

THESIS

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Experiences of the eHealth Application 'Kracht Terug': A Qualitative evaluation Study

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Abstract

Background: In the orthopedic field, there are several kinds of spinal surgery, among which spondylodesis and decompression surgery. Patients who have this surgery report high levels of pain and physical impairment, both before and in the first period after surgery. The consequences of postoperative pain are: a longer stay in hospital; higher healthcare costs; long-term physical and mental recovery; delayed return to work and the risk of developing chronic pain. Acceptance and commitment therapy (ACT) and positive psychology have been proven to be effective for chronic pain, but the question is whether this also has an effect on postoperative pain. An eHealth application 'Kracht TeRUG' has been developed in the overarching study in which elements of ACT and positive psychology are combined with procedural information to support patients during their recovery.

Objective: The aim of the study is to explore the experiences of patients who have undergone spondylodesis or decompression surgery regarding the use of the 'Kracht TeRUG' eHealth (pilot) application.

Methods: Qualitative evaluation study was performed. Data was collected through individual semi-structured interviews by telephone by 14 participants.

Results: The experiences are divided into seven themes and 40 categories and were generated from the data based on the components of the application: commitment with the application; suggestions for improvement; user-friendliness; preparation and peer-support; hospital-information; positive psychology and ACT.

Conclusion and implications of key findings: The app was seen as an added value and user-friendly for most participants. However, some participants thought it was too personal or woolly. One consequence of this is that it is necessary to look at how the application can be suitable for all participants. Further research will have to be conducted into the dosage of the elements in the application.

KEYWORDS: Acceptance and commitment therapy, Positive psychology, telemedicine, mobile application, Spine Surgery, Qualitative research

Abstract Dutch

Achtergrond: Op orthopedisch gebied zijn er verschillende soorten wervelkolomchirurgie, waaronder spondylodese en decompressiechirurgie. Patiënten die deze operatie ondergaan, melden hoge niveaus van pijn en lichamelijke beperkingen, zowel voordien als in de eerste periode na de operatie. De gevolgen van postoperatieve pijn zijn: een langer verblijf in het ziekenhuis; hogere zorgkosten; langer lichamelijk en geestelijk herstel; vertraagde terugkeer naar het werk en het risico op het ontwikkelen van chronische pijn. Acceptance and commitment-therapie (ACT) en positieve psychologie zijn bewezen effectief bij chronische pijn, maar de vraag is of dit ook effect heeft op postoperatieve pijn. In het overkoepelende onderzoek is een eHealth-applicatie 'Kracht TeRUG' ontwikkeld waarbij elementen van ACT en positieve psychologie worden gecombineerd met informatie om patiënten te ondersteunen tijdens hun herstel.

Doel: Het doel van de studie is om de ervaringen van spondylodese en decompressiechirurgie patiënten te onderzoeken ten aanzien van de 'Kracht TeRUG' eHealth applicatie.

Methode: Kwalitatief evaluatieonderzoek werd uitgevoerd. De gegevens zijn verzameld door middel van individuele semigestructureerde telefonische interviews bij 14 deelnemers.

Resultaten: De ervaringen zijn verdeeld in totaal zeven thema's en 40 categorieën, die zijn gegenereerd op basis van de gegevens op basis van de componenten van de applicatie: betrokkenheid bij de applicatie; gebruiksvriendelijkheid; functionele vereisten; voorbereiding en ondersteuning; ziekenhuis-informatie; positieve psychologie en ACT.

Conclusie: De app werd door de meeste deelnemers gezien als een meerwaarde en was daarbij gebruiksvriendelijk. Sommige deelnemers vonden het echter te persoonlijk of te zweverig. Een consequentie hiervan is dat gekeken moet worden hoe de applicatie voor alle deelnemers geschikt kan zijn. Er zal nader onderzoek moeten worden gedaan naar de dosering van de elementen in de applicatie.

