



BACHELOR THESIS

Patient perspective on telemonitoring and implications for implementation

Fleur Lansink Rotgerink - S2001446

Ellis Slotman - S1995235

First supervisor - Prof. Dr. C.J.M. Doggen

Second supervisor - G.M. Peters MSc



Rijnstate

UNIVERSITY OF TWENTE.

Patient perspective on telemonitoring and implications for implementation

*Bachelor thesis Health Sciences
University of Twente*

Fleur Lansink Rotgerink (S2001446)
Ellis Slotman (S1995235)

First supervisor - Prof. Dr. C.J.M. Doggen
Second supervisor - G.M. Peters MSc

Abstract

Background

Due to rising healthcare expenditure and increasing workload in the healthcare sector, there is a need for innovative strategies that enable the utilization of limited resources more efficiently. One solution might be post-operative telemonitoring, by which disease-related and physiological data of the patient are electronically transmitted between the patient's home and the healthcare provider. Telemonitoring using a biosensor might be a solution to send patients home earlier after bariatric surgery. The biosensor for telemonitoring has already been developed, but has not yet been implemented. For effective implementation, the user perspective on this technology is important. However, studies about the patient perspective on post-operative telemonitoring are lacking. Therefore, the objective of this study is to gain a better understanding of the perspective of bariatric patients on post-operative telemonitoring using a biosensor.

Method

The study population consisted of patients from the Vitalys clinic for obesity in Rijnstate hospital in the Netherlands. Inclusion criteria were that the patients underwent surgery with the purpose of weight loss and that they had worn a biosensor during their surgery and recovery in the hospital. Data was collected by means of telephone interviews that were guided by a semi-structured interview guide. The topics in this guide were based on the Unified Theory of Acceptance and Use of Technology (UTAUT) and a literature search on the patient perspective on telehealth. The topics included: performance expectancy, effort expectancy, social influence, privacy, patient-physician relationship, facilitating conditions, experience and voluntariness of use. The interviews were recorded with participants permission and were transcribed afterwards. Coding was used to analyze the data. The software ATLAS.ti was used for this coding.

Results

Six patients participated in the study. In general, patients showed a positive attitude towards telemonitoring using the biosensor at home. Four themes were identified related to the patients' perspective on post-operative telemonitoring. These included: comfort and safety, awareness and control, communication and assistance and privacy. Most patients expressed that post-operative telemonitoring would increase comfort and safety during their recovery. Clear communication with and assistance from the hospital or healthcare provider regarding hospital discharge and technical or medical issues was considered important by all patients. Furthermore, the majority of patients mentioned that insight in their own measurements, for example through an application, can provide more awareness of and control over their health. Patients desired the possible application to have the following functionalities: an overview of the measurements and desired standards, a function to (video)call with a healthcare provider and advice notifications when problems arise. Regarding privacy, few concerns were mentioned.

Conclusions

Patients are willing to use the biosensor for post-operative telemonitoring, which can reduce length of hospital stay while still providing a comfortable and safe recovery. However, before implementing telemonitoring after bariatric surgery there are several terms and conditions which need to be considered, such as shared decision making on hospital discharge, appropriate and timely assistance and fulfillment of privacy guidelines. In addition, the possibilities of a potential mobile application should be explored. Further research might focus on a larger population of bariatric patients and other patient groups to possibly gain new insights and to identify differences and similarities in their perspectives towards telemonitoring.

Table of contents

Introduction.....	1
Methods	4
Study participants.....	4
Data collection.....	4
Data analysis.....	5
Results	6
Comfort and safety.....	6
Awareness and control.....	7
Communication and assistance.....	7
Privacy	9
Discussion	10
Interpretation of the findings.....	10
Strengths and limitations	11
Implications for clinical practice and suggestions for further research	12
Acknowledgements	14
Appendix 1: Patient information form	18
Appendix 2: Interview guide	20
Appendix 3: Literature search and theoretical framework.....	23
Appendix 4: Interview scheme	26

Introduction

The Dutch healthcare expenditure reached an amount of over one hundred billion euros in 2018, an increase of 3 billion over the previous year (1). This increase of 3.1 percent is the highest since 2010. The Institute for Public Health and Environment (RIVM) in the Netherlands developed a trend scenario about the future of public health in the Netherlands (2). This scenario represents what would happen if no changes are made. According to this trend scenario the healthcare expenditure will continue to rise by an average of 2.9 percent per year to 174 billion euros in 2040. The share of healthcare expenditure as a percentage of the Gross National Product (GDP) will increase from 12.7 percent in 2015 to 16.4 percent in 2040. An important factor influencing this growth in healthcare expenditure is the population growth and aging. The number of people aged 65 or above will increase in the future, while the number of people between 20 and 65 will decrease (3). Because of this, the RIVM predicts that the demand for healthcare will rise (2). There will be a growing disease burden along with a greater imbalance between the number of patients and the number of healthcare providers, which will increase the workload in the healthcare sector (4). This aging process and the corresponding increase in workload are not only affecting the Netherlands, but many countries around the world. Therefore, it is necessary to develop and implement innovative strategies in order to limit the rise in healthcare costs while at the same time being able to meet the growing demand for healthcare. There is a need for new solutions that enable the utilization of limited resources more efficiently. Employing technologies that enable remote collection of clinical data, for example telemonitoring, can provide a way to prevent or reduce hospitalizations and improve the self-management of the patient. The reduction of hospitalizations and the improved self-management can provide cost savings and reduce the workload in the healthcare sector.

Telemonitoring is a specific type of telehealth, by which disease-related and physiological data of the patient are electronically transmitted for assessment from a patient in one location, such as their home, to a healthcare provider in a different location (5). Contact can be established between the healthcare provider and patient for feedback or questions. Remotely monitoring patients can assist in early detection of risk factors or complications, which enables timely intervention and reduction of hospitalizations. Besides this, it can improve patients' self-management by providing them with information about their health status and the possibility of self-monitoring. This will increase the involvement of patients in their own care. Different devices can be used for the purpose of telemonitoring (6). Some devices may require the patient to submit their own health data through a smartphone, website or by phone, whereas other technologies may collect and transmit data automatically, like biosensors, wearable devices or implantable devices. Data that is frequently collected by these devices includes blood pressure, oxygen levels, heart rate, temperature and respiration rate.

Research has shown that telemonitoring is promising in the management of various diseases (5). Most publications focus on telemonitoring in cardiovascular, endocrinological and pulmonary diseases and elderly care. Less attention is given to telemonitoring of surgical patients, where remote post-operative monitoring can be of great value in early detection of complications. It provides the opportunity to send patients home safely early after surgery and remotely monitor them for complications.

Despite the promising results of telemonitoring systems, the use of these technologies is not yet widespread (4). Research has shown that healthcare professionals are willing to use telemonitoring

systems, because they perceive that it can help improve self-care, reduce hospitalizations, provide high-quality care and reduce their workload (7). Adequate training, both for patients as well as themselves, and technical support are important conditions for healthcare providers when using telemonitoring (8, 9). Furthermore, they think it is important that there are clear aims and protocols for the use of telemonitoring (10). Nevertheless, ignorance and non-compliance of healthcare providers and patients is still a major barrier to successful implementation and use of telemonitoring services (4). Therefore, it is important to address this barrier by having more attention for the perspective of the users, both healthcare providers and patients, in developing and implementing telemonitoring systems.

According to the Unified Theory of Acceptance and Use of Technology (UTAUT), user perspective is important when it comes to behavioral intention and use behavior of a technology (11). Patients have expectations and needs concerning a particular technology (12). When those are not met, this negatively affects the behavioral intention and use behavior. Research has shown that involving users in the development and implementation of a technology has several benefits including the generation of new ideas and perspectives, which can improve the design, user interface, functionality, usability and quality of technologies (13). The role that a technology will have and its longevity largely depends on the perspective of the patient towards the technology. Therefore, it is crucial to explore the patient perspective on a technology.

However, studies that focus on the patient perspective on telemonitoring are lacking. Most studies use treatment outcome, quality of life and hospital admissions as outcome measures to evaluate telemonitoring strategies (5). Other outcome measures that are reported less frequently are mortality and cost-effectiveness.

