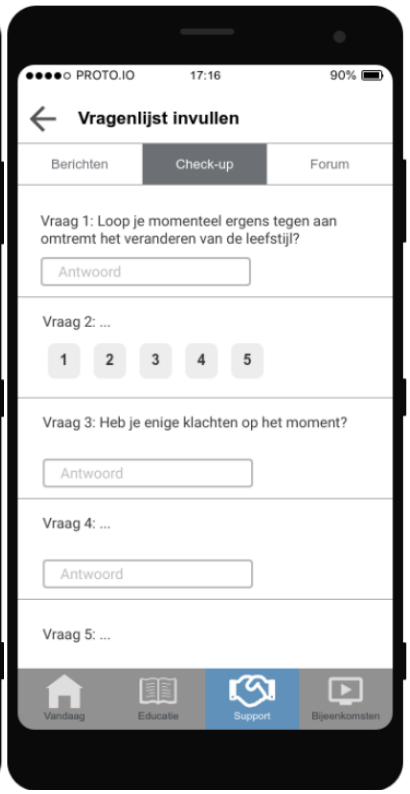

Figure 11b: Example of questionnaire

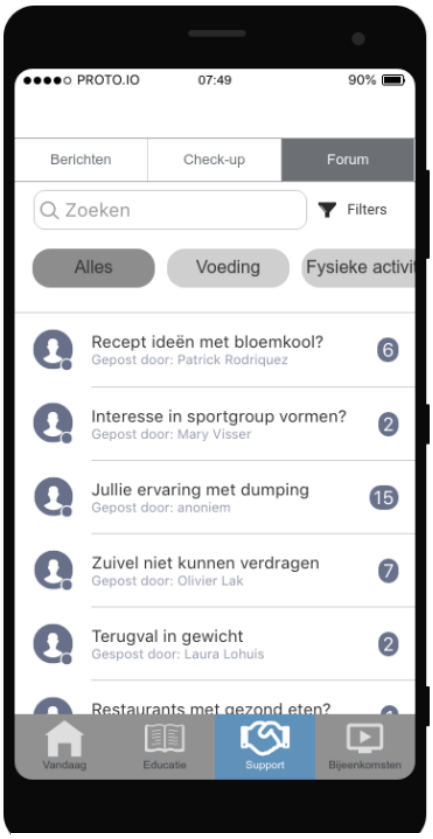

Figure 12: Forum

Forums (req. 20)

Using the bar in the top of the screen shown in figure 11, the patient is able to navigate to the "forum". Here, the patient can receive support from, and give support to other bariatric patient by posting certain topics as discussion threads (figure 12). With discussion threads it is possible to receive multiples responses of multiple people on the topic that has been posted. The patient is able to start a discussion thread, respond to threads or just look at the responses of the topic that is being discussed.

On the right of the different threads, it is possible to see how many responses there are on that certain thread. With the search bar, the patient is also able to search for specific threads with specific key words. Additionally, the patient is able to filter threads to see specific topic using the "filter" button on the top right or by clicking on the grey bubbles under the search bar.

Appointments / meetings

Finally, the patient is able to attend (group) appointments remotely through the application (req. 12). The top of the screen in figure 13a, shows the planned appointments that the patient has. On the right of the planned appointment, it will show a green bar with "in session" indicating that the appointment has begun and the patient is able to attend it. When clicking on the appointment that is in session, the patient is able to attend the appointment (figure 13b).

The bottom part of the screen in figure 12a, shows the concluded group meetings. The patient is able to click on the different meetings and rewatch the group meetings (req. 14). For example, to review the given information again.

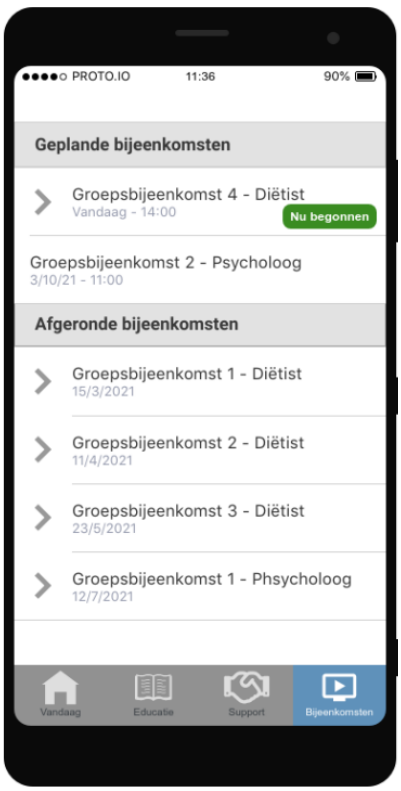

Figure 13a: Appointments/meetings

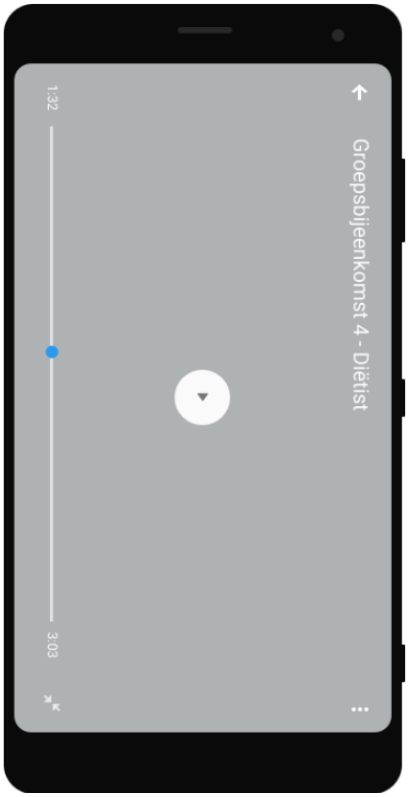

Figure 13b: attending remotely to appointments/meetings

7. Phase 3: Design – Usability testing and evaluation

7.1 Method

Using the resulting prototype of last chapter, an user-based usability test was conducted. This means that the test was held with potential end users, in this case: post-bariatric patients. This was done to test the ease of use of the prototype, and to observe how the patients interacts with the prototype. Afterwards, the prototype was evaluated with the patients.

Setting and participants

The seven bariatric patients that were interviewed in phase 1 of this study were afterwards asked through the telephone whether they wanted to participate in the usability test and evaluation of the prototype. To be able to participate in the usability test, it was required for the patient to have access to a computer, laptop or tablet. Patients who had no access to these devices, were excluded. Consent for being recorded was also essential to be included. Patients were made aware that the test and evaluation would be recorded for data analysis and that the recording would be saved until this study was completed.

Data collection

For the usability test and evaluation of the prototype, different methods were used to collect data: the think-aloud method, questionnaires and semi-structured interview.

Usability testing

During the usability test, patients were given twelve tasks to perform while testing the prototype (appendix I). These tasks were translated into scenarios that could be performed using the functions of the prototype. For example, *"I want to update my step goal"* and *"I want inspiration for new recipes I could cook tonight"*. The functions of the prototype were divided into four main sections: the today (self-monitoring), education, support and appointments/meetings section. Each section had multiple tasks that could be performed. The tasks were given in a unchronological order. This means that the tasks were not put in a order where all the tasks of one section had to be done before moving on to the next section, but that the order of the section were they had to perform the task was randomized. This was done to so it would be less predictable where the next tasks could be found and performed.

While performing the tasks, patients were asked to 'think-aloud'. Meaning that patients were asked to verbalize and share their thoughts while performing the tasks (1). Being able to hear their thought process helps the researcher to better understand the patient's experience and behaviour while they are performing the tasks than when only the actions are observed.

System usability scale (SUS)

The system usability scale (SUS) is a post-test questionnaire to score the perceived usability of the prototype (figure x). The questionnaire consists of 10 items that can be scored with a 5-point Likert scale, where 1 = "strongly disagree" and 5 = "strongly agree". The explanation by A.A. Arain et al. (65) on how to calculate the SUS score was used to calculate the score. When the calculations are done, it ultimately results in a score ranging from 0 to 100. If the score is above 68, the usability of the prototype is considered to be above average and therefore in acceptable ranges. When the score is below 68, the usability of the prototype is considered to be below average and therefore in not acceptable ranges.

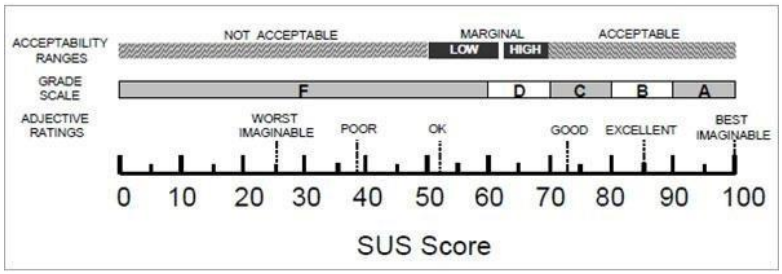

Figure 14. SUS score (2)

Follow-up questions

To get better insight on if the prototype fits the wishes and needs of the patients, three open-ended questions were asked. They were asked to list the top three most and least valuable features in the prototype that could help them with changing and maintaining their lifestyle, and if the prototype was missing any features that could help them with changing and maintaining their lifestyle.

Procedure

After setting a date for the usability test with the included patients, they received an e-mail containing the following: an document containing information regarding the research e.g. the goal and procedure of the research (appendix G), a consent form (appendix H) and a link to the clickable prototype that was being tested during the usability test. An additional e-mail was send with an videoconference invitation through Microsoft Teams in order for the test and evaluation to be held remotely.

During the videoconference appointment, patients were asked to click on the link that would send them to the clickable prototype. Next, they were asked to share their screen with the prototype. This way the researcher (T.V) was able to see how the patients navigated through the prototype.

When all the preparations were done, the usability test and evaluation could begin. This was done using the guide that can be found in appendix I. First, the goal and the procedure of the research was explained to the patients. Next, the procedure for the usability testing was explained in more detail. They were also asked to 'think aloud' during the testing. The first of the 12 tasks was used as an example to make it more clear for the patients. When there were no further questions from the patients and after they were made aware that the recording was going to start, the usability test could start. The researcher told one by one what the task were for the patient, after which the patients could perform the given task.

When all the tasks were performed, patients were asked to fill out the SUS. The Dutch translation of the original SUS was used. In order fill out the SUS, the researcher shared their screen so that the patients could see the questions of the questionnaire. The patients were able to read along with the questions while the researcher read the questions out loud, after which the patients verbally answered the questions. The answers were noted by the researcher. After that, four survey questions were asked gain further insight on the initial opinions of the patients on the prototype. Patients were asked to answer the questions using a 5-likert scale. Where 1 = strongly disagree and 5 = strongly agree. The procedure of asking the questions and noting the answers was executed in the same way as with the SUS.