Kernwoorden: Acceptance and commitment-therapie, positieve psychologie, eHealth, mobiele applicatie, wervelkolomchirurgie, kwalitatief onderzoek

Introduction

In the orthopedic field, there are several kinds of spinal surgery, among which are spondylodesis, a surgery in which vertebrae are joined together, and decompression surgery, a type of surgery used to treat compressed nerves in the lower spine(1,2). Before undergoing these types of surgery, patients report high levels of pain and physical impairment(3–5). For 65-75% of the population, these surgeries are effective in achieving pain relief and improving physical function(3,4). Nevertheless, 20.8% of these patients do not experience improvement in pain relief after surgery and develop chronic pain(6). The consequences of postoperative pain can be: a longer stay in hospital; higher healthcare costs; longer physical and mental recovery; delayed return to work and the risk of developing chronic pain(7–12). Chronic pain entails high direct and indirect costs, for the Netherlands these costs can lead up to 20 billion euros per year(13).

To improve physical, mental and social functioning for chronic pain patients, Acceptance & Commitment Therapy (ACT), a form of behavioural therapy, is found to be effective(14,15). People learn not to suppress unpleasant emotions, feelings and thoughts, but to acknowledge and accept them(14,15). When applied correctly, ACT provides a pain recovery solution. In addition to ACT, positive psychology has been found to be effective for several types of pain(16–19). Whereas ACT is a form of therapy, positive psychology is a type of psychology that emphasizes possibilities rather than impossibilities, by amplify what is good(20). Positive psychology focuses on well-being and optimal functioning(20). In short, ACT and positive psychology show promise for different types of pain, but the question is whether this also has an effect on postoperative pain(15,21).

Various studies have shown that treating chronic pain through eHealth has potential(22–25). eHealth offers opportunities to improve self-management, knowledge, skills and to teach patients how to deal with chronic conditions(26). eHealth offers a cost-effective solution for aging population, as it can be used remotely and with less effort from healthcare professionals(27–29).

To prepare patients for surgery, to enable them to cope with postoperative pain and therefore possibly preventing chronic pain, an application has been developed. This was done in the overarching study 'Development of eHealth for spinal surgery patients - combining information with elements of ACT and positive psychology to improve mental wellbeing and pain-coping'. To test the first version of this application in the overarching study 20 spondylodesis and decompression patients were included.

Even though many eHealth applications are being developed, the implementation and dissemination of eHealth do not reach their full potential. This is often a result of a suboptimal development process by not involving intended users in the development and by not paying enough attention to the implementation of the technology from the start(30). To develop and

implement a high-quality application, it is necessary to include the experiences of intended users(28). An evaluation is important so that it is clear what the users of the application experience which helps to match the app to the right target group and their needs(30). Moreover, these insights can form a basis for improvement and dissemination of the application(30).

Objective

The aim of the study is to explore the experiences of patients who have undergone spondylodesis or decompression surgery regarding their use of the 'Kracht TeRUG' eHealth (pilot) application.

Methods

Design

A qualitative evaluation study was performed(31–33). This design is an effective way of gathering more in-depth experiences directly from the patients who use the application(34).

Population & Domain

The current qualitative study, focusing on the experience of the participants, is part of the overarching intervention study. The overarching intervention study aims to test an eHealth application with elements of ACT and positive psychology for spinal surgery patients.

The intervention group of the overarching study consists of 20 participants. These participants were recruited at an orthopedic center in the Netherlands where the patients undergo spinal surgery.

The participants fit the inclusion criteria of the overarching study, which were: above 18 years of age; indication for spinal surgery; proficient in Dutch.

Intervention

The application is based on elements of positive psychology and ACT. The application contains 13 modules accompanied by weekly assignments. Both types of surgery have three weekly modules before surgery, while decompression surgery has six modules and spondylodesis twelve modules after surgery. The application contains information from the brochures of the orthopedic center, a number of videos, peer support and exercises based on ACT and positive psychology, see table 1. For more information about the application see appendix 2. Figure 1 below shows how the application is represented.

<INSERT FIGURE 1 AND TABLE 1>

Data Collection And Procedures

During the overarching research, 20 participants used the application one month before and three months after surgery. The date of the surgery was different for each participant. The participants were approached for the interview by the researcher (AH) six weeks after their decompression surgery or 12 weeks after the spondylodesis,

Semi-structured interviews were conducted by one of the authors (LM) between January and April 2021. These interviews were held in Dutch by telephone, because of the COVID-pandemic. The interviews were recorded, for which informed consent was requested at the start of the interview. The interviews lasted between 30-60 minutes.