Considering the COVID-19 pandemic, the attention for the user perspective on telehealth and telemonitoring might be more important than ever. The use of telehealth has increased rapidly in recent months due to the outbreak of the Corona virus (14-16). The Dutch government and RIVM drew up guidelines that encouraged social distancing in order to reduce viral spread (17). As a result, many hospital visits were canceled. This was also because sufficient capacity was needed in hospitals for more severe patients with COVID-19. Instead of the cancelled hospital visits, many healthcare providers rapidly offered telehealth (14-16). Virtual consults were held to provide care in a safe manner while honoring self-quarantine requirements (14, 18). However, for telehealth to be effective in this pandemic and possible future emergencies, it has to be adequately integrated into our healthcare system (19). In the long-term, it will be more beneficial if telehealth is implemented proactively rather than reactively. In that way it can help with every day and emergency challenges in healthcare. In order to make telehealth a mainstream component of our healthcare system, the user perspective on these technologies should be examined. Only if this is done adequately, it will be possible to successfully remain and continue the use of telehealth technologies in the future.

An example of a possible future telemonitoring strategy is the use of a biosensor in monitoring patients after bariatric surgery (20). This biosensor is placed on the patient's chest and can measure vital signs such as heart rate, respiration rate and temperature. Patients generally stay in the hospital for a day after their bariatric surgery and are continuously monitored by a vital signs monitor and the healthcare providers in this period. Part of this monitoring in the hospital can possibly be replaced by using the biosensor for home monitoring, so that patients can go home safely early after surgery. Home monitoring can also ensure a better transition between continuous monitoring in the hospital

and going home without any monitoring at all. While current research focusses on examining the validity and reliability of the biosensor and its suitability for telemonitoring, the perspective of the patients towards telemonitoring after bariatric surgery has not yet been explored.

Therefore, the objective of this study is to gain a better understanding of the patient perspective on telemonitoring after bariatric surgery. A qualitative, exploratory study design using telephone interviews will be used to identify themes related to the patient perspective on telemonitoring after surgery using a biosensor.

Methods

Study participants

Patients were recruited from the Vitalys clinic for obesity in Rijnstate Hospital located in Arnhem, the Netherlands. The following inclusion criteria were applied: (i) patients underwent surgery with the purpose of weight loss, which was done by means of a gastric sleeve, gastric bypass or gastric band (21, 22) and (ii) patients had worn a biosensor during their surgery in 2019.

These patients were selected as participants for this current study, in order to examine their perspective towards the use of this biosensor at home for the purpose of telemonitoring.

Patients were approached by means of an email. This email was sent in three batches to different patients. With this email they received a patient information form (appendix 1) that explained the aim of the research and invited them to participate. The patients were asked to respond to the email with their consent when they wanted to participate. With this consent the patients indicated that they agreed with participation in the interview and the use of their data. The answers given in the interview could not be traced back to the patient and the transcripts of the interviews were stored encrypted in Rijnstate Hospital. After giving consent the patients were contacted by telephone to make an appointment for the interview.

Data collection

Interviews were conducted by telephone and were guided by a semi-structured interview guide. The interview guide was in Dutch and can be found in appendix 2. The topics and questions in this guide were drawn up based on the theoretical framework of this study. This framework was obtained by combining topics about the patient perspective on telehealth found in previous studies (23-29) and the UTAUT model (11). An extensive description of the literature search and the setup of the theoretical framework for this study can be found in appendix 3.

The theoretical framework consisted of eight determinants that influence the patient's intention to use and their actual use of technologies. These determinants included: performance expectancy, effort expectancy, social influence, privacy, patient-physician relationship, facilitating conditions, experience and voluntariness of use. These determinants and their definitions are shown in table 1. The determinants were used as main topics for the interview and questions were formulated for each topic. The process of formulating questions based on the eight determinants can be found in the interview scheme in appendix 4. A concept of the interview was presented to a small group of people from the University of Twente, a professor and a PhD candidate. Small adjustments were made in the formulation of the questions to get to a final version. Although areas for exploration were defined, the interview allowed flexibility and deeper examination of arising topics.

Table 1: Determinants in the theoretical framework and their definitions

Determinant	Definition
Performance expectancy	The degree to which an individual believes that using the system is beneficial
Effort expectancy	The degree of ease associated with the use of the system
Social influence	The degree to which an individual perceives that important others believe he or she should use the system
Privacy	Privacy concerning the collection, sharing and use of patient data

Patient-physician relationship	The interaction between the patient and the healthcare provider
Facilitating conditions	The degree to which an individual believes an organizational and technical infrastructure exists to support use of the system
Experience	The experience a patient has with technology
Voluntariness of use	The degree to which the use of the system is voluntarily

Data analysis

The interviews were audio recorded and transcribed with participant's permission. Coding was used to analyze the data. For coding, the software ATLAS.ti was used. The coding process consisted of three phases and started with open coding, where codes were linked to text fragments in the transcripts. Then the data was coded axially, which involved ordering and comparing the codes and merging related codes into themes. In the last phase, selective coding, main categories were established by searching for relationships within the themes.

Results

35 patients were invited to participate. Of these patients six participated in the interview. The mean age of the respondents was 53 years (range 42-67 year). Interviews were 13 to 25 minutes in duration. In general, patients mentioned that they did use technology regularly in their daily life and their attitude towards technology was positive. One patient only used technology when it was necessary. All six patients also expressed satisfaction with the use of the biosensor during their surgery. They mentioned that they did not experience any discomfort from the sensor. In fact, most of them did not even notice the sensor on their skin. From the interviews, twelve initial thematic options were identified. A critical appraisal of relationships within these thematic options led to primary categorisation into four main themes. These themes included comfort and safety, awareness and control, communication and assistance and privacy. Each of these themes is described below along with illustrative quotes.

Comfort and safety

All patients were positive about home monitoring using the biosensor. Patients perceive their home environment to be more pleasant and comfortable than the hospital. A shorter stay in the hospital and recovery at home is therefore preferred.

"There is nothing as pleasant as recovering in your home environment... The familiar environment comforts me. You can just be yourself and you are more at ease." (Patient 4)

"You just prefer to be at home... Your familiar environment, your own bed." (Patient 5)

"The shorter the hospital stay, the better." (Patient 2)

Patients also think that home monitoring can provide a feeling of safety, because they will be monitored for complications for a longer period than would normally happen in the hospital. Another benefit that was mentioned by one patient is that when being monitored, patients would not have to rely solely on their own feelings of wellbeing when they are at home. This was perceived as pleasant and safe, because it was mentioned that the patient's own judgement about his or her health is not always consistent with their actual health status.

"The data from the biosensor speaks for itself. I can say that I feel good, while the sensor shows something different... Such a sensor provides a reliable picture." (Patient 1)

Although home monitoring with the biosensor was mostly associated with increased comfort and safety, some challenges that might have an adverse effect on the comfort and safety of the patient during home monitoring were mentioned by one patient. These were possible problems with the adhesion of the sensor on the skin and the possibility of forgetting to carry the relay device when going out of the coverage area.

Awareness and control

Five patients indicated that they would like to have access to the values that are being measured by the biosensor, for example through an application. These patients mentioned that they would use the data to keep an eye on their health by comparing the measured values with the standards, providing that these standards are given to the patients. In this way patients would feel like they have a better insight in and control over their own health. The access to their own health data would enable patients to check their health status when they are concerned about their health, which can reduce uncertainty and anxiety.

"I would like to see the data... If you have such a sensor and you can keep an eye on those things (measured values), then you want to know which values are desirable. You are going to compare with that." (Patient 1)

"Sometimes I feel restless (about my health) and it reassures me knowing that you worry more than necessary." (Patient 4)

The desire of most patients to have insight in and control over their own health also showed in their willingness to self-measure additional values that the biosensor cannot measure, for example blood pressure and oxygen saturation. Again, five patients expressed that they would appreciate it if they could have an insight in this data. The patients had no concerns about the use of the equipment for these measurements. Based on previous experience with this equipment, all patients described it as easy to use.