Lastly, follow-up questions were asked to the patients regarding their perceived most and least valuable features of the prototype and possible missing features. Patients were able to review the functions of the prototype again to form their opinions.

Data analysis

The paths that were taken by the patients on the prototype to perform each task were reviewed through the video recordings. The following outcomes for each task were noted:

- The patient was able to perform the task on their own
- The patient was able to perform the task with one hint
- The patient was not able to perform the task

Verbalizations from the think aloud process during the usability test of each patient were also reviewed. Issues and strengths that were expressed regarding the prototype were transcribed. Furthermore, the SUS score for each patient and the average score was calculated with the use of Microsoft Excel. The resulting scores were then interpreted with the use of figure 14. Lastly, the answers on the follow-up questions were noted and compared.

7.2. Results

Participants

Seven post-bariatric patients were asked whether they wanted to participate to the usability test and evaluation. One of the patients indicated that they did not want to participate. The other six patients agreed to participate to the usability test and evaluation. However, one patient was excluded from the test since they had no access to a computer, laptop or tablet. Ultimately, five of the seven patients participated to the usability test and evaluation.

Patient #	**Gender**	**Age**	**eHealth technology use** *(other than the provided Fitbit watch of the study by E.K)*
1	Female	51 years	Mobile application that sends reminders to drink water
2	Female	56 years	Mobile application to keep track of nutrition
3	male	49 years	Fitbit watch and mobile application to keep track of nutrition
4	Female	37 years	Mobile application that sends reminders to drink water and that keeps track of the weight
5	Female	64 years	None

Table 9. Patient characteristics

Usability testing

Patients were able to complete most of the tasks on their own. Table 9 gives an overview of which patients were able or were not able to perform a certain task on their own. The overview shows that one patient was able to all of the tasks on their own while others were not able to perform one, two or four tasks on their own. Furthermore, six different tasks of the twelve were not able to be performed on their own by at least one of the patients. Two tasks of these six tasks (task 7 and 11) were not able to be performed by two patients on their own.

Of the six tasks that were not able to be performed on their own, five different tasks (task 3, 7, 9, 11 and 12) could be performed by three different patients when given one hint. For four tasks the hint consisted of telling the patient on what screen the task could be performed, after which they were able to perform the task. Patient 4 stated that they found the forums (task 7) to not be in a *"obvious"* place, and that they *''had expected it to be on the 'today' screen''* (the screen with self-monitoring functions).

For task number 11, the patient was already on the right screen but they needed a hint to look further on that screen to perform the task. After this hint, the patient was able to perform the task. After completing the task, patient 2 commented that *"once you know [where to find it], it is no problem"* and that it is *"more difficult"* because the prototype is *"unknown"* at the moment since they are using it for the first time.

Lastly, two different tasks (task 4 and 11) could not be performed by two different patients. For both patients it was necessary to tell were to click to perform the task. Patient 5 mentioned to find the word 'support' in the screen to be difficult and would have had preferred the Dutch translation 'ondersteuning' so it would be more clear.

Task #	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5
1	+	+	+	+	+
2	+	+	+	+	+
3	+	+	+	+	1
4	+	-	+	+	+
5	+	+	+	+	+
6	+	+	+	+	+
7	1	+	+	1	+
8	+	+	+	+	+
9	+	+	+	+	1
10	+	+	+	+	+
11	+	1	+	+	-
12	+	+	+	+	1

Table 9. Overview of which patients were able or were not able to perform a task

(0) The patient was able to perform the task on their own
(1) The patient was able to perform the task with one hint
(-) The patient was not able to perform the task

System usability scale

Table 10 shows the SUS score of every patient. The scores ranged from 77.5 to 100, with the average score of 90. Since the scores are above 68, the perceived usability of the prototype is considered to be above average and therefore in acceptable ranges.

Task #	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5
SUS score	100	90	90	77,5	92,5
Average SUS score	90				

Table 10. SUS score per patient

Follow-up questions

Survey

To gain further insight on the initial opinions of the patients on the prototype, four survey questions were asked. figure 15 shows the results of this survey. After having taken a first look of the application, patients generally seemed to find the application to be beneficial and were positive about wanting to use it.

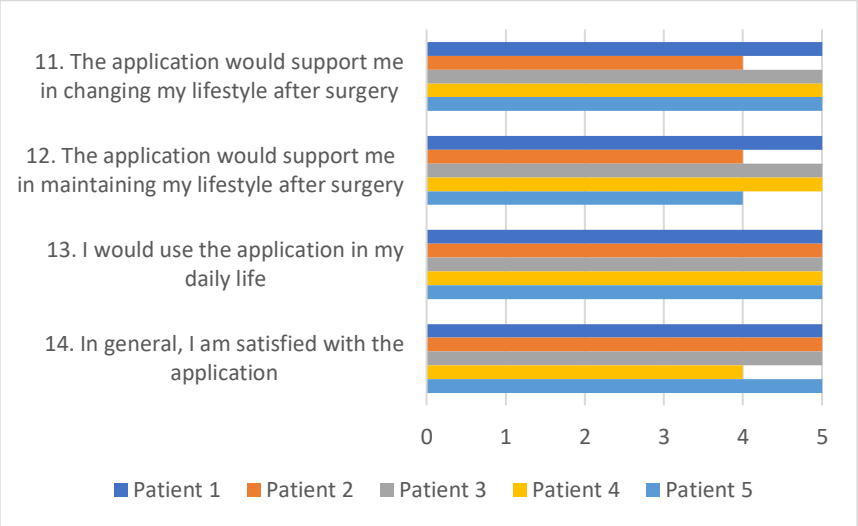

Figure 15. Survey questions about initial opinions of the prototype

Interview

A few of the patients expressed interest in the prototype, for example by stating that they would like to use the application, by asking if it is going to be available in the future and by asking when they could use the application. Patient 4 also stated that *"it was about time that an application like this would be made available for the patients"*.

Most valuable features

When asked which specific features of the prototype were most valuable for them that could support them with changing and maintaining their lifestyle, most of the patients mentioned the support screen. One patient stated that they valued all the functions of the support screen, while others had put emphasize on the chat function with healthcare professionals and the forum with other bariatric patients to be *"very important"* and valuable. Most of the patients also mentioned the 'today' screen with the self-monitoring functions. Some stated that they valued everything on the screen and that it has an overview, while other specified on certain functions on that screen, e.g. that it keeps tracks of the step count and the amount of calories.

Furthermore, it was stated by several patients that they found the appointments/meetings screen to be valuable, since they would be able then to attend online. Patient 3 added that it was also more convenient to have it all in one applications instead of clicking on separate links through the mail to get into the appointment/meeting, which is currently the case. Several patients also mentioned the education screen. They stated to value the whole screen, but patient 1 and 5 explained that they specifically valued the guidelines and the recipes, since the guidelines give *"guidance on what you need to do daily"* and since they are *"sometimes exhausted with figuring out what food to cook".* Information about nutrition and exercise on the education screen was also mentioned.

After listing the valuable features, a couple of patients ended it up saying that they actually found all features to be valuable. Also, aside from mentioning specific features, patients also mentioned general reasons why they found the application to be valuable. Patient 3 stated to *"currently use multiple different applications, so it is easier to have it all in one application [as this one]"*. Furthermore, patient 1 stated that using the application can cause one to have a moment of reflection. Finally, both patients mentioned that the application is valuable since you can *"always carry it with you"*. For example, with the application the patient is always able to send a message to the healthcare professional when they are suddenly stuck with something.

Least valuable features

Most of the patients had no least valuable features or could not think of least valuable features at the moment. Patient 1 explained that when you would use the application for a longer period, that *"along the way you would maybe find out which features you do not use often"*. A couple of patients explained that they found the recipes on the education page to be least valuable to them since they *"do not like to cook"* or that it would just not be useful to them. Patient 2 added that it however could be different for everybody. One patient stated to find the 'today' screen the least valuable, since they would not use these features.

Missing features

One patient mentioned to struggle with memorizing the daily carbohydrates intake and keeping track of this. So they would like to incorporate guidelines on carbohydrates and a way to keep track of it using the application. All of the other patients had no missing features.

8. Discussion

Main outcomes

This study aimed to design and evaluate a low fidelity prototype of an eHealth application that aims to support postoperative bariatric patients into making lifestyle changes using a holistic approach. In order to design the prototype, the first two phases of the CeHRes Roadmap were conducted: (1) contextual inquiry and (2) value specification.

The resulting prototype could be divided into four main sections. The first section consisted of self-monitoring features such as the ability to track the amount of steps taken, calories burned and the weight and see visualization of the progress. The second section consisted of educational components, such as information on physical activity, nutrition and guidelines, and suggestions for exercises and recipes. The third sections consisted of features that could support the patient. This section included a chat function with the healthcare professional for questions, a check-up questionnaire to have insight into if patient require extra help or advice and a forum where patient can receive support from, and give support to other bariatric patient by posting on a forum. The fourth section consisted of the features that gives patients the ability to attend to their (group) meetings remotely and to rewatch their group meetings.

As resulted from the literature search from phase 1 of this study: limited studies are conducted on eHealth interventions that are specifically made for post-bariatric patients that promotes behavioural and/or lifestyle changes. Moreover, to the best of the knowledge of the researcher, no eHealth application currently exists with this aim for this specific target group. There is however, more known about applications for patients with chronic diseases, such as diabetes mellitus (DM), arterial hypertension (AH) and cardiovascular diseases that aims to change and improve lifestyle. Comparable with bariatric patients, it is also important for patients with chronic disease to maintain a healthy lifestyle to decrease risks that are related to their disease (66).

A systematic review (67) researching the efficacy of mobile application found 13 applications that were designed to change the lifestyle of patients with type 2 DM. This review showed that the group that used an eHealth application had experienced short and long-term a reduction in the mean blood glucose (sugar) level, in contrast to patient who did not used an application. This could suggest that features from the applications could have helped the DM patients to change and maintain their lifestyle, which then led to the reduction of their blood glucose (sugar) level.

First, the review mentioned that most of these applications consisted of a feature that could monitor the physical activity and diet of the patient. This is in line with the first section of the prototype of this study, which also consists of self-monitoring components. Second, one application also implemented of examples of exercises to increase motivation for physical activity. This is similar the feature in to the second section of the prototype of this study, where patients can find suggestions and examples for exercises.

Lastly, all but one application made use of at least one of the three types of feedback. One of those types is graphical feedback, where patient health data is visualized. Another type is automated feedback, such as feedback on the progress of their personal goals. In person or remote feedback from healthcare professionals on the health data was mentioned as the last type of feedback for the patient. The prototype of this study consists of graphical feedback of health data and automated feedback, which can be found in the first section of the prototype. However, the prototype does not consist of feedback from healthcare professionals of the health data of patients. As mentioned before by healthcare professionals during the interviews in phase 1 of this study: given the amount of bariatric patients it would be impossible to review health data of every bariatric patient. Therefore, it would be recommended to make criteria of the health data so that healthcare

professionals only get a notifications of patients that actually need help and support. For example, when the patients gains X amount of weight in X amount of time. This function could lead to early detection of need for support from healthcare professionals. Nonetheless, it is up to the patient whether they want to share their health data and if they want to make use of this function.