The interview scheme was based on the content of the application and was based on research from Köhle (2017)(35). The topics were: hospital-information; preparation and peer-support; exercises in weekly modules about ACT; exercises in weekly modules about positive psychology.

Convenience sampling was used, as maximum variation had already been applied for inclusion in the intervention group of the overarching study.

Data Analysis

All the steps of Thematic analysis by Braun and Clarke were used(36). The interviews were recorded, conducted, anonymized and transcribed verbatim by one researcher (LM). For coding and analysis process Atlas.ti software 9.0 was used. For the analysis, the data was read and re-read by both researchers (AH-LM) to familiarize themselves with the interviews. Subsequently, the interviews were open coded by both researchers independently, with afterwards a discussion to reach consensus. After the interviews took place, a member check was done, where a summary of the result of the interview was returned to the participants. Several participants replied that they agreed with the summary, no participants responded with suggested alterations.

An iterative process during data collection and data analysis was done. Interviews were analyzed after they have been taken and the interview schedule was updated from this to be used with subsequent participants. Whereby inductive and deductive coding is applied during data analysis. Four categories were added inductively: answers repeated, duplicates, prefer application over paper brochure and recommendation. No new themes were created and no codes were merged.

The trustworthiness and credibility of the research are guaranteed through the description and the use of the thematic analysis with the above steps. This ensures a transparent process and makes replication possible. Extern and intern validity are guaranteed using interviews that have been drawn up using literature(37,38).

Ethical Issues

The current study takes place within the overarching study. That study was conducted according to the principles of the Declaration of Helsinki and the Data Protection Act (AVG). It was approved by the Medical Ethics Research Committee of the Radboud University Nijmegen Medical Centre and has been labelled as non-WMO research (File number: 2019-5608) and by the ethical committee of the University of Twente (191080).

The evaluated intervention was non-invasive, as the participants could choose how much time they put into it and they could stop at any time. Finally, given the inclusion criteria, there is no question of an incapacitated subject or vulnerable groups.

Results

Participant

To facilitate the reporting of the results, the consolidated criteria for reporting qualitative studies (COREQ) were used (39). Between January and April 2021, 14 participants were interviewed, whereby the mean age was 65 years. Of these participants, 11 had decompression surgery, for more characteristics of the participant see table 2.

<INSERT TABLE 2>

Seven themes have been formulated to answer the research question: general impression; commitment with the application; suggestions for improvement; user-friendliness; preparation and peer-support; hospital-information; positive psychology and ACT. The themes were formed from a number of categories, see table 3. For the extensive table with codes, see Appendix 3.

<INSERT TABLE 3>

General Impression

First of all, a general question was asked what the participants thought of the application. Most participants indicated that it was an informative and user-friendly application, appreciating some aspects of positive psychology and ACT. For the participants' answers, see table 4.

<INSERT TABLE 4>

Commitment With The Application

The theme commitment with the application consists of the following categories: added value; prefer application over paper brochure; recommendation; reasons not to use; number

of uses. The majority had commitment with the application. Of the 14 participants, the most participants thought the app had added value. For example, PT11 said: *'An app is quite easy, because you always have your phone at hand'*. However, a number of participants did find that the information in the app corresponded to what the doctor or the clinic brochure contained. However, PT14 said: *Compared to the information I received in the hospital, this (-the app-) contained more than they explained to me.* Besides that the app had added value, almost all participants would also recommend the app. In contrast, a few participants who indicated reasons for not using the application, like PT11: *I enjoyed participating, but it was not for me because I have no pain.* In general, most participants still used the application once a week, although some participants stated to have used the information modules several times, especially before surgery.

Suggestion For Improvement

The theme suggestion for improvement consists the following categories: tips; mistakes; missing and duplicates. Most participants thought the application was fine, but there were still a number of participants who had comments. When asking for the tips, it emerged that some parts were too early. A number of participants also found it too extensive, such as: PT10: *it could be shorter and more concise.* In addition to the tips, there were also a number of mistakes, For example, PT 1 indicated that there were still some slight hitches in it and PT14 indicated that it sometimes happened that everything was gone. It also emerged that a number of things were missed in the application, such as medication at night: PT2: *there was little in the night about what I could do with the medication.* Where PT9 indicated that he was missing exercises *'After the surgery there is nothing about physiotherapy exercises'*. Regarding duplicates in the application, only a few participants indicated this. To which PT16 said: *There are a lot of duplicates, but on the other side I think that's fine too.*