"Personally, I would not mind (taking additional measurements) ... I have a blood pressure monitor at home so that is no problem for me personally. I mean that is placing the band around your arm, push the button and the device is going to do its job." (Patient 4)

"That is okay for me, because I already do that (measuring blood pressure and oxygen saturation) at home... It is not that hard, so I can do that." (Patient 5)

Communication and assistance

Shared decision making

Most patients indicated that the decision on discharge and subsequent home monitoring must be made in consultation with the healthcare provider. All patients mentioned that they trust the healthcare provider in their judgement, but that there should also be attention for their own feelings about their health. If the healthcare provider considers it responsible to send the patient home, but the patient is not yet feeling confident enough, then this must be taken into consideration. The same goes for the opposite situation, in which the patient wants to go home but the healthcare provider does not consider this responsible. In the end, it must be a mutual decision between the patient and healthcare provider. Furthermore, all patients said they would not let the decision about home monitoring depend on the opinion of relatives. Two patients mentioned that they would discuss it with family first, but that in the end they would make the decision themselves. Two patients stated that positive experiences of other patients will stimulate to use the biosensor as well.

"I can imagine that you want to go home yourself and the physician does not think it is responsible. And then I think the decision should lie with the physician, but the other way around as well. I think it should be possible in consultation." (Patient 3)

"Well, I guess that it has to go in consultation. You should not feel like the physician wants you to go home, because when you leave, a hospital bed will be empty. I understand that beds are very important in a hospital, but when you do not feel confident to leave the hospital, I think you should have a good conversation with the physician." (Patient 4)

"If it is medically responsible it is okay, but I have to be capable... It must be justified that I can go home with the biosensor and I also have to be a bit self-reliant." (Patient 6)

"Well what I was saying, something new needs to be further developed and if experiences show that it is positive, I am more inclined to use it as well." (Patient 6)

Personal contact with the healthcare provider

Four patients did not express concerns about the loss of personal contact with the healthcare provider when they are monitored at home instead of at the hospital. However, two patients mentioned that the loss of personal contact would be a downside of home monitoring. One of them suggested contact with the healthcare provider by phone or video call. This patient also mentioned that, when there would be an application for the biosensor, a contact function could possibly be integrated into this application. The other one stated that personal contact can be missed in the first days of telemonitoring, but after a while face-to-face evaluation is desirable.

"The information you get in the hospital, even if it is simple questions you can ask a nurse, I am going to miss that at home... Suppose there would be an app, I think it would be nice if you also have a function in that app with which you can start a video conversation with a physician or a nurse." (Patient 4)

"I think you should have physical contact after the lapse of time. So not with everything, also with hustle and bustle and such, but I find that you have to evaluate face-to-face after a while." (Patient 6)

Assistance

All patients indicated that they do not expect help when they are discharged from the hospital and receive a biosensor for home monitoring. They expect that the biosensor will be placed on their chest before hospital discharge and that they do not need to take any further actions. One patient stated that when there would be an application, user instructions are expected, for example by means of an instruction video.

Whereas the patients expressed no need for help when they start using the biosensor, they do expect some form of assistance when issues arise. Four patients expect the hospital to contact them when serious technical problems arise. Two of them suggested that problems that can be resolved by the patients themselves, like problems with the internet connection, could be notified in the potential application. The other two patients mentioned to expect a phone number that they can call when technical problems arise. All patients expect to be contacted when there are deviations in the

measurements that need medical attention. One patient suggested that advice can be provided in the potential application for minor deviations that do not require medical attention, but that can be addressed by for example taking rest. Overall, patients were confident that there would be appropriate assistance when technical problems or medical issues arise. However, it was mentioned twice that if a patient would have to wait for help, especially when they are living on their own, this could possibly lead to anxiety.

"I assume that if it is noticed that the data no longer reaches the hospital, I will be contacted."
(Patient 3)

"That you get a notification from the app, saying that there is no internet connection. Keep an eye on it yourself and see if you can do something to resolve the problem." (Patient 2)

"Well I think you automatically have some kind of app that you install on your phone or tablet. That app gives a signal which says you have to try to stay calm or that it automatically gives some kind of advice. And when it is urgent, it will automatically send a signal to the hospital that medical attention is required." (Patient 4)

"I think if you are alone, it (home monitoring with the biosensor) might have disadvantages, because you cannot intervene fast enough if something is wrong and you have to wait for help... People who do not have the medical knowledge may become very insecure and anxious." (Patient 3)

Privacy

In general, patients did not express concerns about the privacy of their data. All patients expect the biosensor to comply with the privacy guidelines. Besides this, three patients stated the information that is being collected and shared as not being privacy sensitive. Therefore, they were not concerned about unauthorized persons accessing their data. One thing that was mentioned twice is that the biosensor should not be able to affect the bodily functions of the patient, such as heart rate, because this could lead to life-threatening situations in the case that the device would be hacked.

"If the biosensor complies with the privacy guidelines, then that (the biosensor sending information to the hospital) is fine with me... When working according to the official guidelines, information does not end up in the wrong hands." (Patient 3)

"Well, even if it did happen, what is anyone else going to do with data like my heart rate? I do not think the information is privacy sensitive. It is not data like my bank account details... As long as they cannot remotely control my heartbeat, I am fine." (Patient 2)

"It would be a different matter if the sensor can affect you. That when your heartrate is too low you get impulses or something through the sensor... Then you would walk around with a device, say it is hackable, that enables someone to harm you remotely." (Patient 1)

Discussion

The central aim of this qualitative, exploratory study was to gain a better understanding of the patient perspective on telemonitoring after bariatric surgery. Four main themes about the patient perspective on telemonitoring were identified. These included: comfort and safety, awareness and control, communication and assistance and privacy. Patients in this study showed a positive attitude towards telemonitoring using the biosensor. They expressed that it would provide them with comfort and safety during their recovery and that insight in their own measurements could make them feel more in control over their health. Communication with and assistance from the hospital or healthcare provider were considered important with regard to hospital discharge and technical or medical issues. Few privacy concerns were mentioned by the patients.

Interpretation of the findings

Previous research on telehealth interventions in patients with chronic kidney failure and diabetes showed that patients associated telehealth with a sense of comfort and safety (23, 24). They expressed feeling more comfortable in their own familiar environment and that being monitored around the clock made them feel more secure. This study adds to this knowledge by showing the perspective of bariatric patients towards these factors. The patients in this study were positive towards early hospital discharge and home monitoring, because they perceived their home environment to be more pleasant and comfortable than the hospital. They also mentioned that they would feel safer with home monitoring, because their health status is being monitored for a longer period after surgery. These findings indicate that home monitoring after surgery has the potential to reduce length of hospital stay, while increasing the comfort and safety of recovery.

Prior studies on telemonitoring in pulmonary rehabilitation and diabetes management showed that patients valued the access to their own measurements because it promoted their self-knowledge and helped them to confirm their health status (24, 28). This study shows that this also applies to telemonitoring after bariatric surgery. The majority of the patients would value having access to the measurements of their heart rate, respiration rate and temperature, so that they are able to compare these to the desired standards. They expressed that this could help them confirm their health status, especially when they are feeling concerned or worried about their health. Research has shown that an important condition for patient empowerment is that the patients are provided with sufficient background knowledge (30). Other research also showed that when patients did not have sufficient background knowledge, this led to confusion and frustration (31). Therefore, when giving patients access to their measurements, they should be well informed about which values are desired and when measurements deviate.

This study shows that regarding telemonitoring after bariatric surgery, shared decision making on hospital discharge and home monitoring appears to be of great importance to patients. They trust their physician to make an informed decision about their discharge, but feel like their feelings and confidence should also be taken into consideration. Previous research showed that patients had different experiences regarding hospital discharge, some patients had been heard about their own feelings and confidence and some had not (32). Furthermore, it showed that healthcare providers did not sufficiently prioritise discharge consultations with patients and family due to time restraints and competing care obligations. When implementing post-operative telemonitoring after bariatric

surgery, the patient and healthcare provider have to consult and come to a joint decision about hospital discharge and subsequent home monitoring. Additionally, it is important that healthcare providers take proper time for this consultation. Most patients indicated that, when eventually being monitored at home, they would not miss the personal contact with their healthcare provider. This is in contrast with other studies that showed that patients regarded telehealth as a threat to the relationship with their healthcare providers (26, 33, 34). This can possibly be explained by the fact that these studies focused on telehealth in patients with chronic heart failure. Due to the chronic nature of their disease, the patients in these studies were used to having regular contact with their healthcare providers and might therefore be more prone to miss this contact than surgical patients.