Another systematic review (66) that was focused on researching lifestyle improvement features on mobile applications found 24 applications for people with chronic diseases, such as DM, AH and cardiovascular diseases. Use of the applications has shown to lead to improvements in a more balanced diet, regular exercise and weight loss. Features of these applications mainly consisted of monitoring the health, such as the physical activity, diet and weight. Which again is in line with the first section of the prototype (self-monitoring components) of this study. Some applications in the review also consisted of basic health information and specific information on their disease. This is similar to second section of the prototype, which consist of educational components. Furthermore, regular checking up on the patients was found to be an important feature in an application according to the review. This could be could be compared to the third section of the prototype where patients can fill out a check-up questionnaire. Lastly, reminders and alerts were also found to be an important feature according to the review. This is in line with the findings of the literature search in phase 1 of this study. One of the main features that could be found in eHealth interventions that promoted lifestyle change for post-bariatric patients were reminders. Even though in phase 2 of this study requirements were made regarding reminders and alerts, these features were not implemented in the prototype since they were “should have” requirements. It is recommended to implement these features in the possible next prototype.

During the interviews in phase 1 of this study, patients emphasised the appreciation of group support during their postoperative care. This led to the forum feature that can be seen in the third section of the prototype. This findings and feature is supported by the findings of Reifegerste et al. (68) and Atwood et al (69). These studies suggests that the use of online forums can adults with obesity and bariatric patients with informational and emotional support. It was also found that patients were able to encourage each other regarding adhere to lifestyle guidelines after the surgery through the forum when patients expressed difficulties with adhering to it (68). Therefore it is recommended for patients to have access to online support groups, such as forums.

Some patients also expressed that they were not able to attend to certain (group) appointments during the postoperative care since the appointments were on location. Reasons that were given were transportation issues, personal circumstances and the distance to the location. This could a problem, since a low attendance rate of postoperative (group) meetings has also been shown to be an important predictor of unsuccessful weight loss and weight regain after bariatric surgery (25, 26, 28, 30). Because of this the fourth section in the prototype with the feature to attend to the appointments remotely when patients are not able to attend was implemented. One bariatric clinic in Australia (70) offered postoperative follow-up through videoconferencing instead of the standard face-to-face follow-up for patients that lived far away form the clinic. It was found that patients were highly satisfied with this service, and that this service could save time and money for the patients.

Another study found that conveying information remotely was as effective as conveying it face-to-face to educate the patients. They also recommended to have the option for patients to see to the follow-up remotely to facilitate patients who prefer this kind of service which then could lead to better adherence.

The usability tests that were conducted by the patients during this study, showed that they were able to complete most of the tasks on their own while navigating the application. Furthermore, the prototype was given an average SUS score of 90, ranging from 77.5 to 100, by the patients. These results suggest the overall usability of the application to be positive. In addition, patients generally seemed to find the application to be beneficial and were positive about wanting to use it.

Patients expressed excitement and satisfaction about the features of the prototype. They found the support features with the chat function and forum, and the self-monitoring features to be the most valuable. Most patients expressed that they had no least valuable features. However, a couple of patients mentioned to find the recipes on the education page and the section with the self-monitoring functions to be least valuable to them. These findings shows a difference in the needs of patients. It is difficult to design an application with features that are fully tailored for each individual patient. A solution could be for patients to be able to "hide" the feature that they do not find useful in the application. This way it will not be in display for the patients who do not want to use the feature, but it will still be available for the patients who do want to use it.

Lastly, this study suggests that developing this eHealth application could be valuable for post-bariatric patients. As mentioned before, to the best of the knowledge of the researcher, no other eHealth application currently exists that are specifically made for post-bariatric patients with the aim to promote behavioural and/or lifestyle changes.

Furthermore, this applications could provide convenience for the patients since it would have most of the bariatric related components in one application. This was also mentioned be a patient during this study. This patient stated to *"currently use multiple different applications, so it is easier to have it all in one application as this one"*.

However, it also became clear that most of the features of this prototype are in line with already existing lifestyle application for patients with chronic diseases. This suggests that the expressed needs by post-bariatric patients for lifestyle change support are similar to those with chronic diseases. It can also suggest that interviewing patients about their needs, might not be the best method to come up with new innovative interventions. Therefore, it is not recommended to conduct interviews with stakeholders when wanting to develop an innovative interventions. Nonetheless, stakeholders should still be a part of the development process to evaluate if the product is in line with their needs.

Strengths and limitations

Strengths

The use of the CeHRes roadmap, which centralises a holistic approach during the development process, is one of the strengths of this study. By involving the stakeholders with the development of the prototype it was possible to identify their wishes and needs during the interviews, and to have insight into their experiences and opinions of the prototype during the usability testing. Involving the patients also ensures that the prototype fits their wishes and needs. This can ultimately increase the chances of successful adoption and long-term use of the application (1).

Furthermore, other than using the identified wishes and needs of the stakeholders following the interviews, findings from already existing literature were also used for the development of the prototype.

Another strength is that data saturation was reached for the interviews with the patients. No additional information was provided by the last patient that was interviewed. This suggests that most, if not all, desired information for this study has been collected.

Additionally, in 2015 in the Netherlands, 80% of the total bariatric surgeries were performed on females (71). This is in line with the sample group of this study. Furthermore, most of the surgeries were performed on patients ranging from 46 to 55 years old, while least of the surgeries were performed on patients younger than 25 years and patients older than 65 years (71). This is also in line with the sample group, except for one patient. Given this, it can be suggested that the sample group is a representative sample of the post-bariatric population.

Limitations

Due to Covid-19 restrictions, the postoperative care that was given during this study was a bit different from the standard postoperative care that was normally given before the restrictions. Because of this, it is possible that the care changes again when the restrictions changes or are gone. This means that the experiences of the patients in this study of the postoperative care can differ from patients that receive the standard care.

Also, because of the restrictions, interviews and usability tests were conducted remotely. Even though it was more convenient for the patients -since they did not need to travel to do the interview and test-, the patient and researcher were not able to see each others nonverbal communications cues. Examples of cues are: the body language, facial expression and gestures. Observing these cues could give the researcher additional information regarding the response of the patients (40, 72). Moreover, there could have been a lack of identity between the patients and researcher since they were not able to see each other. The lack of identity and lack of nonverbal communication cues could eventually lead to that patients are more cautious about revealing sensitive information (72).

Another limitation of this study is the fact that the same patients that conducted the usability tests, also conducted the interviews prior to it. Even though this approach tests and ensures if the prototype fits the wishes and needs that they conveyed during the interviews, it could have also led to distorted results. It is possible that patients were overly positive about the prototype since they saw what they wanted to see in the application. Therefore, it is recommended to also include post-bariatric patients to the usability tests who were not part of the development process of the prototype to prevent bias.

There is a also possibility of response bias for the survey that was conducted after the usability test. This occurs more often with surveys that uses Likert scales where respondents are asked if they agree or disagree with a statement. In case of response bias, results from the survey might be influenced by the fact that patients want to give the answer that is socially desirable. This can cause their answers on the survey to be overly positive (73).

Additionally, according Bradley et al. (72) it should be avoided to ask patients what they would think in the future, since they can not predict what they would think at a later moment. An example from the survey would be: *"I would use the application in my daily life"*. Even though their answers might not be valid, it can give insight on whether the initial opinion of the patients are negative or positive of the prototype.

Furthermore, it might have been difficult for patients to form a clear opinion on the prototype after the usability test because they have only seen and used it for a moment. To have more valid results on the experience and opinions of bariatric patients on the prototype, it is recommended to have patients use a more functional version of the prototype for a period of time. This way patients can use it as they would actually use it in their daily life, after which it is more clear for the patient what their opinion about the prototype would be.

Also, patients who had bariatric surgery six months prior to the study were included. However, previous studies suggest that patients who are one year post-surgery are at a high risk point for beginning weight regain (36). So, it is possible that that patients that one year post-surgery have different needs then that are identified in this study. Therefore, it is recommended for future research to include bariatric patients that are at least one year post-surgery.

Recommendations for further research

The prototype of the eHealth application is currently at a Technology Readiness Level (TRL) of 4. The TRL is a method to estimate the phase of development and maturity of a new technology. Where in level 4, components of the technology are tested on a small scale through a low-fidelity prototype. This is comparable with the usability test that was conducted of the prototype (74).

The next step would be to create an prototype of the application with a TRL of 5. During this level, a medium tot high-fidelity prototype should be created (74). At least the "could have" and "should have" requirements that were created in phase 2 of this study should be implemented in this prototype if possible. The prototype should be functionable enough for post-bariatric patients -that are at least one year post-surgery- to test and use the prototype for a short period of time (e.g. for a week) on their mobile phone. After this, a qualitative study should be conducted with the post-bariatric patients to have insight into their experiences and opinions of the prototype. The good points and points of improvements should be clear after this study, and whether the patient experience and satisfaction of the prototype is positive or not. Also, to check if of the application is in line with the wants and needs of the patients.

Next, it would be recommended to create a high-fidelity prototype which should be improved based on the results of the qualitative study. This prototype would put the prototype at a TRL of 6, where the components and functionality of the prototype should be close to the final product. It would be recommended for post-bariatric patients -that are at least one year post-surgery- to test this prototype for an extended period, e.g. for four weeks.

It is also recommended for the study to have quantitative results on the user activity, similar to the study of Versteegden et al. (35). For example, how many times and how may days a specific feature was used be the patient, and how many times the prototype was opened. After this, is should be clear how much each feature was actually used by the patient and thus which features are possibly valuable or not to the patient. It should also become clear if patients use the prototype for the whole study period or if they stop using is after a certain period, which can suggest if patients will keep using the prototype for a short-term period.

Additionally, it would be recommended to conduct a qualitative study to once again to gain insight into the experiences and opinions of the prototype: the good points and points of improvements, whether the patient experience and satisfaction of the prototype is positive or not and if the application is in line with the wants and needs of the patients. These qualitative results could also give an explanations to the quantitative results. Ultimately, the effectiveness of the application on weigh loss and maintenance should be researched.

Conclusion

This study designed and evaluated an eHealth application that aims to support postoperative bariatric patients into making lifestyle changes based on literature review on the state of art on eHealth interventions for post-bariatric patients, and interviews with healthcare professionals and post-bariatric patients. Outcomes from the literature search and interviews resulted into 31 requirements for the design and content of the application. Eighteen requirements were ultimately used to design the prototype of the application. The prototype consisted of self-monitoring features, educational components, features where healthcare professionals can support the patients, a forum where patients can support each other, and a videoconferencing feature for the appointments of the patients during the postoperative care. Usability tests and evaluations of the prototype conducted by post-bariatric patients, suggest the overall usability and the satisfaction of the prototype to be positive. It is recommended to continue developing and evaluating the application with stakeholders to ensure that the application is in line with their wants and needs.