User-friendliness

The theme user-friendliness consists the following categories: easy use; language; layout; answers repeated; feedback form a professional; reminders; number of modules. In general, all participants indicated that the application was user-friendly. Almost all participants found it easy to use, as PT12: *'The questions were clear, the way of filling in simple'*. The terms of language were also requested under user-friendliness. Here, slightly more than half indicated that it was not too difficult. PT5 indicated it was not that difficult to understand even for his level of education. It also emerged that more than half of the participants liked that the answers given earlier were returned at a later time. It also emerged that a few participants missed being able to ask for feedback from a professional, whereby personal contact were missed. Reminders were also integrated into the application so that the participants were

reminded when a new module was. All participants indicated that they experienced this as pleasant. However, there was a mistake in it, so many did not receive it, but experienced the idea as an added value. Regarding the number of modules, most participants indicated that it was fine, only a few participants would have preferred it instead of every week.

Preparation And Peer-Support

The theme preparation and peer-support consists of the following categories based on the elements in de application: Video of the nursing ward, video about the operating room, practical tips; recovery-process-module; quotes patient. In general, the components of preparation and peer support were experienced as pleasant. With regard to the video about the nursing unit and operating room, almost all participants indicated that they experienced it as reassuring: PT10 *'It is reassuring like this, it is exactly right'* and PT14: *'it is not frightening coming in because you knew what was coming'*. In addition, there were a number of practical tips in the application. Most participants this help them during the recovery process. PT1 indicated that he preferred to receive them after the operation. Also with this part, as with the next part, some have not seen it. Subsequently, the recovery-process-module was asked, this module was experienced as pleasant. However PT5 indicated that he had not experienced any pain and that the module did not apply to him. In addition, more participants indicated that they had experienced no pain. Finally, they were asked about the module of quotes of other patient. Most have already experienced this pleasantly, against PT1 indicated *'It may be nice for other people, but I want to follow my own plan and own trajectory'* and PT14 *'Not every surgery is the same, but it does contain tips and tools and that makes me calm'*. PT7 stated *'Reading a lot of other people's experiences reassured me that I was not going crazy and felt that it was normal'*.

Hospital-Information

Normally, patients only received a paper brochure with information. From this information of the brochure, the following was processed in the application: contact details; information about the surgery; information back disorder; physiotherapy and discharge criteria; physical guidelines after surgery; medication. The categories are based on this. When asked about what the participants thought of this, most indicated it was pleasant to experience the hospital information in the application. In addition, all parts were requested separately. So are the contact details who were processed in the application, this was seen as pleasant whereby PT14 said: *'that it is nice that it is in the app, because you always have it with you'*. The information about the surgery was also described. This one was clearly described, only PT1 found the period after the surgery not very clearly described. The same goes for the information about the back disorder, however a few participant indicated that they had also received the

information from the doctor. Wherein PT14 indicated it was less negative than the doctor said. Information was also available about the physiotherapy and discharge criteria, which were experienced as pleasant by almost all participants, only one participant thought it was not extensive enough. The physical guidelines after surgery were also incorporated in the app, which was also experienced as pleasant and clear. However, a few participants indicated that they more often picked up the brochure for the physical guidelines. Only PT11 found the physical guidelines not specific enough. Finally, the information about the medication was asked. Most participants indicated that it was clear, but there were a few tips: PT 2 indicated that it was clear but would have liked to know if he could take pain medication at night. PT7 found the paper version easier because it contained an intake schedule.