The patients in this study expected the biosensor to be installed by the healthcare provider in the event of hospital discharge and that no more assistance will be needed at that time. However, patients did expect appropriate assistance on technical and medical issues when they are being monitored at home. Previous research on telehealth interventions showed that patients had concerns about potential issues with the technology and lack of assistance (26, 35, 36). This confirms the importance of assistance when issues arise. Therefore, when implementing telemonitoring, it is important that patients can rely on assistance at all times and that they do not have to wait for it for too long. Furthermore, patients suggested that some form of assistance can be provided through an application in case of minor issues in order to reassure them.

Prior studies showed conflicting results on privacy concerns with regard to telehealth technologies (26, 37, 38). In this study, no concerns were mentioned about the privacy of the patients' data. All patients expected the biosensor to comply with the privacy guidelines. Besides, the data collected by the biosensor was described as not privacy sensitive. Nevertheless, it is important to take the possible privacy issues into consideration at all times, because judgements about the sensitivity of data vary from person to person (39, 40). It is remarkable that two patients mentioned that the biosensor should not be able to affect the patient's bodily functions, because this could lead to life-threatening situations in the case that the device would be hacked. Regarding the biosensor, it is very unlikely that this would be a threat, because the sensor is worn on the skin and not inside the body. In the case of monitoring with implantable devices, it would be important for developers to be knowledgeable about the risks of cybersecurity.

Strengths and limitations

This study is unique because it was the first to explore the perspective of bariatric patients towards telemonitoring. Another strength of this study was its exploratory nature and the use of a comprehensive theoretical framework to guide the exploration of the patient perspective on telemonitoring after bariatric surgery. However, the results of this study should be considered in the context of some limitations. First, the response rate of this study was only 17.1%. A study on the comparison of telephone interviews and in-person interviews, reviewed several studies with telephone interviews response rates of 73.5% or higher (41). Provided that this was the anticipated response rate, the response rate of this study can be considered low. To increase the response rate, reminders were sent to the possible participants. In addition, adjustments were made in the email during the recruitment process. Prior studies showed that personalization of invitations using

personal greetings and titles significantly increased response rate (42, 43). Therefore, the email was adjusted by making it more personal using personal greetings.

There are several possible reasons for the low response rate according to the Leverage-Saliency theory and Social Exchange Theory (44, 45). First, it is possible that the perceived burden of participating outweighed the perceived importance of the research. The COVID-19 pandemic that took place during this study might have decreased the interest of patients in this study, because the pandemic and the patients' health was probably their main concern. Besides this, people are more likely to participate when there is an ongoing exchange relationship with the interviewer or research institution. In this study, it is possible that the participants did not feel an obligation to participate, because they possibly did not feel a connection with the obesity clinic Vitalys. Another factor that might have influenced the response rate, is that no deadline was mentioned in the invitation email. Previous research showed that the response rate improved when a deadline was included in the invitation (46). Finally, the nature of the interviews might have influenced the response rate. In general telephone interviews have shown to have lower response rates in comparison to face-to-face interviews (47, 48).

The low response rate might have caused non-response bias in a way that only patients with a positive experience using the biosensor in the hospital participated in this study. This could have caused the respondents to differ from the non-respondents in their attitude towards the biosensor, which might have caused an overestimation of the positive attitude of patients towards telemonitoring. It could potentially explain why there were no negative views towards telemonitoring within this study.

Another limitation relates to the patients that were invited to participate in this study. All of them previously participated in research on the biosensor. This could potentially mean that the patients had a more favourable attitude towards technology in general and potential future telemonitoring than patients that did not participate in this previous research. This might have introduced selection bias that could have further contributed to overestimation of the positive attitude of the patients towards the biosensor and telemonitoring.

Implications for clinical practice and suggestions for further research

The results of this study have implications for the implementation of telemonitoring after bariatric surgery. Before implementing a telemonitoring service in post-operative care, it should be ensured that it meets the wishes and needs of the patients that were pointed out in this study. First, shared decision making on hospital discharge and subsequent telemonitoring should be ensured, so that both parties participate in the decision. Besides this, it is important that there is appropriate and timely assistance in case of technical or medical issues. Furthermore, the biosensor should comply with the privacy guidelines and the data of the patients should only be accessible by authorized individuals. Lastly, the possibilities for a potential application should be explored. The desired functionalities of an application described by the patients include: an overview of their measurements and the desired standards, a function to call or videocall with a healthcare provider, advice notifications in case of minor technical or medical issues and automatic notifications to the hospital in case of severe technical or medical problems.

Further research might build on this research by examining the patient perspective on post-operative telemonitoring in a larger population of bariatric patients to examine if there are other insights that were not identified in this study. Besides this, future research might focus on telemonitoring in other patient groups to identify differences and similarities in their perspectives towards telemonitoring.

Acknowledgements

The authors thank all patients who participated in the study; Rijnstate Hospital and Vitalys for their support in the recruitment of participants, especially Laura Deden for her suggestions; Brigit Hogeweg and Esther Pallast for making adjustments in the patient information form and invitation email and professor C.J.M. Doggen and G.M. Peters MSc for guidance and feedback during the research process.

References

1. Centraal Bureau voor de Statistiek. Zorguitgaven stijgen in 2018 met 3,1 procent. 21-6-2019. Available from: <https://www.cbs.nl/nl-nl/nieuws/2019/25/zorguitgaven-stijgen-in-2018-met-3-1-procent>.
2. Rijksinstituut voor Volksgezondheid en Milieu. Volksgezondheid Toekomst Verkenning Synthese. 2018. Available from: <https://www.vtv2018.nl/synthese>.
3. Centraal Bureau voor de Statistiek. Prognose bevolking; geslacht en leeftijd, 2019-2060. 18-12-2018. Available from: <https://opendata.cbs.nl/statline/#/CBS/nl/dataset/84346NED/table?ts=1567950952210>.
4. Ashkan H, Sormeh N, Pedram T, Alireza K. Remote telemonitoring of cardiovascular patients: Benefits, barriers, new suggestions. *Artery Research*. 2018;22(C):57-63. DOI: <https://doi.org/10.1016/j.artres.2018.04.001>.
5. Farias FACd, Dagostini CM, Bicca YdA, Falavigna VF, Falavigna A. Remote Patient Monitoring: A Systematic Review. *Telemedicine and e-Health*. 2019;26(5):576-83. DOI: 10.1089/tmj.2019.0066.
6. Vegesna A, Tran M, Angelaccio M, Arcona S. Remote Patient Monitoring via Non-Invasive Digital Technologies: A Systematic Review. *Telemedicine and e-Health*. 2016;23(1):3-17. DOI: 10.1089/tmj.2016.0051.
7. Aamodt IT, Lycholip E, Celutkienė J, Strömberg A, Atar D, Falk RS, et al. Health care professionals' perceptions of home telemonitoring in heart failure care: Cross-sectional survey. *Journal of Medical Internet Research*. 2019;21(2) DOI: 10.2196/10362.
8. Asua J, Orruño E, Reviriego E, Gagnon MP. Healthcare professional acceptance of telemonitoring for chronic care patients in primary care. *BMC Medical Informatics and Decision Making*. 2012;12(1):139. DOI: 10.1186/1472-6947-12-139.
9. Fairbrother P, Ure J, Hanley J, McCloughan L, Denvir M, Sheikh A, et al. Telemonitoring for chronic heart failure: The views of patients and healthcare professionals - a qualitative study. *Journal of Clinical Nursing*. 2014;23(1-2):132-44. DOI: 10.1111/jocn.12137.
10. Boyne JJJ, Vrijhoef HJM. Implementing Telemonitoring in Heart Failure Care: Barriers from the Perspectives of Patients, Healthcare Professionals and Healthcare Organizations. *Current Heart Failure Reports*. 2013;10(3):254-61. DOI: 10.1007/s11897-013-0140-1.
11. Venkatesh V, Morris MG, Davis GB, Davis FD. User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*. 2003;27(3):425-78. DOI: 10.2307/30036540.
12. Shah SGS, Robinson I, AlShawi S. Developing medical device technologies from users' perspectives: A theoretical framework for involving users in the development process. *International Journal of Technology Assessment in Health Care*. 2009;25(4):514-21. DOI: 10.1017/S0266462309990328.
13. Shah S, Robinson I. Benefits of and barriers to involving users in medical device technology development and evaluation. *International journal of technology assessment in health care*. 2007;23:131-7. DOI: 10.1017/S0266462307051677.
14. Patel PD, Cobb J, Wright D, Turer R, Jordan T, Humphrey A, et al. Rapid Development of Telehealth Capabilities within Pediatric Patient Portal Infrastructure for COVID-19 Care: Barriers, Solutions, Results. *Journal of the American Medical Informatics Association : JAMIA*. 2020 DOI: 10.1093/jamia/ocaa065.
15. Hollander JE, Carr BG. Virtually perfect? Telemedicine for covid-19. *New England Journal of Medicine*. 2020;382(18):1679-81. DOI: 10.1056/NEJMp2003539.
16. Landi GH. UPMC among health systems fast-tracking tech, telehealth projects for COVID-19 2020. Available from: <https://www.fiercehealthcare.com/tech/health-system-cios-covid-19-response-we-ve-never-experienced-anything-like>.
17. Rijksinstituut voor Volksgezondheid en Milieu. Het coronavirus en de zorg in ziekenhuizen 2020. Available from: <https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/zorg/ziekenhuizen>.