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Appendix

Appendix A: baseline patient characteristics of studies

First author	Study size	Mean age (years) (SD)	Gender (% females)	Mean BMI (kg/m2)	Operation type
A. Arnaert (2021)	n = 22	49	59%	Unknown	Unspecified
L. E. Bradley (2016)	n = 60 recruited n = 20 baseline measurement n = 16 interacted with first module n = 11 completed **Intervention group:** n = 49 **Control group:** n = 51	54.3 (12.1)	85%	Unknown	75% gastric bypass 15% gastric sleeve 10% gastric banding
S. Cassin (2020)	n = 136 recruited n = 100 completed **Intervention group:** n = 49 **Control group:** n = 51	48.40 (8.51)	82%	Unknown	Roux-en-Y-gastric bypass and sleeve gastrectomy
V. A. Santiago (2020)	n = 10	50.9 (7.7)	100%	46.8 (5.8)	Unspecified
M. Lauti (2018)	n =95 completed **Intervention group:**	**Intervention group:** 45.6 (7.2) **Control group:**	**Intervention group:** 32% **Control group:**	**Intervention group:** n = 42.5 (7.9) **Control group:**	Sleeve gastrectomy

	n = 47 **Control group:** n = 48	47.0 (8.8)	38%	n = 42.4 (6.0)	
C. W. Mangieri (2018)	n = 56 completed **Intervention group:** n = 28 **Control group:** n = 28	**Intervention group:** 52.5 (9.0) **Control group:** 53.0 (10.6)	**Intervention group:** 84% **Control group:** 92%	**Intervention group:** 35.34 (8.27) **Control group:** 36.97 (6.91)	Laparoscopic sleeve gastrectomy
D. P. A. Versteegden (2021)	n = 1098	45.6 (11.1)	79%	42.5 (5.3)	Unspecified
C. D. Wang (2019)	n = 192 **Intervention group:** n = 96 **Control group:** n = 96	43.6 (8.7)	78%	Unknown	Unspecified
P. Klasnja (2020)	n = 51 recruited n = 45 started with the intervention	45.0 (11.9)	84%	Unknown	Unspecified
C. I. Voils (2020)	n = 81 recruited n = 30 baseline measurement n = 28 completed **Intervention group:** n = 49 **Control group:** n = 51	56.9 (10.0)	20%	32.7 (6.1)	Unspecified

Appendix B: Interview guide healthcare professionals

*Dit is het interviewschema voor een semigestructureerd interview voor **zorgverleners** die te maken hebben met het verlenen van nazorgtraject aan bariatrische patiënten.*
De onderstaande dikgedrukte woorden zijn de topics van het interview en de vragen die eronder staan, dienen als leidraad van de vragen die gesteld worden per topic.

Ten eerste, bedankt dat je tijd hebt vrijgemaakt en dat u wil deelnemen aan dit interview.

Mijn naam is Thuvan Vu. Ik volg momenteel de studie Gezondheidswetenschappen aan de Universiteit Twente. Voor mijn afstudeeropdracht onderzoek ik hoe het nazorgtraject vanuit het ziekenhuis verbeterd kan worden voor patiënten die bariatrische chirurgie hebben ondergaan.

Zoals voorheen besproken met u, zal ik dit interview opnemen met een geluidsrecorder. Het gehele interview zal anoniem worden verwerkt, waardoor uw antwoorden tijdens het interview niet te herleiden zijn naar u. Na het onderzoek zullen de geluidsbestanden verwijderd worden. Klopt het dat u toestemming heeft gegeven om het interview op te nemen?

Dan start ik nu met de opname.

Algemene informatie

- Zou u kunnen vertellen wat uw functie is binnen ZGT?

Huidige situatie/behandeling vóór de bariatrische operatie

- Zou u kunnen uitleggen hoe het traject voor bariatrische patiënten eruit ziet voordat ze de operatie hebben ondergaan vanuit uw functie?
    - Hoe wordt het traject aangeboden en hoe vaak?
        - bijv. door middel van groepsbijeenkomsten of individuele bijeenkomsten met de patiënt. Digitale of fysieke bijeenkomsten etc.
    - Wanneer worden deze bijeenkomsten gehouden voor de patiënt? (op welk moment van hun traject)
    - Wat wordt er verteld en besproken tijdens deze bijeenkomsten, en op wat voor een manier?
        - Bijv. aan de hand van presentaties, video's etc.
    - Zijn de bijeenkomsten binnen het traject verplicht of facultatief voor de patiënten?

- Ontvangen patiënten buiten deze bijeenkomsten ook nadere informatie over de voorzorg en/of nazorg van de operatie wat ze thuis kunnen doornemen?
    - Bijv. folders, websites, video's, informatiebrieven etc.

- Wat is doorgaans de groepsgrootte van de verplichte bijeenkomsten?
    - Komt het voor dat patiënten niet (meer) komen opdagen bij deze bijeenkomsten?
        - Heeft u een (percentuele) schatting van de patiënten die niet (meer) komen opdagen?
- Hoeveel patiënten melden zich doorgaans aan voor de facultatieve bijeenkomsten? (of percentage van de patiënten)

Huidige situatie/behandeling na de bariatrische operatie

- Zou u kunnen uitleggen hoe het traject voor bariatrische patiënten eruit ziet nadat ze de operatie hebben ondergaan vanuit uw functie?
    - Hoe wordt het traject aangeboden en hoe vaak?
        - bijv. door middel van groepsbijeenkomsten of individuele bijeenkomsten met de patiënt. Digitale of fysieke bijeenkomsten etc.
    - Wanneer worden deze bijeenkomsten gehouden? (hoeveel weken na de operatie)
    - Wat wordt er verteld of besproken tijdens deze bijeenkomsten en op wat voor een manier?
        - Bijv. mondeling, presentatie, video's etc.
    - Zijn de bijeenkomsten binnen het traject verplicht of facultatief voor de patiënten?

- Ontvangen patiënten buiten deze bijeenkomsten ook (nadere) informatie over de nazorg wat ze thuis kunnen doornemen?
    - Bijv. folders, websites, video's, informatiebrieven etc.
- Hoeveel mensen zijn er doorgaans aanwezig tijdens de bijeenkomsten en/of melden zich aan voor de bijeenkomsten?
    - Zijn er ook mensen die niet meer komen opdagen (bij de verplichte bijeenkomsten)?
        - Weet u waarom?

Verbetering nazorgtraject

- Welke punten in het nazorgtraject vindt u waardevol om patiënten te ondersteunen van het doorvoeren van leefstijlveranderingen?

- Zijn er aspecten in het nazorgtraject waarvan u denkt dat dat beter kan in uw ogen als [functie zorgverlener]?
    - Zou u een voorbeeld hiervan willen geven?

- Hebben patiënten wel eens bij jullie aangegeven welke aspecten binnen het nazorgtraject zij waardevol of goed vonden?
    - Bijv. een bepaald onderwerp dat werd behandeld of de manier hoe een onderwerp werd behandeld
    - Zou u een voorbeeld hiervan willen geven?

- Hebben patiënten wel eens bij jullie aangegeven dat er aspecten in het huidige nazorgtraject zijn waarvan zij denken dat het beter kan?
    - Bijv. een bepaald onderwerp dat werd behandeld, de manier hoe een onderwerp werd behandeld of de frequentie van de bijeenkomsten
    - Zou u een voorbeeld hiervan willen geven?

Leefstijl veranderen bij bariatrische patiënten

- Wat is uw ervaring met patiënten die hun leefstijl moeten veranderen na de operatie?
    - Hebben patiënten aangegeven of ze moeite hebben met het veranderen van hun leefstijl tijdens contactmomenten met u?
        - Op welk moment van het traject was dit? (hoeveel maanden na de operatie)
        - Waar hadden ze hulp bij nodig?
        - Was u in staat om hierbij te helpen?
            - Hoe heeft u geholpen en wat was de oplossing?

- Denkt u dat het huidige nazorgtraject genoeg ondersteuning en motivatie biedt aan de patiënten om leefstijl verandering te ondergaan?
    - Waarom wel of niet?
    - Wat zou volgens u beter kunnen hieraan?

eHealth en bariatrie

Tegenwoordig speelt de rol van eHealth een steeds belangrijkere rol voor de gezondheidszorg. Zoals: monitoring, videobellen, coaching applicaties etc.

Vertellen over wat ik wil doen → applicatie ontwerpen

- Bent u hier bekend mee?
- Wordt er al gebruik van eHealth tijdens de huidige nazorgtraject?
    - Zo ja, wat dan? Wat doet het? Hoe bevalt het?

- Waar zou eHealth jullie kunnen helpen tijdens het nazorgtraject en op welke manier?

Dit waren alle vragen voor het interview. Heeft u zelf nog vragen, aanvullingen of opmerkingen?

Dan wil ik u nogmaals bedanken voor uw deelname aan dit interview en uw medewerking.

Appendix C: Interview guide patients

*Dit is het interviewschema voor een semigestructureerd interview voor **postoperatieve bariatrische patiënten.***
De onderstaande dikgedrukte woorden zijn de topics van het interview en de vragen die eronder staan, dienen als leidraad voor de vragen die gesteld worden per topic.

Ten eerste, bedankt dat u wil deelnemen aan dit interview.

Mijn naam is Thuvan Vu. Ik volg momenteel de studie Gezondheidswetenschappen aan de Universiteit Twente. Voor mijn afstudeeropdracht onderzoek ik hoe de nazorg vanuit het ziekenhuis verbeterd kan worden voor patiënten die een maagverkleining hebben ondergaan. Met nazorg bedoelen we de begeleiding die vanuit het ziekenhuis wordt gegeven na de operatie, zoals de groepsbijeenkomsten met zorgverleners en alle andere contactmomenten met de zorgverleners.

Zoals voorheen besproken met u, zal ik dit interview opnemen met een geluidsrecorder. Het gehele interview zal anoniem worden verwerkt, waardoor uw antwoorden tijdens het interview niet te herleiden zijn naar u. Na het onderzoek zullen de geluidsbestanden verwijderd worden. Klopt het dat u toestemming heeft gegeven om het interview op te nemen?

Dan start ik nu met de opname.