Positive Psychology And ACT

The theme positive psychology and ACT consists the categories based on the elements of ACT and psychology in the application: three positive things; conscious enjoyment; letter to yourself; video 'how does pain work'; valuable picture; positive statements; surgery worthwhile; desire to do after surgery; wish question; mindfulness exercises; emotion quadrant. In general, some participants indicated that the parts of psychology were too much or woolly, but when discussing the parts separately, the exercises were good. Then the different parts were questioned, for each part there were a number of participants who could not remember or had not seen it. In the exercise of the three positive thing, most participants indicated that they experienced this as pleasant. PT7 hereby indicated that *'you start looking at little things that make you happy and grateful, it helps for a more positive mindset'*. Also in the exercise conscious enjoyment, most participants indicated that they experienced it as pleasant. PT1 indicated *'that it is good not to always assume negative'*. However, this was not the case with the letter to yourself, where most participants indicated that they did not experience it as pleasant. This was also in case with the animation video about how does pain works and most participants found this to have no added value. Also in the exercise selecting the valuable picture on the mobile there were a few who experienced this as pleasant, however most participants could not remember the exercise. Then the exercise about positive statements was asked, almost everyone found it a pleasant exercise. PT1 indicated *'it does help you to keep looking at it positively'*. This also applies to the questions 'what makes the surgery worthwhile' and 'the desire after surgery'. PT7 said *'I thought it was good, but it made me sad, because it really starts to look at your own desire at that moment and that is what you have not been able to do for a long time'*. Subsequently, the wish question was asked. The majority thought it had an added value, PT5 indicated: *'The wish question helps to look in the right direction'*. Mindfulness exercises were also incorporated in the application, which was experienced by half as pleasant and calming. Some thought this was woolly and a few found

this more useful for other people, but not for themselves. Finally, the emotion quadrant was asked, in which participants had to indicate how they felt before and after a module. The majority liked this. PT3 indicated *'Then you could see that you were also making progress or that you were standing still a bit.'*

Discussion And Conclusion

Discussion

This study explored the experience of the application 'Kracht TeRUG' based on elements of ACT and positive psychology. Seven themes represented the experiences of the application: general impression; commitment with the application; suggestions for improvement; user-friendliness; preparation and peer-support; hospital-information; positive psychology and ACT. The general impressions showed that the app was positively experienced and user-friendly. The components of 'preparation and peer support' and 'hospital information' were seen as reassuring. In addition, some participants experienced the parts of ACT and positive psychology as woolly and too much. Almost all participants indicated that the following component had no added value for them: video about how pain works and a letter to yourself. Because of this, the parts of ACT and positive psychology are discussed, since not everyone has experienced as pleasant.

The study by Lyubomirsky et al(40) showed that it is a challenge to correctly dose the interventions with regard to positive psychology. They indicate that positive activities lead to happiness, but the question is how often you should apply this. This also emerged in the current research, partly that some participants found it to contain too many psychological elements, while others experienced it as pleasant. It also emerged within the current study that not everyone accepts the elements of ACT and positive psychology and found it woolly. In the research by Likođlu(41) shows that ACT does not show the same development in every patient when it comes to psychological flexibility. ACT does have an influence, but shows its own development style for each patient(41). In other words, not every participant accepts the elements of ACT. This can also be seen in the current research where not everyone is open to ACT and describes it as woolly, personal or too much.

In addition, patients in the current study indicated that they have difficulty with keeping control of pain or were struggling. Hemmings et al(41) looked at acceptance of ACT within an application for people with a generalized anxiety disorder. Participants stated that the content was helpful and relevant to the fear when they were struggling with pain(41). It allowed for better symptom control(41). Since it was an app, the participants could use it themselves so often that their fears were kept under control(41). In the current study, instead of the symptom fear, postoperative pain was looked at with the use of ACT. Participants indicated because they knew the experiences of other patients, among other things, that they had the idea that

the symptoms that they had were normal. The current study also showed that they liked it that it was an application, since they always had the phone with them. This was also reflected in the study by Hemmings et al.

From the methodologic point of view the strength and limitations were looked at. One of the strengths of this research is the transparent process, whereby the COREQ checklist is used(39). Also, the Braun & Clarke checklist was used to apply thematic analysis, which also increases reliability(42). External and internal validity are guaranteed using interviews that have been drawn up using literature(37,38). Thereafter, triangulation has been applied by coding independently by the researchers. Finally, member check has been applied and verification is done by returning an overview of the result of the interviews to the participants. Another strong point is that the data collection and analysis took place by means of an iterative process.