18. Lurie N, Carr BG. The Role of Telehealth in the Medical Response to Disasters. *JAMA internal medicine*. 2018;178(6):745-6. DOI: 10.1001/jamainternmed.2018.1314.
19. Smith AC, Thomas E, Snoswell CL, Haydon H, Mehrotra A, Clemensen J, et al. Telehealth for global emergencies: Implications for coronavirus disease 2019 (COVID-19). *Journal of Telemedicine and Telecare*. 2020;1357633X20916567. DOI: 10.1177/1357633X20916567.
20. Vitalys. Pilot Bariatrie@Home. Available from: <https://www.vitalys.nl/biosensor>.
21. Vitalys. Een gastric sleeve operatie bij Vitalys. Available from: <https://www.vitalys.nl/gastricsleeve>.
22. Vitalys. Een gastric bypass operatie bij Vitalys. Available from: <https://www.vitalys.nl/gastricbypass>.
23. Warner MM, Tong A, Campbell KL, Kelly JT. Patients' Experiences and Perspectives of Telehealth Coaching with a Dietitian to Improve Diet Quality in Chronic Kidney Disease: A Qualitative Interview Study. *Journal of the Academy of Nutrition and Dietetics*. 2019;119(8):1362-74. DOI: <https://doi.org/10.1016/j.jand.2019.01.023>.
24. Lee PA, Greenfield G, Pappas Y. Patients' perception of using telehealth for type 2 diabetes management: a phenomenological study. *BMC Health Services Research*. 2018;18(1):549. DOI: 10.1186/s12913-018-3353-x.
25. Hirvonen N, Enwald H, Käsäkoski H, Eriksson-Backa K, Nguyen H, Huhta A-M, et al. Older adults' views on eHealth services: a systematic review of scientific journal articles. *International Journal of Medical Informatics*. 2020;135:104031. DOI: <https://doi.org/10.1016/j.ijmedinf.2019.104031>.
26. Woo K, Dowding D. Factors Affecting the Acceptance of Telehealth Services by Heart Failure Patients: An Integrative Review. *Telemedicine and e-Health*. 2017;24(4):292-300. DOI: 10.1089/tmj.2017.0080.
27. Gorst SL, Armitage CJ, Brownsell S, Hawley MS. Home Telehealth Uptake and Continued Use Among Heart Failure and Chronic Obstructive Pulmonary Disease Patients: a Systematic Review. *Annals of Behavioral Medicine*. 2014;48(3):323-36. DOI: 10.1007/s12160-014-9607-x.
28. Inskip JA, Lauscher HN, Li LC, Dumont GA, Garde A, Ho K, et al. Patient and health care professional perspectives on using telehealth to deliver pulmonary rehabilitation. *Chronic Respiratory Disease*. 2017;15(1):71-80. DOI: 10.1177/1479972317709643.
29. Kandola DK, Banner D, Araki Y, Bates J, Hadi H, Lear SA. The Participant Recruitment Outcomes (PRO) study: Exploring contemporary perspectives of telehealth trial non-participation through insights from patients, clinicians, study investigators, and study staff. *Contemporary Clinical Trials Communications*. 2018;11:75-82. DOI: <https://doi.org/10.1016/j.conctc.2018.05.005>.
30. Schulz PJ, Nakamoto K, editors. "Bad" literacy, the internet, and the limits of patient empowerment. 2011 AAAI Spring Symposium Series; 2011.
31. Maneze D, Weaver R, Kovai V, Salamonson Y, Astorga C, Yogendran D, et al. "Some say no, some say yes": Receiving inconsistent or insufficient information from healthcare professionals and consequences for diabetes self-management: A qualitative study in patients with Type 2 Diabetes. *Diabetes Research and Clinical Practice*. 2019;156:107830. DOI: <https://doi.org/10.1016/j.diabres.2019.107830>.
32. Hesselink G, Schoonhoven L, Vernooij-Dassen M, Wollersheim H. Are patients discharged with care? A qualitative study of perceptions and experiences of patients, relatives and care providers. *Nederlands Tijdschrift voor Geneeskunde*. 2013;157. DOI: 10.1136/bmjqs-2012-001165.
33. Sanders C, Rogers A, Bowen R, Bower P, Hirani S, Cartwright M, et al. Exploring barriers to participation and adoption of telehealth and telecare within the Whole System Demonstrator trial: a qualitative study. *BMC Health Services Research*. 2012;12(1):220. DOI: 10.1186/1472-6963-12-220.
34. Hall AK, Dodd V, Harris A, McArthur K, Dacso C, Colton LM. Heart failure patients' perceptions and use of technology to manage disease symptoms. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association*. 2014;20(4):324-31. DOI: 10.1089/tmj.2013.0146.

35. Scheibe M, Reichelt J, Bellmann M, Kirch W. Acceptance factors of mobile apps for diabetes by patients aged 50 or older: a qualitative study. *Medicine* 20. 2015;4(1):e1. DOI: 10.2196/med20.3912.
36. Lu JF, Chi MJ, Chen CM. Advocacy of home telehealth care among consumers with chronic conditions. *J Clin Nurs*. 2014;23(5-6):811-9. DOI: 10.1111/jocn.12156.
37. Demir G, Speedie SM, Finkelstein S. Change of patients' perceptions of TeleHomeCare. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association*. 2001;7(3):241-8. ISSN 1530-5627S.
38. Seto E, Leonard KJ, Masino C, Cafazzo JA, Barnsley J, Ross HJ. Attitudes of heart failure patients and health care providers towards mobile phone-based remote monitoring. *Journal of medical Internet research*. 2010;12(4):e55-e. DOI: 10.2196/jmir.1627.
39. Nowak GJ, Phelps JE. Understanding privacy concerns: An assessment of consumers' information-related knowledge and beliefs. *Journal of Direct Marketing*. 1992;6(4):28-39. DOI: <https://doi.org/10.1002/dir.4000060407>.
40. Phelps J, Nowak G, Ferrell E. Privacy Concerns and Consumer Willingness to Provide Personal Information. *Journal of Public Policy & Marketing - J PUBLIC POLICY MARKETING*. 2000;19:27-41. DOI: 10.1509/jppm.19.1.27.16941.
41. Rahman R. Comparison of Telephone and In-Person Interviews. 2015. Available from: https://pdfs.semanticscholar.org/8647/a5a0349174fbf7cc5d2805b4c538665238ef.pdf?_ga=2.255900811.1831181446.1593419967-1427111690.1593419967.
42. Heerwegh D, Vanhove T, Matthijs K, Loosveldt G. The effect of personalization on response rates and data quality in web surveys. *International Journal of Social Research Methodology*. 2005;8(2):85-99. DOI: 10.1080/1364557042000203107.
43. Joinson A, Woodley A, Reips U-D. Personalization, authentication and self-disclosure in self-administered Internet surveys. *Computers in Human Behavior*. 2007;23:275-85. DOI: 10.1016/j.chb.2004.10.012.
44. Dillman DA. Mail and Internet surveys: The tailored design method--2007 Update with new Internet, visual, and mixed-mode guide. 2011. ISBN 1118044630.
45. Groves RM, Singer E, Corning A. Leverage-saliency theory of survey participation. *Public Opinion Quarterly*. 2000;64(3):299-308. DOI: 10.1086/317990.
46. Saleh A, Bista K. Examining Factors Impacting Online Survey Response Rates in Educational Research: Perceptions of Graduate Students. *Journal of MultiDisciplinary Evaluation*. 2017;13(29):63-74. Available from: https://journals.sfu.ca/jmde/index.php/jmde_1/article/view/487.
47. Babbie ER. The practice of social research. 2010. ISSN 0495598429 9780495598428 0495598410 9780495598411.
48. Singleton R, Straits BC. Approaches to social research. 2010. ISSN 9780195372984 0195372980.
49. World Health Organization ROFS-EA. Strengthening the doctor-patient relationship New Delhi: WHO Regional Office for South-East Asia; 2013. Available from: <https://apps.who.int/iris/handle/10665/205942>.
50. Hale T, Kvedar J. Privacy and Security Concerns in Telehealth. *The virtual mentor : VM*. 2014;16:981-5. DOI: 10.1001/virtualmentor.2014.16.12.jdsc1-1412.