Persoonlijke informatie
Allereerst zou ik graag een aantal persoonlijke vragen willen stellen

- Kunt u kort wat over uzelf vertellen; wat doet u in het dagelijks leven?
- Zou u kunnen mij vertellen waarom u besloten heeft om de operatie te ondergaan?
- Welke zorg en begeleiding heeft u vanuit het ziekenhuis ontvangen na de operatie tot en met nu?
    - Met welke zorgverleners bent u in contact gekomen?
- Wat vindt u van de begeleiding die u tot nu toe heeft ontvangen?
    - Wat vind/vond goed of waardevol aan deze begeleiding?
    - Zijn er punten die u toch liever anders had willen zien of onderwerpen die u heeft gemist?

Ervaring nazorgtraject: diëtiste
(De bijeenkomsten die door die diëtist wordt gehouden in het nazorgtraject bestaan uit 4 verplichte groepsbijeenkomsten en 3 facultatieve groepsbijeenkomsten)

Dan zou ik nu graag specifiek willen ingaan op de hulp en begeleiding die u heeft ontvangen van de diëtiste.

- Kunt u mij vertellen op welke momenten na de operatie u in aanraking bent gekomen/contact heeft gehad met de diëtiste?
- Wat vindt u van de hulp en begeleiding die u heeft gekregen van de diëtiste?
    - Wat vond u goed?
    - Wat kan beter?
- Was u aanwezig de verplichte bijeenkomsten?
  <u>Indien nee:</u>

- waarom niet?

<u>Indien ja:</u>

- Wat vond u van deze bijeenkomsten?
- Op een schaal van 1 tot 10, hoe waardevol vond u deze bijeenkomsten?
- Wat vond u goed of waardevol aan deze bijeenkomsten?
  - Bijv. een bepaald onderwerp dat werd behandeld of de manier hoe een onderwerp werd behandeld
- Zijn er punten die beter konden aan de bijeenkomsten?
  - Bijv. een bepaald onderwerp dat werd behandeld, de manier hoe een onderwerp werd behandeld of een onderwerp die u heeft gemist.
- Wat vond u van de mate van informatie die per bijeenkomst werd verstrekt?
  - Bijv. te veel of te weinig informatie per bijeenkomst, sommige onderwerpen liever eerder binnen het traject gehad of informatie die dubbelop werd gegeven.
- Wat vond u van de manier hoe de bijeenkomsten werden gehouden?
  - Bijv. dat het werd gehouden door middel van presentaties of dat groepsbijeenkomsten waren.
    - Had u het liever anders gewild?
      - Bijv: kleinere of grotere groepen, interactiever of dat er meer ruimte was om individuele vragen te stellen.

- Was u aanwezig bij de facultatieve bijeenkomsten?

<u>Indien nee:</u>

- waarom niet?
  - Wist u dat deze bijeenkomsten aangeboden werden?

<u>Indien ja:</u>

- Wat vond u van deze bijeenkomsten?
- Op een schaal van 1 tot 10, hoe waardevol vond u deze bijeenkomsten?
- Wat vond u goed of waardevol aan deze bijeenkomsten?
  - Bijv. een bepaald onderwerp dat werd behandeld of de manier hoe een onderwerp werd behandeld
- Zijn er punten die beter konden aan de bijeenkomsten?
  - Bijv. een bepaald onderwerp dat werd behandeld, de manier hoe een onderwerp werd behandeld of een onderwerp die u heeft gemist.
- Wat vond u van de mate van informatie die per bijeenkomst werd verstrekt?
  - Bijv. te veel of te weinig informatie per bijeenkomst, sommige onderwerpen liever eerder binnen het traject gehad of informatie die dubbelop werd gegeven.
- Wat vond u van de manier hoe de bijeenkomsten werden gehouden?
  - Bijv. dat het werd gehouden middels presentaties en in de vorm van groepsbijeenkomsten.
    - Had u het liever anders gewild?
      - Bijv: kleinere of grotere groepen, interactiever of dat er meer ruimte was om individuele vragen te stellen.

Ervaring nazorgtraject: fysiotherapeut
(De bijeenkomsten die door de fysiotherapeut wordt gehouden in het nazorgtraject bestaan uit 2 facultatieve groepsbijeenkomsten)

- Kunt u mij vertellen op welke momenten na de operatie u in aanraking bent gekomen/contact heeft gehad met de fysiotherapeut?
- Wat vindt u van de hulp en begeleiding die u heeft gekregen van de fysiotherapeut?

- Was u aanwezig bij de facultatieve bijeenkomsten?
  <u>Indien nee:</u>
    - waarom niet?
        - Wist u dat deze bijeenkomsten aangeboden werden?

  <u>Indien ja:</u>
- Wat vond u van deze bijeenkomsten?
- Op een schaal van 1 tot 10, hoe waardevol vond u deze bijeenkomsten?
- Wat vond u goed of waardevol aan deze bijeenkomsten?
    - Bijv. een bepaald onderwerp dat werd behandeld of de manier hoe een onderwerp werd behandeld
- Zijn er punten die beter konden aan de bijeenkomsten?
    - Bijv. een bepaald onderwerp dat werd behandeld, de manier hoe een onderwerp werd behandeld of een onderwerp die u heeft gemist.
- Wat vond u van de mate van informatie die per bijeenkomst werd verstrekt?
    - Bijv. te veel of te weinig informatie per bijeenkomst, sommige onderwerpen liever eerder binnen het traject gehad of informatie die dubbelop werd gegeven.
- Wat vond u van de manier hoe de bijeenkomsten werden gehouden?
    - Bijv. dat het werd gehouden middels presentaties en in de vorm van groepsbijeenkomsten.
        - Had u het liever anders gewild?
            - Bijv: kleinere of grotere groepen, interactiever of dat er meer ruimte was om individuele vragen te stellen.

Ervaring nazorgtraject: verpleegkundig specialist
(Er worden geen bijeenkomsten gehouden in het nazorgtraject door de verpleegkundige. De verpleegkundige neemt telefonisch contact op met de patiënt.)

- Kunt u mij vertellen op welke momenten na de operatie u in aanraking bent gekomen/contact heeft gehad met de verpleegkundige?
- Wat vond u van de hulp en begeleiding die u heeft gekregen van de verpleegkundige?
- Op een schaal van 1 tot 10, hoe waardevol vond u deze contactmomenten?
    - Wat vond u goed of waardevol aan deze contactmomenten?
    - Zijn er punten die beter konden aan deze contactmomenten?
        - Wat vond u dat beter kon aan de contactmomenten?

Ervaring nazorgtraject: psycholoog
(De bijeenkomsten die door de psycholoog wordt gehouden in het nazorgtraject bestaan uit 5 facultatieve groepsbijeenkomsten)

- Kunt u mij vertellen op welke momenten na de operatie u in aanraking bent gekomen/contact heeft gehad met de psycholoog?
- Wat vindt u van de hulp en begeleiding die u heeft gekregen van de psycholoog?

- Was u aanwezig bij de facultatieve bijeenkomsten?
  Indien nee:
    - waarom niet?
        - Wist u dat deze bijeenkomsten aangeboden werden?

  Indien ja:
- Wat vond u van deze bijeenkomsten?
- Op een schaal van 1 tot 10, hoe waardevol vond u deze bijeenkomsten?
- Wat vond u goed of waardevol aan deze bijeenkomsten?
    - Bijv. een bepaald onderwerp dat werd behandeld of de manier hoe een onderwerp werd behandeld
- Zijn er punten die beter konden aan de bijeenkomsten?
    - Bijv. een bepaald onderwerp dat werd behandeld, de manier hoe een onderwerp werd behandeld of een onderwerp die u heeft gemist.
- Wat vond u van de mate van informatie die per bijeenkomst werd verstrekt?
    - Bijv. te veel of te weinig informatie per bijeenkomst, sommige onderwerpen liever eerder binnen het traject gehad of informatie die dubbelop werd gegeven.
- Wat vond u van de manier hoe de bijeenkomsten werden gehouden?
    - Bijv. dat het werd gehouden middels presentaties en in de vorm van groepsbijeenkomsten.
        - Had u het liever anders gewild?
            - Bijv: kleinere of grotere groepen, interactiever of dat er meer ruimte was om individuele vragen te stellen.

Leefstijl veranderen na de bariatrische operatie
Dan zou ik nu graag willen ingaan op hoe het veranderen van de leefstijl na de operatie tot nu toe is gegaan bij u.

- Heeft u het gevoel dat u voldoende ondersteuning en begeleiding heeft gekregen van het ziekenhuis om uw leefstijl te veranderen?
    - Waarom wel of niet?
    - Wat zou volgens u beter kunnen hieraan?

- Wat motiveerde u in de periode direct na de operatie om uw leefstijl te veranderen?
- Is dit nog steeds uw motivatie om uw leefstijl te veranderen of om uw aangepaste leefstijl te behouden?
    - Indien nee: wat motiveert u op dit moment om uw leefstijl te veranderen?
    - Indien ja: zijn er nog meer dingen die u motiveren om uw leefstijl te veranderen op dit moment?
- Heeft u tot nu toe moeite gehad met het veranderen van uw leefstijl?
    - Waar had u moeite mee?
    - Op welke momenten?

eHealth

Ten slotte zou ik graag een aantal vragen willen stellen die betrekking hebben technologieën en applicaties die u kunnen ondersteunen met het verbeteren van uw gezondheid en leefstijl. Voorbeelden hiervan zijn: applicaties op de telefoon waarbij u bijvoorbeeld de voeding kan bijhouden. Of een FitBit horloge die u tijdens het onderzoek heeft gebruikt, deze kon bijvoorbeeld het aantal stappen per dag en uw lichamelijke activiteit bijhouden.

- Heeft u vóór het onderzoek al eerder gebruik gemaakt dit soort technologieën of applicaties?
    - Indien ja, welke?
        - Maakt u nog gebruik van deze technologie(n) en/of applicatie(s)?
            - Waarom wel of niet?
        - Welke functies vindt/vond u waardevol om te gebruiken?

Uitleg geven over wat ik wil doen tijdens mijn afstudeeropdracht: Voor mijn afstudeeronderzoek wil ik een applicatie ontwerpen die speciaal gericht is voor patiënten die een maagverkleining zijn ondergaan. Het is de bedoeling dat deze applicatie de patiënt kan ondersteunen na de operatie en om bijvoorbeeld te helpen met het veranderen van de leefstijl. Deze applicatie wil ik ontwerpen aan de hand van dit interview, interviews met andere patiënten die een maagverkleining zijn ondergaan en zorgverleners.

- Wat vindt u hiervan?
    - Zou dit waardevol zijn voor u?
- Welke functies zou volgens u waardevol zijn om te hebben in de applicatie?
  (Indien ze het niet snappen, voorbeelden geven: het bijhouden van de voeding, het kunnen terugvinden van informatie die tijdens die bijeenkomsten zijn gegeven, extra informatie over leefstijlveranderingen door de zorgverleners, forums zodat je in contact kan komen met lotgenoten etc.)

Dit waren alle vragen voor het interview. Heeft u zelf nog vragen, aanvullingen of opmerkingen?