The limitations of the study are that it was not possible to achieve data saturation on all themes. This did not happen with the suggestions for improvement and the many tips for the application. One of the limitations of thematic analysis is its flexibility. A disadvantage of thematic analysis is that the flexibility can cause the data to be broad(36). Another drawback is that there is limited interpretation of the data and the thematic analysis is poorly defined(36). Another limitation is that the interviews were done by telephone due to the COVID-19 pandemic, which made it impossible to see non-verbal communication. As a result, less rich data could possibly be found. In addition, the focus has been placed on the various components in the application, which made the participants very controlled, but also ensured that everything was questioned.

As there were different opinions about the application, further research will have to be done on how this can best be solved so that the application can meet the requirements of all participants. For example, one can look at the amount of the exercises of positive psychology and ACT. It can also be examined what the influence is if participants do not experience pain.

Conclusion

The application 'Kracht TeRUG' is in general experienced as positive. The informative part of the app was experienced as pleasant by almost all participants, especially the physical guidelines after surgery. The parts of positive psychology and ACT were experienced by the majority as soothing and helpful. However, some participants found it woolly, personal or too much.

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Abbreviations

eHealth: electronic health

ACT: Acceptance and commitment therapy

APPENDIX 1: TABLES AND FIGURES

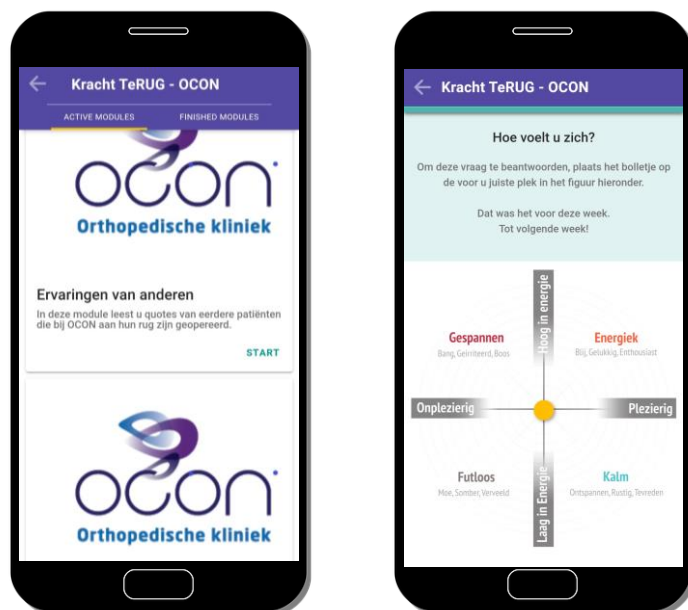


Figure 1:
eHealth application 'Kracht TeRUG'

Table 1:
Content of the eHealth application Kracht TeRUG

Hospital-information	Preparation and peer-support	Exercises in weekly modules about ACT	Exercises in weekly modules about positive psychology
Information about spinal condition	Video nursing ward and surgery room.	A wish question: <i>what if you can make a wish for your health? What would that change? How can you take a step in that direction now?</i>	A letter to yourself: <i>to encourage yourself when recovery is tough</i>
Information about the surgery	Practical tips from previous patients	The question: <i>What makes the surgery worthwhile, what are valuable activities to (continue to) do?</i>	Positive statements: <i>to encourage yourself when recovery is tough</i>
Information about physiotherapy and the discharge criteria from hospital	Experiences and quotes from previous patients	Valuable image: <i>which photo (on your phone) shows what you find important and valuable, how can you spend time on it during your recovery</i>	Three positive things: <i>For what were you grateful today and what was your own part in this?</i>
Physical guidelines after surgery for spondylodesis /decompression	How does pain work including an animation	Mindfulness exercises: <i>body scan and breathing</i>	Conscious enjoyment: <i>what activities have you undertaken today that often go without attention, but that you have consciously engaged in and enjoyed today. E.g. cooking or showering or walking.</i>
Pain medication	Recovery; Description of the recovery process	Emotion quadrant: before and after the module, the participants indicate how they feel.	
Contact details of the hospital including a list of complications when to contact			

Table 2:
Participant characteristics at time of interview

N	14
Female, n	5
Age in years, mean (range)	65 (34-70)
Surgery, <i>n</i>	
Decompression	11
Spondylosis	3
Education level ^a , <i>n</i>	
Low	4
Middle	5
High	5
Occupational status, <i>n</i>	
Paid work	4
Retired	8
Incapacitated	1
Housewife/man	1
Living together, <i>n</i>	12

^a Low: primary and lower secondary education; middle: upper secondary education; high: higher vocational training and university.