Appendix 1: Patient information form

Proefpersoneninformatie voor deelname aan medisch-wetenschappelijk onderzoek



Het patiëntenperspectief op Bariatrie@Home

Geachte heer/mevrouw,

U heeft in 2019 mee gedaan aan de pilot Bariatrie@Home. In Bariatrie@Home onderzoeken we samen met de Universiteit Twente of we in de toekomst meer zorg bij patiënten thuis kunnen verlenen. In de pilot onderzochten we de werking van de Biosensor; een slimme pleister die belangrijke lichaamsfuncties bewaakt. Wij willen vragen of u mee wilt doen aan een vervolgonderzoek over de kijk van patiënten op Bariatrie@Home. In deze brief ontvangt u informatie over dit onderzoek. Lees deze informatie rustig door en vraag de onderzoekers om uitleg als u vragen heeft. U kunt er ook over praten met uw partner, vrienden of familie. Meedoen is vrijwillig. Als u mee wilt doen, kunt u hiervoor toestemming geven via de mail.

Wat is het doel van het onderzoek?

Het doel van dit onderzoek is om te weten te komen wat patiënten vinden van Bariatrie@Home. Wat vindt u ervan dat wij patiënten na hun operatie willen monitoren in hun eigen thuisomgeving? En hoe zou bijvoorbeeld uw thuisomgeving hier tegenover staan? Met thuis monitoren bedoelen we het van een afstand in de gaten houden van een patiënt.



Wat houdt meedoen aan het onderzoek in?

Telefonisch interview

Als u meedoet met dit onderzoek, zullen onderzoekers van de Universiteit Twente een telefonisch interview afnemen. Het interview duurt ongeveer 30 minuten. In dit interview zullen vragen worden gesteld over het gebruik van de biosensor. Tijdens het interview zullen geluidsopnamen worden gemaakt.

Gebruik en bewaren van uw gegevens

Tijdens het interview zal uw naam bekend zijn bij de onderzoekers. Wat u vertelt tijdens het interview zal wel worden opgenomen en 15 jaar bewaard worden in Rijnstate ziekenhuis. Uw naam wordt hierbij niet opgeslagen, waardoor de opname niet naar u te herleiden zal zijn. Ook in rapporten en eventuele publicaties van dit onderzoek zijn de resultaten van dit onderzoek niet tot u te herleiden. Als u hier vragen of klachten over heeft raden we u aan contact op te nemen met de onderzoekers.

Als u niet wilt meedoen of wilt stoppen met het onderzoek

U beslist zelf of u meedoet aan het interview. Deelname is vrijwillig. Als u wel meedoet, kunt u zich altijd bedenken en toch stoppen, ook tijdens het onderzoek. U hoeft niet te zeggen waarom u stopt. De antwoorden die tot dat moment zijn verzameld, worden gebruikt voor het onderzoek. Als u dit niet wilt zullen deze worden vernietigd.

Heeft u vragen?

Bij vragen kunt u contact opnemen met het onderzoeksteam. Dit team is bereikbaar op telefoonnummer: 06-12457324 of per e-mail op: biosensor@rijnstate.nl.

Als u klachten heeft over het onderzoek, kunt u dit bespreken met de onderzoekers. Wilt u dit liever niet, dan kunt u zich wenden tot de klachtenfunctionaris van Rijnstate ziekenhuis, telefoonnummer: 088-0057539.

Toestemmingsverklaring

Als u mee wilt doen aan het interview, vragen wij u om toestemming te geven door te reageren op deze mail. Door uw toestemming geeft u aan dat u de informatie heeft begrepen en instemt met deelname aan onderzoek naar het patiëntenperspectief op Bariatrie@Home. Ook geeft u toestemming voor het gebruik van de gegevens uit het interview voor dit onderzoek zoals hierboven vermeld. We vragen u om in de mail aan te geven dat u mee wilt doen aan het onderzoek. Daarnaast vragen we u om een telefoonnummer te vermelden waarop de onderzoekers u kunnen bereiken. U wordt dan gebeld door Ellis Slotman of Fleur Lansink Rotgerink van de Universiteit Twente om een afspraak te maken voor het interview. Indien u wilt worden geïnformeerd over de resultaten van dit onderzoek, kunt u dit ook aangeven in de mail.

Dank voor uw aandacht.

Appendix 2: Interview guide

Introductie

Voordat we beginnen met het interview, wil ik u vragen of u toestemming geeft om het interview op te nemen, zodat we het interview later kunnen terugluisteren. Gaat u hiermee akkoord?

Ik zal eerst even kort een introductie geven en daarna zal ik overgaan naar de vragen.

De reden dat we u voor dit interview hebben gevraagd is dat u in 2019 mee heeft gedaan aan een onderzoek naar de biosensor. Hierbij werd de biosensor als pleister op uw borst geplakt en werden uw ademhaling en hartslag gemeten tijdens uw operatie in het ziekenhuis.

Dit interview is er om te kijken wat u als patiënt zou vinden van het thuis gebruiken van deze biosensor. Hierbij moet u zich voorstellen dat u eerder naar huis zou gaan na de operatie. De biosensor wordt dan in het ziekenhuis op uw borst geplakt voordat u naar huis gaat. De biosensor meet uw hartslag, ademhaling, temperatuur en beweging. Deze informatie wordt dan vanuit uw huis automatisch naar het ziekenhuis gestuurd. Op deze manier kunnen de zorgverleners u in de gaten houden als u in uw eigen omgeving bent. De pleister kunt u er na een paar dagen zelf af halen.

In dit interview zal ik uw vragen stellen over het thuis gebruiken van de biosensor. Er zijn geen goede of foute antwoorden en de antwoorden die u geeft zullen niet naar u te herleiden zijn. U kunt altijd stoppen met het interview en u kunt altijd verduidelijking vragen als u een vraag niet begrijpt. Heeft u tot nu toe nog vragen? (Wanneer er geen vragen zijn kan gestart worden met het interview)

Topics

- Mag ik vragen hoe oud u bent?

Anders

- In welke leeftijdscategorie valt u?

Ervaring

De eerste vragen gaan over uw ervaring met technologie.

- Maakt u in het dagelijks leven veel gebruik van technologie zoals een smartphone, tablet, laptop of computer?
 - Wat vindt u van deze technologie?
- Heeft u ervaring met technologie voor zorg op afstand? Dit kan bijvoorbeeld videobellen met de arts of een gezondheidsapp zijn.
 - Zo ja, wat voor technologie?
 - Hoe beviel dat?
- Kunt u wat vertellen over hoe u het gebruik van de biosensor in het ziekenhuis heeft ervaren?

Verwacht gebruiksgemak

Het idee van de biosensor is dus om u als patiënt eerder naar huis te laten gaan en u thuis in de gaten te houden met de biosensor.

- Wat zou u ervan vinden als u eerder naar huis zou kunnen na uw operatie en dat u dan thuis in de gaten gehouden zou worden?

- Waarom?