Dan wil ik u nogmaals bedanken voor uw deelname aan dit interview en uw medewerking.

Appendix D: Requirement templates

Requirement #: 1	**Requirement type:** Function & Events
Value: Increased insight and awareness of own lifestyle	**Attribute:** Tracking physical activity (amount of steps)
Description: The application is able to retrieve step data from the mobile phone of the patient, when the patient consents to it	
Rationale: With this function the amount of steps are automatically tracked and entered in the to-be-developed application, which is more convenient for the patient.	
Source: Literature search and interviews	
Priority: must have	**Conflicts:** For this requirement, it is required for the patient to carry the mobile phone with them

Requirement #: 2	**Requirement type:** Function & Events
Value: Increased insight and awareness of own lifestyle	**Attribute:** Compatibility with other mobile health devices
Description: The application is compatible with other mobile health devices and is able to retrieve the data from these devices (e.g. an activity tracker and digital scale)	
Rationale: This requirement is for patients who have other mobile health devices such as an activity tracker or digital scale so they can see their data in the to-be-developed application. This way patients only have to use one application for convenience. Furthermore, the health data is automatically entered in the eHealth application, which is also convenient for the patient.	
Source: Literature search and interviews	
Priority: Could have	**Conflicts:** Might not be possible for all mobile health devices

Requirement #: 3	**Requirement type:** Content and structure
Value: Easy overview of progression	**Attribute:** Having insight into their own lifestyle
Description: The application contains an overview with of the daily progression and daily personalized goals (e.g. amount of steps, calorie count and weight)	
Rationale: The overview makes it easy for the patient to keep track of their progression. An increased awareness of their progression, can result into patients making behavioural changes to reach their goals.	
Source: Interviews	
Priority: must have	

Requirement #: 4	**Requirement type:** Interaction & Usability
Value: Increased insight and awareness of own lifestyle	**Attribute:** Tracking and monitoring own lifestyle
Description: The patient is able to enter their weight, food intake and exercise values in the application	
Rationale: This way the patient can keep track of and have insight into their lifestyle. Patients might already do this on another existing application. However, it can be more convenient for the patient to have all functions regarding lifestyle support after surgery in one application, like in this to-be-developed application.	
Source: Literature search and interviews	
Priority: must have	**Conflicts:** Whether patients are going to use it

Requirement #: 5	**Requirement type:** Style & Aesthetics
Value: Increased insight and awareness of own lifestyle	**Attribute:** Having insight into their own lifestyle
Description: The application shows visualizations of the progress (e.g. the amount of steps, the weight and caloric intake)	
Rationale: Visualization can make the progress easier to understand, easier to compare with the progress of another day and more appealing to see for the patient. Furthermore, the patient is able to see the progress in a glance with the visualizations.	
Source: Interviews	
Priority: must have	

Requirement #: 6	**Requirement type:** Content and structure
Value: Being informed	**Attribute:** Easy to understand information
Description: The information in the application are delivered as easy as possible to understand for the patient.	
Rationale: Patients have different level of knowledge and education. So it is important to make the information that is given in the application as easy as possible to understand. This can make the understanding of the information more effective. This can also result into more patients that are able and willing to use the application.	
Source: Interviews	
Priority: Must have	

Requirement #: 7	**Requirement type:** Content & Structure
Value: Easy and quick access to information	**Attribute:** To have educational components
Description: The application contains (general) information, examples and exercises on behavioural changes after the surgery and problem solving skills (e.g. guidelines and e-learnings on food intake and physical activity)	
Rationale: Patients currently receive information through (group) appointments and digital content that is send afterwards. Having educational content on the to-be-developed application can result to easier access to information for patients. Furthermore, it can be more convenient for patients to have all the information in one place. So in this case, the application.	
Source: Literature search and interviews	
Priority: must have	**Conflicts:** Whether patients are going to use it and healthcare professionals and/or other experts need to take time to generate the information for the application

Requirement #: 8	**Requirement type:** Style & Aesthetics
Value: Easy to understand information	**Attribute:** Different ways to convey information
Description: The given information is able to be conveyed through images, text, videos or fact sheets	
Rationale: For certain educational content, it is easier and clearer when it is conveyed in a certain way. For example, examples of exercises through a video is easier to understand than through text. Patients can also have a certain preference of how information is conveyed. For example, some could prefer guidelines through a fact sheet while others prefer it in text.	
Source: Literature search and interviews	
Priority: must have	

Requirement #: 9	**Requirement type:** Content & Structure
Value: Less workload for healthcare professionals and easy and quick access to information for patients	**Attribute:** To have a frequently asked questions section
Description: The application contains a section for frequently asked questions (FAQ)	
Rationale: Health care professionals often receive questions through the email that can be answered in the same way. Currently they have to answer the patient one by one. Therefore, it is desirable to have a section in the application that contains frequently asked questions with the answers. Furthermore, when implemented in the application, patients can easily and quickly access the information.	
Source: interviews	
Priority: Could have	**Conflicts:** Healthcare professionals need to take some time to generate the FAQ with the answers

Requirement #: 10	**Requirement type:** Content & Structure
Value: Inspiration on ways to change behaviour	**Attribute:** Suggestions for behaviour change
Description: The application contains suggestions on what patients can execute to increase or maintain weight loss (e.g. exercise and recipe suggestions)	
Rationale: The suggestions can result into inspiration for ways to change behaviour to the patients. For example, when the patient does not know what to eat, they can look for healthy recipes suggestions. Or when they want to do a quick and easy work-out session, they can look for exercise suggestions on the application.	
Source: Literature search	
Priority: Must have	**Conflicts:** Whether the patients carry out the suggestions

Requirement #: 11	**Requirement type:** Interaction & Usability
Value: Easier contact with healthcare professionals	**Attribute:** Communication with healthcare professionals
Description: The patient is able to remotely communicate with the healthcare professional through the application (e.g. through a chat function)	
Rationale: With this function, it is easier for patients to ask questions or for help to healthcare professionals. The ease of communication with the healthcare professionals can decrease the barrier of contacting the healthcare professionals for help or advice, which can contribute into patients asking for help earlier when they face problems.	
Source: Literature search and interviews	
Priority: must have	

Requirement #: 12	**Requirement type:** Interaction & Usability
Value: A higher appointment rate	**Attribute:** For patients to be able to attend remotely to appointments
Description: The patient is able to attend to (group) appointments with the healthcare professional remotely using the application (e.g. video calling and conferencing)	
Rationale: It can happen that patients are not able to be physically present the during the (group) appointment. For example, due to transportation issues or because of the distance to the hospital. It would be valuable for patients to still be able to attend at home through, for instance, videoconferencing.	
Source: Literature reviews and interviews	
Priority: must have	**Conflicts:** Technical issues can occur during the appointments and the healthcare professionals need to understand how to set up the remote appointment

Requirement #: 13	**Requirement type:** Interaction & Usability
Value: Physical group appointments	**Attribute:** For patients to only attend remotely to appointments when necessary
Description: The patient has to be invited to the videoconference to be able to attend to the group appointments	
Rationale: Most healthcare professionals prefer patients to be physically present during group appointments. For example, to read the body language of patients or for the group support between patients themselves. So, it is desirable that patients are only able to remotely participate to the group appointments when they have a valid reason. This function ensures that patients are not choose right away to attend remotely. Furthermore, it is more practical for patients to be invited to concerning appointments, than that they are able to attend every appointment that is being held.	
Source: Interviews	
Priority: must have	**Conflicts:** Whether healthcare professionals have the time to invite the patients, or whether a third person is needed for this task

Requirement #: 14	**Requirement type:** Function & events
Value: Availability of given information	**Attribute:** For patients to (re)watch group appointments
Description: The patient is able to view the group appointments again using the application	
Rationale: This can be valuable for patients who want to rewatch or remember certain information that was given during the group appointment. This is also valuable for patients who were not able to attend to the group appointment, so that they are still able to receive the information that was given by the healthcare professionals.	
Source: Interviews	
Priority: must have	

Requirement #: 15	**Requirement type:** Interaction & Usability
Value: Remote communication	**Attribute:** For patients to be able to attend remotely to appointments
Description: The patient is able to use the chat and microphone during the videoconference of the group appointment (e.g. for questions)	
Rationale: It is valuable for the patient and healthcare professional when the patient is still able to remotely interact during the group appointment in ways that would also possible if the patient was physically present. For example, to ask a questions.	
Source: Interviews	
Priority: must have	

Requirement #: 16	**Requirement type:** Interaction & Usability
Value: Easy way to contact healthcare professionals	**Attribute:** Communication with healthcare professionals
Description: The patient is able to make an online appointment with the healthcare professional through the application (e.g. a videocall)	
Rationale: Being able to make an online appointments can decrease the barrier of contacting the healthcare professionals for help or advice. It also does not require for the patients to be physically present in the hospital, which also can be easier and less of a barrier for patients.	
Source: Interviews	
Priority: Should have	

Requirement #: 17	**Requirement type:** Function & events
Value: Being able to help patients in the early stages of their problems	**Attribute:** Insight on needs of patients
Description: The application contains a periodic questionnaire to check-up on the patient (e.g. questions on the current wellbeing and problems regarding the lifestyle change)	
Rationale: This questionnaire can help healthcare professionals to have insight into if patient require extra help or advice. This way, healthcare professionals are able to help patients in the early stage of their problems.	
Source: Literature review and interviews	
Priority: must have	**Conflicts:** Whether patients are going to use it

Requirement #: 18	**Requirement type:** Content & Structure
Value: Questions that are relevant to the different types of health care professionals	**Attribute:** Insight on needs of patients
Description: The questionnaire contains specific questions relevant to the different healthcare professional (e.g. dietician, physical therapist, nurse and psychologist)	
Rationale: There are different types of healthcare professionals who have their own expertise on certain domains were they can help patients with. Because of this, it is desirable if the questionnaire contains questions that are relevant to the different types of healthcare professionals. For example questions relevant for the dietician or nurse.	
Source: Interviews	
Priority: must have	**Conflicts:** Healthcare professionals need to take some time to generate questions for the questionnaire

Requirement #: 19	**Requirement type:** Interaction & Usability
Value: Less workload for healthcare professionals and being able to help patients in the early stages of their problems	**Attribute:** Insight on needs of patients
Description: The corresponding healthcare professional receives a notification when certain answers to the questionnaire are out of the determined norm	
Rationale: Taking in account the amount of patients, it is more convenient when the healthcare only receive a notification when a questionnaire score is outside of the determined norm to review the questionnaire, instead of all the completed questionnaires.	
Source: Interviews	
Priority: must have	**Conflicts:** Healthcare professionals need to take some time to determine the norms and healthcare professionals might need extra time during their workday to contact and help the patients and