Table 3:
Themes and codes describing patients experiences surrounding the application 'Kracht Terug'

Themes	Category
General impression	Positive general opinion Negative general opinion
Commitment with the application	Added value Prefer application over paper brochure Recommendation Reasons for not using
Suggestions for improvement	Number of usus Tips Mistakes/Errors Missing
User-friendliness	Duplicates Easy use Language Answers repeated Feedback from professionals Reminders
Preparation and peer-support	Number of modules Video Nursing ward Video surgery room Practical tips Recovery-process-module
Hospital-information	Quotes patients Contact details of the hospital Information about the surgery Information spinal disorder Physiotherapy and discharge criteria

Positive psychology and ACT	Physical guidelines during recovery Medication General opinion psychology Three positive things Conscious enjoyment Letter to yourself Video 'how does pain work' Valuable picture Positive statements Surgery worthwhile Desire to do after surgery Wish question Mindfulness exercises Emotion quadrant
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Table 4:
Quotes about the general opinion about the application

Participant	Quote
PT 1	In itself I liked it, because it was quite informative.
PT 2	What struck me the most were those questions about mood and so on. Well I thought at one point that I was participating in a research of the "Evangelical Broadcasting".
PT 3	All the questions appealed to me and the help of the other patients, how they dealt with it and so on, that was impressive
PT 4	I found it to be quite vague with all kinds of questions, I didn't know what to do with them
PT 5	In itself appropriate after what has happened. How to live, how to do. So that is okay.
PT 6	I found it very informative, only the exercises that came with it, they are interesting at the moment, but at some point you have lost them from your memory.
PT 7	I actually thought it was very nice to have, especially when I panicked, then I could read whether others had experienced the same. For my state of mind it was comforting and nice to have.
PT 8	It says those ups and downs, but I actually didn't have any ups and down. I found some questions difficult to answer.
PT 9	I think it was fine, I do have a few suggestions, but that is purely about user-friendliness.
PT 10	It was a useful app. Everyone was asked how you feel and all those things. I thought that was quite a lot.
PT 11	I haven't had any pain at all, and it's all about asking pain. So it wasn't really for me.
PT 12	At first I was very positively surprised by it, I also had support from it and at one point I got a little tired with it.
PT 13	Everything in it, except for a few words, everything in it I have already read.
PT 14	Every time you open something, it contains clear questions, clear directions. I thought it was clear and it benefited me.

APPENDIX 2: EHEALTH APPLICATION INTERVENTION

The eHealth application consists of 13 modules (43):

- Introduction (how does the app work)
- Information about the condition of spondylodesis or stenosis
- Information about the surgery (spondylodesis or decompression)
- Videos nursing ward and tour operating room
- Information about physiotherapy and discharge criteria from the hospital after surgery
- Practical tips from previous patients
- How does pain work (incl. Animation)
- Pain medication
- Rules after surgery (e.g. which movements not to make during the first few weeks)
- Recovery (motivational and informative texts)
- Experiences of others (quotes from previous spinal surgery patients)
- Attention exercises (mindfulness body scan and breathing)
- Contact with the hospital (incl. for which complications to call)

Various information modules of the eHealth application are based on existing brochures and leaflets from the orthopedic center(38). In addition to the above modules, the participants also receive weekly modules, which are three modules for the surgery. Decompression patients have new, weekly modules for six weeks after surgery. Spondylodesis patients have new weekly modules for twelve weeks after surgery.

The weekly modules contain: information that is relevant at that time (e.g. rules of that week and quotes from previous patients about that period) and one or two positive psychology exercises each week. The positive psychology and ACT exercises in the application are:

- Mindfulness: breathing;
- Mindfulness: body scan;
- Wish question: what if you can make a wish for your health? What would that change? How can you take a step in that direction now?;
- What makes the surgery worthwhile, what are valuable activities to (continue to) do?;
- A letter to yourself: to encourage yourself when recovery is tough;
- Positive statements: to encourage yourself when recovery is tough;
- Valuable image: which photo (on your phone) shows what you find important and valuable, how can you use it during your recovery time;
- Three positive things: For what were you grateful today and what was your own part in this?;

- Conscious enjoyment: what activities have you undertaken today that often go without attention, but which you have consciously engaged in and enjoyed. E.g. cooking or showering or walking.