Verwacht nut

- Denkt u dat er voordelen zitten aan het thuis in de gaten gehouden worden met de biosensor?
 - Welke?
 - Waarom?
 - Voor wie?
- Denkt u dat er ook nadelen zijn?
 - Welke?
 - Waarom?
 - Voor wie?
- Zou u het fijn vinden als u de gegevens die worden gemeten, zoals ademhaling, hartslag en temperatuur, zelf ook zou kunnen zien, bijvoorbeeld via een app?
 - Waarvoor zou u deze gegevens willen gebruiken?
 - Denkt u dat u hiermee een goed beeld zou krijgen van uw gezondheid? (Indien dit nog niet wordt genoemd bij de vorige vraag)
 - Of een gevoel dat u controle heeft over uw gezondheid? (Indien dit nog niet wordt genoemd bij de vorige vraag)
 - Wat vindt u daarvan?

Faciliterende condities

De volgende vragen gaan over de ideale situatie rondom het gebruik van de biosensor.

- Verwacht u hulp als u de biosensor voor het eerst zou gebruiken?
 - Op welke manier?
 - Van wie?
- Wat verwacht u als er technische problemen zijn met de biosensor, bijvoorbeeld als de verbinding wegvalt?
 - Met wie zou u dan contact willen hebben?
 - Wie zou volgens u in actie moeten komen om het probleem op te lossen?
- Wat verwacht u als er afwijkingen worden gemeten in uw ademhaling, hartslag of temperatuur?
 - Hoe moet er dan worden opgetreden?
 - Verwacht u dat uw zorgverlener dan contact met u zoekt?
 - Wanneer de vraag niet duidelijk is voor de patiënt, kan doorgevraagd worden: Stel er gaat een alarm af als er afwijkingen worden gemeten, wie moet dit alarm dan ontvangen? U zelf, het ziekenhuis, de huisarts?

Omdat de biosensor niet alle waarden meet, zult u misschien thuis zelf nog een aantal keer uw bloeddruk en de hoeveelheid zuurstof in uw bloed moeten meten. Dit kan met behulp van een bloeddruk band om de arm en een vingerklip.

- Wat vindt u hiervan?
- Denkt u dat u overweg zou kunnen met deze bloeddrukband en vingerklip?
 - Zo nee, denkt u dat uw familie hierbij kan helpen?

Sociale invloed

- Zou de mening van familie of vrienden belangrijk voor u zijn wanneer u de keuze maakt om de biosensor wel of niet thuis te gebruiken?
 - Waarom?
- Zou u de biosensor gebruiken als u weet dat andere patiënten deze gebruiken?
 - Waarom?

Vrijwilligheid van gebruik

- Vindt u dat u zelf de keuze moet hebben om in het ziekenhuis of thuis gemonitord te worden of mag dit ook voor u besloten worden door een arts?
 - Waarom?

Privacy

De volgende vragen gaan over de privacy rondom de biosensor.

- Wat vindt u ervan dat de biosensor informatie over uw hartslag, temperatuur, ademhaling en beweging doorstuurt naar het ziekenhuis?
- Denkt u dat de informatie in verkeerde handen zou kunnen vallen?
 - Bent u hier bang voor?
 - Zo ja, is er iets wat gedaan kan worden om deze zorgen weg te nemen?
- Denkt u dat de biosensor informatie zou kunnen delen die u eigenlijk niet wilt delen?
 - Zo ja, welke informatie?
 - Bent u hier bang voor?
 - Zo ja, is er iets wat gedaan kan worden om deze zorgen weg te nemen?

Relatie patiënt-zorgverlener

De laatste vragen gaan over het contact met uw zorgverleners.

- Zou u bij het gebruik van de biosensor thuis het persoonlijk contact met uw arts of verpleegkundige missen?
 - Waarom?
- Met wie zou u contact willen houden tijdens het thuis monitoren?
- Op welke manier zou u vanuit huis contact willen hebben?

Afsluiting

Ik ben aan het einde van het interview gekomen. Heeft u nog iets gemist, of wat toe te voegen? Bedankt voor uw deelname. Dan zet ik nu de opname stop. Als u later nog vragen of opmerkingen heeft kunt u ons bereiken op de contactgegevens die in de informatiebrief voor dit onderzoek vermeld stonden. (Indien de persoon aangegeven heeft de resultaten van het onderzoek te willen ontvangen, zeggen dat je hem/haar zult informeren over de bevindingen van het onderzoek en gegevens noteren)

Appendix 3: Literature search and theoretical framework

A literature search was carried out to set up a theoretical framework for this study. The database Scopus was used to search for literature. The following search terms were used: “telehealth patient perspective”, “telemedicine patient perspective”, “telemonitoring patient perspective”, “telehealth acceptance”, “telehealth experience”, “telehealth experience patient”, “patient perspective importance”, “patient perspective technology”, “technology acceptance model”, “utaut health”, “utaut interview”, “utaut interview guide”, “utaut health interview”. The search was restricted to articles published in 2010 or later. No other restrictions were made.

The literature search focused on finding an appropriate theoretical model for assessing user acceptance and user behavior. Such a model could help identify factors that are important to users and that influence their intention to use and their actual use of a technology. Another aim was to find existing research about the patient perspective on the use of various telehealth services, to find out what was already known. Together, the topics from previous research and the theoretical model constituted the theoretical framework for this study.

Theoretical model

The literature search resulted in finding a suitable theoretical model for assessing user acceptance and user behavior. The model that was chosen for this study is the Unified Theory of Acceptance and Use of Technology (UTAUT) (11). This model was chosen because of its completeness. The UTAUT model is based on the essential elements of eight previously established models. These eight models were compared and similarities across the models were used to formulate the UTAUT. Because of this, the model contains the combined power of the individual models.

The UTAUT (figure 1) consists of three determinants which directly influence behavioral intention (performance expectancy, effort expectancy and social influence) and one determinant that directly influences use behavior (facilitating conditions) (11). These determinants are the predictors. There are also some factors which influence the predictors (gender, age, experience and voluntariness of use). Together, these predictors and factors influence the behavioral intention and use behavior of a technology.

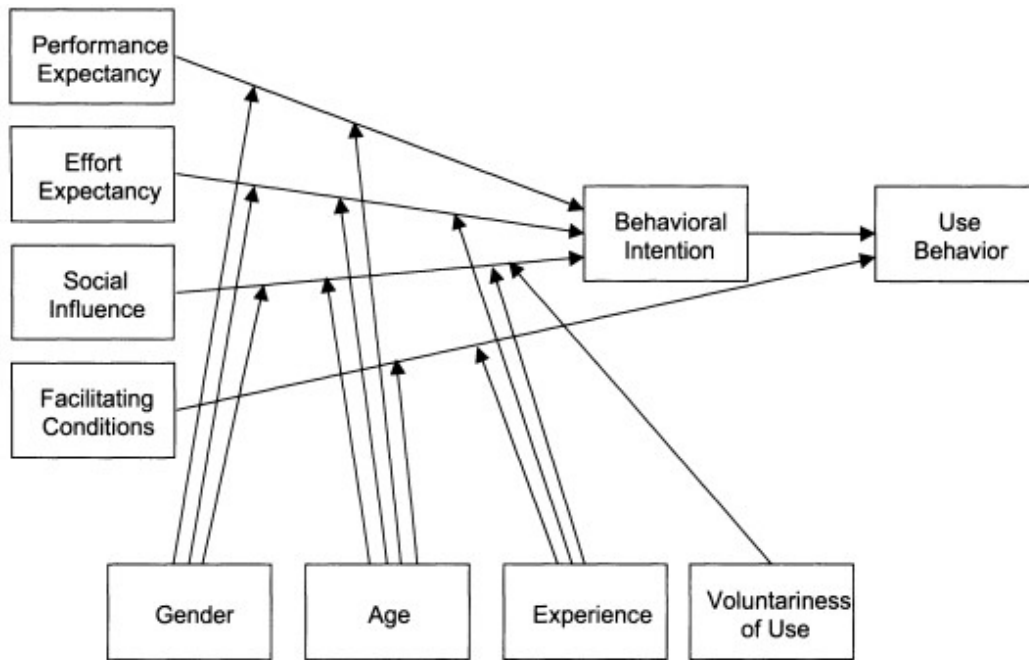


Figure 1: Unified Theory of Acceptance and Use of Technology

Previous research on the patient perspective

The literature search also resulted in a list of topics that patients mentioned in previous research on the patient perspective on various telehealth technologies. These topics are shown in table 2.