Requirement #: 20	**Requirement type:** Function & events
Value: Support from and connecting with other bariatric patients	**Attribute:** A place support and connect with peers
Description: The patients are able to support each other through the applications (e.g. forums where patients can ask post experiences, tips and questions)	
Rationale: Patients can experience similar processes and problem after the surgery. With a place to support and connect with each other on the application, like a forum, patients are able to help and relate with each other.	
Source: Interviews	
Priority: must have	**Conflicts:** A moderator is needed to check the forums and to check if the posts are appropriate

Requirement #: 21	**Requirement type:** Content & Structure
Value: For patients to be aware of scheduled appointments	**Attribute:** A higher attendance rate for appointments
Description: The application contains an agenda where patients can view the scheduled (group) appointments with the healthcare professional	
Rationale: It can be convenient for the patient to have all bariatric related components in one application. Furthermore, this function is also convenient for when patients forgot to write the appointment into their planning and have forgotten when they have their next appointment.	
Source: Interviews	
Priority: Should have	**Conflicts:** Whether patients are going to use it

Requirement #: 22	**Requirement type:** Interaction & Usability
Value: Easy signing up for optional appointments	**Attribute:** A higher attendance rate for optional appointments
Description: The patient is able to view the scheduled dates for the optional group appointments and is able to sign up for the appointments they wish to attend	
Rationale: : It can be convenient for the patient to have all bariatric related components in one application. The application can also make it easier for the patient to view and sign up for the appointments in comparison with opening a web browser and having to log in, or to call to sign up for the appointment. Therefore, using the application, can be less of a barrier to sign up for the appointments	
Source: Interviews	
Priority: Should have	**Conflicts:** Whether patients are going to use it

Requirement #: 23	**Requirement type:** Content & Structure
Value: Informed decision making	**Attribute:** A higher attendance rate for optional appointments
Description: The patient is able to read were the optional group appointment is about before signing up to the optional group appointments	
Rationale: For patients to be aware what is being discussed during the optional group appointments, so patients can make an informed decisions on whether they want to join the optional appointments.	
Source: Interviews	
Priority: Should have	

Requirement #: 24	**Requirement type:** Interaction & Usability
Value: Increased insight of own lifestyle	**Attribute:** Reminder to keep track of lifestyle
Description: The application sends reminders to track their lifestyle (e.g. their food intake, weight and exercises)	
Rationale: For patients to be reminded to keep track of their lifestyle so that they have insight into their lifestyle.	
Source: Literature search	
Priority: Must have	**Conflicts:** Whether patients are going to do it after the reminder

Requirement #: 25	**Requirement type:** Interaction & Usability
Value: Reminder for scheduled appointments	**Attribute:** Higher attendance rate
Description: The application sends reminders of the scheduled appointments when it is close to the scheduled date	
Rationale: A reminder for the patients that they have a scheduled appointment where they have to attend to, in case when they had forgotten about it.	
Source: Interviews	
Priority: Should have	

Requirement #: 26	**Requirement type:** Interaction & Usability
Value: Reminder for behavioural change	**Attribute:** Motivations for behavioural change
Description: The application sends motivational notifications or notifications with suggestions to encourage behavioural change (e.g. suggestions to start exercising or the encouragement to keep it up with the food intake)	
Rationale: Receiving these notifications can motivate and remind patients to keep working on their behavioural change	
Source: Literature search	
Priority: Could have	**Conflicts:** Whether patients are going carry out the suggestions

Requirement #: 27	**Requirement type:** Function & events
Value: Notifications are send to patients when relevant and executable	**Attribute:** Motivations for behavioural change
Description: The notifications are tailored to the time of the day, the day of the week, the weather and the recorded lifestyle values of the patients (e.g. the amount of steps, food intake and weight)	
Rationale: When the notifications are relevant to the planning and environment of patients, they might be more inclined to act on these notifications. For example, when the notification is send to the patient to take a evening walk, patients might feel like to do so when it is nice weather outside while they might not feel like to do so when it is raining outside.	
Source: Literature search	
Priority: Could have	**Conflicts:** The notifications might still not be perfectly tailored to the planning and environment of the patients

Requirement #: 28	**Requirement type:** Interaction & Usability
Value: Awareness of progress	**Attribute:** Motivations for behavioural change
Description: The patient receives feedback from the application regarding the progress (e.g. of the food intake and physical activity) (e.g. you still have X steps to go to reach your goal!)	
Rationale: Being aware of the goal progress, can motivate patients to reach their goals.	
Source: Interview	
Priority: Should have	**Conflicts:** Whether patients react accordingly to the reminder

Requirement #: 29	**Requirement type:** Function & events
Value: Being rewarded when reaching goals	**Attribute:** Motivations for behavioural change
Description: The application has a reward system (e.g. getting achievements when reaching the goals for a certain amount of time)	
Rationale: Being rewarded and being aware of their achievements can motivate patients so keep reaching their goals.	
Source: Interviews	
Priority: Should have	**Conflicts:** Whether patients react accordingly to the rewards

Requirement #: 30	**Requirement type:** Interaction & Usability
Value: Awareness of progress	**Attribute:** Motivations for behavioural change
Description: The patients receives a notification when a goal has not been reached for a certain amount of time to increase awareness (e.g. the step or food intake goal)	
Rationale: Being aware of the goal progress, can motivate patients to reach their goals.	
Source: Interviews	
Priority: Should have	**Conflicts:** Whether patients react accordingly to the notifications

Requirement #: 31	**Requirement type:** Interaction & Usability
Value: Being able to set personal goals	**Attribute:** Motivations for behavioural change
Description: The patient is able to set personalized goals in the application (e.g. step and weight goal)	
Rationale: People are all different from each other, which means that people also have different personal goals from each other. Therefore, it is important for the patient to be able to set their own personal goals. Setting up goals can also challenge and motivate patients to reach those personal goals.	
Source: Literature search and interviews	
Priority: must have	**Conflicts:** Whether patients are going to use it

Appendix F: requirements implemented in clickable prototype

ID	Requirement
TODAY section	
3.	The application contains an overview with of the daily progression and daily personalized goals (e.g. amount of steps, calorie count and weight
4.	The patient is able to enter their weight, food intake and exercise values in the application
5.	The application shows visualizations of the progress (e.g. the amount of steps, the weight and caloric intake)
10.	The application contains suggestions on what patients can execute to increase or maintain weight loss (e.g. exercise and recipe suggestions)
31.	The patient is able to set personalized goals in the application (e.g. step and weight goal)
EDUCATION section	
7.	The application contains (general) information, examples and exercises on behavioural changes after the surgery and problem solving skills (e.g. guidelines and e-learnings on food intake and physical activity)
8.	The given information is able to be conveyed through images, text, videos or fact sheets
10.	The application contains suggestions on what patients can execute to increase or maintain weight loss (e.g. exercise and recipe suggestions)
SUPPORT section	
11.	The patient is able to remotely communicate with the healthcare professional through the application (e.g. through a chat function)
17.	The application contains a periodic questionnaire to check-up on the patient (e.g. questions on the current wellbeing and problems regarding the lifestyle change)
20.	The patients are able to support each other through the applications (e.g. forums where patients can ask post experiences, tips and questions)
APPOINTMENTS/MEETINGS section	
12.	The patient is able to attend to (group) appointments with the healthcare professional remotely using the application (e.g. video calling and conferencing)
14.	The patients is able to view the group appointments again using the application

Appendix G: Information letter usability test and evaluation prototype

Geachte heer/mevrouw,

Mijn naam is Thuvan Vu en namens het obesitascentrum van Ziekenhuisgroep Twente (ZGT) voer ik mijn afstudeeronderzoek uit voor de master Gezondheidswetenschappen aan de Universiteit Twente. Middels deze brief wordt u uitgenodigd om mee te doen aan dit medisch-wetenschappelijk onderzoek. Deelname aan het onderzoek is geheel vrijwillig. Voordat u de keuze maakt om deel te nemen of niet, is het belangrijk om meer te weten over het onderzoek. Lees deze informatiebrief daarom rustig door. Heeft u na het lezen van de informatiebrief nog vragen? Dan kunt u terecht bij mij, de onderzoeker. U kunt mijn contactgegevens aan het eind van deze informatiebrief vinden.

Achtergrond en doel van het onderzoek
Onder bariatrische chirurgie worden alle operaties verstaan die tot doel hebben om het gewicht te verminderen. Voor succesvol gewichtsverlies op de lange termijn na de ingreep, is het van belang een gezonde leefstijl te realiseren en te behouden. Het is aan de patiënt zelf om deze nieuwe leefstijl door te voeren in het dagelijks leven. Dit blijkt voor een deel van de patiënten lastig te zijn, waardoor een deel onvoldoende gewicht verliest of weer aankomt in gewicht na bariatrische chirurgie.

Mobiele applicaties kunnen patiënten ondersteunen bij het doorvoeren van leefstijlveranderingen op manieren wat met alleen mankracht niet mogelijk is. Er is onderzocht welke functies een mogelijk mobiele applicatie zou moet bevatten om patiënten te kunnen ondersteunen na bariatrische chirurgie. Dit is gedaan middels interviews met zorgverleners en patiënten die bariatrische chirurgie hebben ondergaan. Tijdens deze interviews zijn de ervaringen en meningen verzameld over de huidige nazorg die wordt geleverd door Ziekenhuisgroep Twente (ZGT). Met nazorg wordt bedoeld: de begeleiding die vanuit het ziekenhuis wordt gegeven na de operatie, zoals de groepsbijeenkomsten met zorgverleners. Daarnaast zijn de wensen van mogelijk functies in een mobiele applicatie in kaart gebracht tijdens deze interviews.

Aan de hand van de resultaten van de interviews en bestaande literatuur is er een eerste ontwerp van een mobiele applicatie ontwikkeld die patiënten zou kunnen ondersteunen na de operatie. Tijdens dit onderzoek zal het ontwerp getest worden op gebruiksvriendelijkheid en zal uw mening worden uitgevraagd over het ontwerp.

Wat meedoen inhoudt
Voorbereiding
Via de mail ontvangt u een uitnodiging voor een videobelsessie middels Microsoft Teams. Hiervoor hoeft u niets te downloaden en hoeft u geen account aan te maken: via de uitnodiging kunt u deelnemen als gast. Tevens ontvangt u via de mail een link naar het eerste ontwerp van de applicatie. Er zal aan u gevraagd worden om de link te openen en uw scherm te delen via Microsoft Teams, zodat de onderzoeker met uw scherm kan meekijken. Tijdens het videobellen, zal de onderzoeker deze stappen nogmaals met u doorlopen. Het is dus geen probleem als u hier niet bekend mee bent. Het is aan te raden om de videobelsessie te houden op de computer of laptop.