The intensity of the use of the eHealth application is dependent on the participants' personal preference(43). The participant can read the information at their own pace and decide what to read or not to read(43). This will probably result in using the application to obtain information and fill in some exercises on goals and expectations before surgery. During the patients' hospital stay, they can read the information and use the exercises as well.

The most intensive period of using the eHealth application will be during the patients' recovery at home. The information modules will be continuously accessible, combined with the weekly modules containing mindfulness exercises and positive psychology/ACT exercises(43). The minimum expected intensity of use is once a week for 20 to 30 minutes(43). Finally, the application is an extra service and does not mean that contact with the doctor is no longer there.

APPENDIX 3: THEMES AND CODES DESCRIBING PATIENTS EXPERIENCES SURROUNDING THE APPLICATION 'KRACHT TERUG'

Themes	Category	Code	
General impression	Positive general opinion	Informative, fits the situation, clear Comforting	
	Negative general opinion	Woolly Too much psychological focus	
Commitment with the application	Added Value	Preparation for surgery was clear App is easy accessible, always close at hand	
	Prefer application over paper brochure	Duplicates with the brochure Brochure/booklet was easier Repetition/complementary to what the doctor said Everything is also available on the internet Having the brochure and the app was nice, being able to read it again	
	Number of uses	Daily Weekly, regularly When I was curious Sporadically	
	Recommendation	It benefited me Comforting, especially for people who think negatively Informative	
	Reasons for not using	Did not get the reminder Content doesn't suit me	
	Suggestions for improvement	Tips	Information/exercise is too complicated Hard to find, a lot of scrolling, help button Way of asking questions Questionnaire is too long Missing physiotherapy exercises Perform with two people
		Mistakes/Errors	Beauty flaws Not discovered When closed, everything disappeared Was a week ahead
		Duplicates	No There is a lot of repetition
		Missing	Circumstances with COVID-19 Missing information Extensive physical guidelines
		User-friendliness	Easy use
Language			To difficult Too easy
Lay-out			Looks goo Lots of scrolls/screen too small Help button/tree Pictures
Answers repeated	Fine/Good Reminds of what you have written down Insight as to whether it went better		
Reminders	Not had, but added value Had sporadic, but added value Always had and added value		
Feedback from a professional	Don't worry it wasn't there Missed this though		
Number of modules	Fine Too much, preferably every two weeks		
Preparation and peer-support	Video Nursing ward C1		Comforting Not seen
	Video surgery room	Less frightening/reassuring Not seen	

	Practical tips	Preferably after surgery Has helped Not seen
	Recovery-process-module	Had no pain, no added value then Not seen Fine
	Quotes patients	Nothing done/did not remember Want to follow your own trajectory Reassuring to hear different opinion/tips tools/valuable
Hospital-information	Contact details of the hospital	General phone number is fine Great, you always have the app with you Missing a contactperson
	Information about the surgery	Clear Not clear after surgery
	Information spinal disorder	Same as the doctor said Clearly
	Physiotherapy and discharge criteria	Fine Not seen Not comprehensive enough
	Physical guidelines during recovery	Pleasant/clear Picked up the brochure rather than the app
	Medication	Clear/reference book Paper version easier Quickly out of the way Little is known about nighttime
Positive psychology and ACT	General opinion psychology	Positive general opinion Negative general opinion/woolly
	Three positive things	Pleasant to do, makes you think, creates awareness Woolly, not for me Not done
	Conscious enjoyment	Helps not always assume negative Became sad They didn't know anymore
	Letter to yourself	Woolly/this was not for me Good practice
	Emotion quadrant	Fine Did not appeal to me
	Positive statements	Backup/fine Woolly Not done
	Mindfulness exercises	Pleasant, important, gives peace of mind and/or body, beautiful Useful to others, but not to me Not done
	Valuable picture	Nice I don't remember/didn't appeal to me
	Surgery worthwhile	Has an added value Woolly/personal
	Desire to do after surgery	Nice Woolly/too personal
	Video 'how does pain work'	No added value Not seen Added value
	Wish question	Has an added value Woolly/not necessary