Table 2: Topics from the literature search on the patient perspective on telehealth

• Fear of making mistakes or losing data/equipment (25)
• Concerns about privacy (26, 37, 38)
• Concerns about ease of use (26)
• Concerns about changes in the care process: loss of personal contact with the healthcare provider or putting an extra burden on the healthcare provider (26, 33, 34)
• Limited understanding of the purpose of the technology (27)
• Lack of experience (25)
• Lack of assistance when using new technologies (25)
• Doubts about the relevance of the technology (25)
• Feeling more comfortable at home using telehealth than in a clinical setting (23)
• Concerns about technical problems and costs (25, 35, 36)
• Concerns about time and effort (25)
• Telehealth provides better access to healthcare (23)
• Telehealth gives a feeling of safety and increases the self-management (23, 24, 28)
• Telehealth provides support and encouragement (28)
• Concerns about one's own technological skills (29)

Theoretical framework of this study

The UTAUT model and the topics from previous studies were combined to set up the theoretical framework for this study. The topics from the literature search were classified according to the UTAUT model. Some topics from the literature search could not be matched to the determinants in the UTAUT model, so two new determinants were formed (patient-physician relationship and privacy). In addition, the demographic characteristics of the patients were not considered relevant to this study and therefore gender and age have been omitted. This resulted in a framework with eight determinants that influence a patient's intention to use and actual use of a technology. This framework is shown in figure 2. These eight determinants were considered to be the most important to address when exploring the patient perspective on telemonitoring technologies.

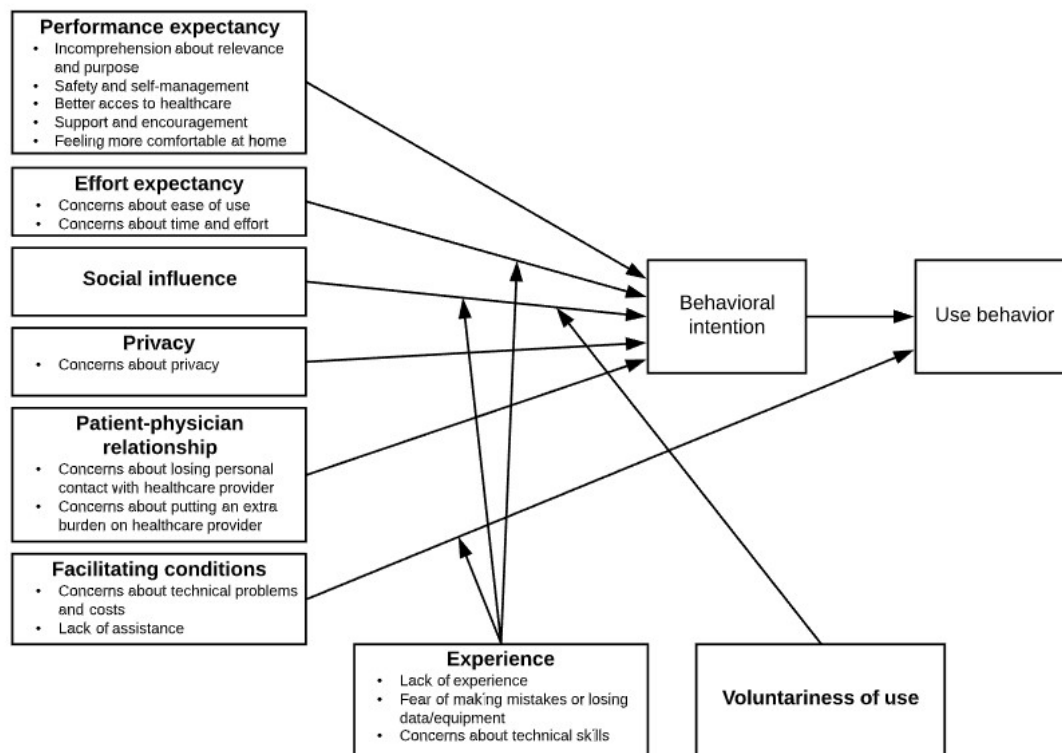


Figure 2: Theoretical framework based on the Unified Theory of Acceptance and Use of Technology and the literature search

Appendix 4: Interview scheme

Category	Definition	What we want to know	Questions
Experience	The experience a patient has with technology (11)	<ul style="list-style-type: none"> If patients have experience with technology in general (tablets, smartphones, laptops etc) If patients have experience with technology for telehealth and how this experience was 	<ul style="list-style-type: none"> Do you have experience with technology like tablets, smartphones, tablets or computers? Do you have experience with technology for telehealth? For example, video calls or a health app? If yes, what kind of technology? How was your experience with this technology? How did you experience the use of the biosensor in the hospital?
Effort expectancy	The degree of ease associated with the use of the system (11)	<ul style="list-style-type: none"> Whether the use of telemonitoring provides ease for the patient 	<ul style="list-style-type: none"> How would you feel about not having to stay in the hospital and being monitored at home instead? Why?
Performance expectancy	The degree to which an individual believes that using the system is beneficial (11)	<ul style="list-style-type: none"> What patients think are the benefits of using telemonitoring If patients expect that telemonitoring will lead to a better insight in their own health If patients expect that telemonitoring will lead to more control over their own health 	<p>The idea is to send patients home after surgery and monitor them using the biosensor.</p> <ul style="list-style-type: none"> Do you think there are benefits to being monitored at home with the biosensor? Which benefits? (why?) Do you think there are also disadvantages? Which disadvantages? Would you like to be able to see the data that is being measured yourself, for example with an app? Why? Where would you use this data for? Do you think the data will give you more insight in your own health? Do you think the data will give you more control over your own health?
Facilitating conditions	The degree to which an individual believes an organizational and technical infrastructure exists to support use of the system (11)	<ul style="list-style-type: none"> If patients expect support/help when they start using telemonitoring What patients expect if there are technical problems What patients expect if abnormalities are being measured in their values What patients think of additional equipment they possibly have to use 	<ul style="list-style-type: none"> Do you expect help when first using the biosensor? In which way? Whose help? What do you expect when there are technical problems with the biosensor, for example when it loses connection? Who would you like to have contact with? Who do you think has to take action to fix the problem? What would you expect when abnormalities are measured in your breathing, heart rate or temperature? What actions should be taken? Do you expect your healthcare provider to contact you? <p>Because the biosensor cannot measure everything, you might have to measure your blood pressure and the amount of oxygen in the blood yourself a couple of times. This can be done using a blood pressure band and a finger clip.</p> <ul style="list-style-type: none"> What do you think of this? Do you think you can handle this technology? If not, do you think your family can help you with this?

Social influence	The degree to which an individual perceives that important others believe he or she should use the system (11)	<ul style="list-style-type: none"> • If patients would use the technology if people who are important to them think they should use it • If patients would use the technology if they know that other patients use it 	<ul style="list-style-type: none"> • Would the opinion of family and friends be important to you when you have to decide whether you want to use the biosensor or not? • Would you use the biosensor if you know that other patients use it?
Voluntariness of use	The degree to which the use of the system is voluntarily (11)	<ul style="list-style-type: none"> • If patients think that the use of telemonitoring should always be voluntary 	<ul style="list-style-type: none"> • Do you think that it should be your own choice to be monitored at home or in the hospital or are you okay with your healthcare provider making this decision? • Why?
Patient-physician relationship	The interaction between the patient and the healthcare provider (49)	<ul style="list-style-type: none"> • If patients would miss the personal contact with the healthcare provider when they use telemonitoring • With whom patients want to remain contact when using telemonitoring • How patients want to communicate with this person from home 	<ul style="list-style-type: none"> • Would you miss the personal contact with your healthcare provider when you would be monitored at home? • Why? • With whom would you like to remain contact while monitoring at home? • How would you want to communicate with that person from home?
Privacy	Privacy concerning the collection, sharing and use of patient data (50)	<ul style="list-style-type: none"> • What patients think about their data being collected, shared and used • If patients have certain fears concerning the privacy and safety of their data 	<ul style="list-style-type: none"> • What do you think about the biosensor collecting information on your heart rate, temperature, breathing and movements and sharing it with the hospital? • Would you be afraid that the biosensor shares information that you would not like to share? • If yes, which information? • Would you be afraid that the information could end up in the wrong hands?