Gebruikerstest en evaluatie van prototype
Wanneer u het eerste ontwerp van de applicatie heeft geopend op de computer/laptop, is het mogelijk om door de applicatie te navigeren. Dit is vergelijkbaar met het gebruik van een echte mobiele applicatie. Van de onderzoeker krijgt u een aantal taken wat u moet uitvoeren tijdens het doorlopen van het ontwerp. Hierdoor kunt u ook zien welke mogelijke functies de applicatie te bieden heeft. Ten slotte zal het ontwerp met u geëvalueerd worden, waarbij uw mening over het prototype wordt gevraagd.

Tijdens de videobelsessie, zal de gebruikerstest en evaluatie opgenomen worden via Microsoft Teams. Dit zal door de onderzoeker duidelijk en mondeling worden aangekondigd. Daarnaast is het niet verplicht om uw camera aan te zetten tijdens de videobelsessie. De gehele sessie zal maximaal 60 minuten duren.

Als u niet wilt meedoen of wilt stoppen met het onderzoek
U beslist zelf of u meedoet aan het onderzoek. Deelname is vrijwillig. Als u niet wilt meedoen, wordt u op de gebruikelijke manier behandeld. Als u besluit niet deel te nemen, hoeft u verder niets te doen. Als u wel meedoet, kunt u zich altijd bedenken en toch stoppen, ook tijdens het onderzoek. Ook dit zal geen consequenties hebben voor u of uw verdere behandeling. U wordt op de gebruikelijke manier behandeld. U hoeft niet te zeggen waarom u stopt. Wel moet u dit direct melden aan de onderzoeker. De gegevens die tot dat moment zijn verzameld, worden gebruikt voor het onderzoek. Als er nieuwe informatie over het onderzoek is die belangrijk voor u is, laat de onderzoeker dit aan u weten. U wordt dan gevraagd of u blijft meedoen

Gebruik en bewaren van uw gegevens
Voor dit onderzoek worden uw persoonsgegevens verzameld, gebruikt en bewaard. Het gaat om gegevens zoals uw naam, geboortedatum en operatiedatum. Het verzamelen, gebruiken en bewaren van uw gegevens is nodig om de vragen die in dit onderzoek worden gesteld te kunnen beantwoorden en de resultaten te kunnen verwerken in mijn scriptie.

Vertrouwelijkheid van gegevens
Uw privacy zal zo goed mogelijk worden beschermd. Er wordt op geen enkele wijze vertrouwelijke informatie of persoonsgegevens van of over u doorgegeven aan derden. Uw gegevens zullen worden gecodeerd op een manier dat deze niet te herleiden zijn naar u. Uw gegevens en de onderzoeksresultaten zullen in de scriptie onder een pseudoniem verwerkt worden, waardoor deze gegevens ook niet te herleiden zijn naar u.

Bewaartermijn gegevens
Uw gegevens zullen gedurende het onderzoek bewaard blijven. Hierna zullen de gegevens vernietigd worden.

Toestemming voor het gebruik van uw gegevens intrekken
U kunt uw toestemming voor het gebruik van uw gegevens op ieder moment intrekken. Maar let op: trekt u uw toestemming in, en hebben onderzoekers dan al gegevens verzameld voor een onderzoek? Dan mogen zij deze gegevens nog wel gebruiken.

Geen vergoeding voor meedoen
U wordt niet betaald voor het meedoen aan dit onderzoek. Ook ontvangt u geen onkostenvergoeding.

Ondertekening toestemmingsformulier
Indien u na zorgvuldige overweging besluit deel te nemen aan dit wetenschappelijk onderzoek, dan vraag ik u om het toestemmingsformulier te ondertekenen en van een datum te voorzien. Door uw schriftelijke toestemming geeft u aan dat u de informatie heeft begrepen en instemt met deelname aan het onderzoek. Mocht u op dit moment of tijdens de studie vragen of klachten hebben, dan kunt u altijd contact met mij opnemen.

Met vriendelijke groet,

Thuvan Vu (Student Master Gezondheidswetenschappen, onderzoeker)
E-mail: t.t.v.vu@student.utwente.nl

Appendix H: Consent form usability test and evaluation prototype

Titel onderzoek: Gebruikerstest en evaluatie eerste ontwerp mobiele applicatie voor postoperatieve bariatrische patiënten
Verantwoordelijke onderzoeker: Thuvan Vu (Student Master Gezondheidswetenschappen Universiteit Twente)

In te vullen door deelnemer

Ik bevestig hierbij dat ik voldoende ben geïnformeerd over het onderzoek en dat ik in de gelegenheid ben geweest om vragen te stellen.

Ik weet dat mijn deelname aan het onderzoek vrijwillig is, en dat ik op ieder moment mijn toestemming kan intrekken zonder een reden te geven.

Ik geef toestemming voor het verzamelen en gebruiken van de verkregen informatie tijdens het onderzoek voor de beantwoording van de onderzoeksvraag van het onderzoek.

Ik geef toestemming om beeld- en geluidsopnames te maken tijdens het onderzoek.

Ik begrijp dat de verkregen informatie van de beeld- en geluidsopnames geheel anoniem verwerkt zal worden en dat deze gegevens niet te herleiden zijn naar mij.

Ik geef toestemming voor deelname aan het onderzoek.

Naam deelnemer: ……..

Handtekening …… Datum: ……

In te vullen door uitvoerende onderzoeker

Ik verklaar hierbij de deelnemer voldoende geïnformeerd te hebben over het onderzoek. Ik zal resterende vragen over het onderzoek naar vermogen beantwoorden.

Naam deelnemer: ……..

Handtekening …… Datum: ……..

Appendix I: Guide of usability test and evaluation prototype

Bedankt voor uw deelname aan dit onderzoek. Tijdens het onderzoek zou ik graag de eerste versie van een applicatie willen laten testen door u. Deze applicatie is speciaal bedoelt om mensen te ondersteunen met het hanteren van een gezonde leefstijl en het behouden van de leefstijl en gewichtsverlies na een maagoperatie. De content van de applicatie is gebaseerd op meningen, ervaringen en behoeftes van mensen die een maagoperatie hebben ondergaan en van de zorgverleners waarmee ze in contact komen na de operatie, en bestaande literatuur.

Om de gebruiksvriendelijkheid en de content van de applicatie te evalueren, gaan we vandaag twee dingen doen: allereerst zal ik aan u vagen om verschillende taken uit te voeren tijdens het gebruik van de applicatie. Ik wil u hierbij vragen om hard op na te denken terwijl u deze taken uitvoert. Ik zal zo dadelijk een voorbeeld geven. Daarna zal ik graag uw mening uit willen vragen over het gebruiksgemak en de functies van het prototype.

Heeft u tot nu toe vragen?

Dan zou ik nu uitleggen wat er van u wordt verwacht tijdens de eerst fase van het onderzoek: ik ga een aantal taken opnoemen die u moet uitvoeren en waarbij u hard op moet nadenken tijden het uitvoeren van deze taken. Ik zal beginnen met een voorbeeld. De eerste taak is bijvoorbeeld: “Ik wil inloggen op de applicatie”. Dan is het de bedoeling dat de gedachtegang verteld. Dus bijvoorbeeld: ik zie de knop inloggen en daar klik ik nu op.

Dit kan in het begin misschien een beetje raar aanvoelen, maar het zal ons helpen begrijpen hoe u de app precies gebruikt. Ik zal u eraan herinneren wanneer je vergeet om uw gedachten te delen.
Er zijn geen verkeerde gedachten of antwoorden. We testen de applicatie en niet u als gebruiker. U helpt mij het testen van het prototype. Is alles duidelijk tot nu toe?

Dan zou ik nu graag willen beginnen met het onderzoek.
Ik start nu moet de opname.

Dan geef ik u nu de eerste taak.

Taken

1. Ik wil inloggen op de applicatie
2. Ik wil zien hoeveel stappen ik deze week heb gezet
3. Ik heb een vraag en wil een bericht sturen naar de diëtist
4. Ik wil mijn gewicht toevoegen op de applicatie
5. Ik wil de groepsbijeenkomst van vandaag online bekijken
6. Ik wil mijn stappendoel bijwerken
7. Ik wil de forum bekijken om berichten van medelotgenoten te zien
8. Ik wil een e-learning maken
9. Ik wil de tip van de dag zien
10. Ik wil inspiratie voor nieuwe recepten die ik vanavond zou kunnen koken
11. Ik wil mijn maandelijkse controle vragenlijst invullen zodat de zorgverleners tijdig een seintje krijgen wanneer ik ergens tegenaan loop en hulp nodig heb
12. Ik wil meer informatie over de richtlijnen rondom fysieke activiteit

Bedankt voor het uitvoeren van deze taken. We gaan nu verder met enkele vragen over uw ervaring en tevredenheid van de applicatie. Ik noem een aantal uitspraken op. Deze uitspraken moet u beoordelen van 1 tot 5, waarbij 1 helemaal niet mee eens is en 5 helemaal mee eens. Heeft u vragen hierover?

		Helemaal niet mee eens				**Helemaal mee eens**
		1	2	3	4	5
1.	Ik denk dat ik dit de applicatie regelmatig zou willen gebruiken					
2.	Ik vond de applicatie onnodig ingewikkeld					
3.	Ik vond dat dat de applicatie makkelijk te gebruiken was					
4.	Ik denk dat ik de steun van een technisch persoon nodig heb om de applicatie te kunnen gebruiken					
5.	Ik vond de verschillende functies van de applicatie goed met elkaar geïntegreerd					
6.	Ik vond dat er te veel tegenstrijdigheden in de applicatie zaten					
7.	Ik kan me voorstellen dat de meeste mensen snel met de applicatie overweg kunnen					
8.	Ik vond de applicatie omslachtig in gebruik					
9.	Ik voelde me zelfverzekerd tijdens het gebruik van de applicatie					
10.	Ik moest veel over de applicatie leren voordat ik het goed kon gebruiken					
11.	De applicatie zou mij ondersteunen bij het veranderen van leefstijl na de operatie					
12.	De applicatie zou mij ondersteunen bij het behouden van de leefstijl na de operatie					
13.	De applicatie zou ik in mijn dagelijks leven willen gebruiken					
14.	Over het algemeen ben ik tevreden over de applicatie					

Ten slotte wil ik een aantal open vragen stellen aan u:

- Wat vond u de meest waardevolle functies in de applicaties die kunnen helpen bij het veranderen van de leefstijl en het behouden van de leefstijl? (Een top drie als u die heeft)
- Wat vond u de minst waardevolle functies in de applicaties die kunnen helpen bij het veranderen van de leefstijl en het behouden van de leefstijl? (Een top drie als u die heeft)
- Zijn er functies die je mist in de applicaties die u zou kunnen helpen bij het veranderen van de leefstijl en het behouden van de leefstijl?

We hebben nu het einde van het onderzoek bereikt. **Ik stop nu met de opname.**
Nogmaals bedankt voor uw deelname. Heeft u nog vragen of opmerkingen?