Cognitive Bias Modification Training Targeting Fatigue in Kidney Patients: Usability study

Jody Amber Geerts, Marcel E. Pieterse, Gozewijn D. Laverman, Femke Waanders, Nicole Oosterom, Jacqueline T. Slegten, Elske Salemink, Christina Bode

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Jody Amber Geerts[1] MSc; Marcel E. Pieterse[1] PhD; Gozewijn D. Laverman[2] Prof Dr; Femke Waanders[3] Dr med; Nicole Oosterom[2] MSc; Jacqueline T. Slegten[3] MSc; Elske Salemink[4] PhD; Christina Bode[1] PhD

[1]Centre for eHealth & Well-being Research Section Psychology, Health and Technology University of Twente Enschede NL
[2]Department of Internal Medicine Division of Nephrology ZGT Hospital Almelo NL
[3]Department of Internal Medicine Isala Hospital Zwolle NL
[4]Department of Clinical Psychology Utrecht University Utrecht NL

Corresponding Author:
Jody Amber Geerts MSc
Centre for eHealth & Well-being Research
Section Psychology, Health and Technology
University of Twente
De Zul 10
Enschede
NL

Abstract

Background: Fatigue is an important symptom for many patients, including kidney patients. Cognitive Bias Modification (CBM) training is a promising technique to counter fatigue symptoms.

Objective: The current study aimed to evaluate a CBM training among kidney patients and health care professionals. Using an iterative design process, evaluating expectations and experiences with the training, acceptability and applicability in the clinical setting were assessed.

Methods: This study is a longitudinal, qualitative, and multiple stakeholder-perspective usability study interviewing end-users and health care professionals during the prototyping phase and after end of training. Semi-structured interviews were conducted with 29 patients and 16 health care professionals. The interviews were transcribed and analysed thematically.

Results: Generally, participants were positive about the training and its applicability. The biggest negatives were doubts about effectiveness and annoyance about the repetitive character of CBM. Barriers for applicability were patients' varying computer skills, the subjectivity of fatigue, and integration with regular treatment, (e.g., role of health care professionals). Possible solutions were assigning representatives among nurses, offering the training on an app, and providing assistance via a helpdesk. The iterative design process, including the repeated waves of testing user expectations and experiences, yielded complementary data.

Conclusions: The current study provided one of the first user evaluations of a CBM training, both among patients and care providers. Acceptability and applicability appear positive although barriers were identified. The proposed solutions need further testing, preferably following the same frameworks, as the iteration in the current study contributed positively to the quality of the training.

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Cognitive Bias Modification Training Targeting Fatigue in Kidney Patients: Usability study

Background. Fatigue is an important symptom for many patients, including kidney patients. Cognitive biases, such as attentional bias and self-identity bias, are thought to influence fatigue. Cognitive Bias Modification (CBM) training is a promising technique to counter fatigue symptoms.

Objective. The current study aimed to evaluate a CBM training among kidney patients and health care professionals. Using an iterative design process evaluating expectations and experiences with the training, acceptability and applicability in the clinical setting were assessed.

Methods. This study is a longitudinal, qualitative, and multiple stakeholder-perspective usability study interviewing end-users and health care professionals during the prototyping phase and after end of training. Semi-structured interviews were conducted with 29 patients and 16 health care professionals. The interviews were transcribed and analysed thematically. Next to a general evaluation of the training, acceptability of the training was evaluated using the Theoretical Framework of Acceptability (TFA) and applicability was assessed by evaluating obstacles and solutions for implementation in the kidney care setting.

Results. Generally, participants were positive about the training and its applicability. The biggest negatives were doubts about effectiveness and annoyance about the repetitive character of CBM. The acceptability was judged with a mixed evaluation, with a negative evaluation on perceived effectiveness, mixed results for burden, intervention coherence and self-efficacy, and positive results for affective attitude, ethicality, and opportunity costs. Barriers for applicability were patients' varying computer skills, the subjectivity of fatigue, and integration with regular treatment, (e.g., the role of health care professionals). Possible solutions were assigning representatives among nurses, offering the training on an app, and providing assistance via a helpdesk. The iterative design process,

including the repeated waves of testing user expectations and experiences, yielded complementary data.

Conclusions. To our knowledge, this study is the first to introduce a CBM training targeting fatigue. Furthermore, the current study provided one of the first user evaluations of a CBM training, both among kidney patients and their care providers. Overall, the training was evaluated positively, although acceptability had mixed results. Applicability appeared positive although barriers were identified. The proposed solutions need further testing, preferably following the same frameworks, as the iteration in the current study contributed positively to the quality of the training. Therefore, future research is encouraged to follow the same frameworks and take into account stakeholders and end-users in eHealth design.

*Keywords***.** Cognitive bias, patient perspective, qualitative study, nephrology, fatigue, vitality, acceptability, applicability, usability, design

Fatigue has been recognized as one of the most frequent and important symptoms in many illnesses and has been rated as one of the key factors leading to decrease in quality of life [1]. Patients with chronic kidney disease are no exception: In particular in patients dependent on chronic haemodialysis, the prevalence of severe fatigue is very high (53.3% [2]). Psychological processes are important determinants of fatigue. Even in haemodialysis patients, where physical factors are considered as strong determinants of fatigue severity, psychological aspects, such as stress, negative beliefs about fatigue and unhelpful behaviours, still predict 36.4% of fatigue severity [3]. Furthermore, it has been shown that biases in more automatic processing of information (implicit cognitive biases) are important predicting and maintaining factors in multiple illness related symptoms, including fatigue. For instance, Hughes et al. [4] showed that chronic fatigue syndrome patients consistently show an attentional bias towards health-threatening cues compared to healthy controls. Other biases also play a role, for example identity bias (a distorted perception of the self) and memory bias (distortions in memory retrieval processes) were found to be related to pain severity [5-7].

A novel technique that targets cognitive biases is Cognitive Bias Modification (CBM) where cognitive

biases are directly re-trained by using simple computer tasks [8]. Although not confirmed by all studies in this field [9,10], CBM has produced promising results countering pain [11,12], depression, trait and social anxiety [13-17], alcohol dependency and addiction [11,15,18-22], fear of cancer recurrence [23], eating disorders [11,24], and unhealthy consumer behaviour such as cigarette smoking, alcohol use, and unhealthy eating [25]. Because CBM is based on simple computer tasks, it is an easy, accessible and cheap option compared to other interventions. Furthermore, CBM is thought to be especially useful in stressful situations due to it being directed at more unconscious or implicit processes and requiring less active reflection from the participant [13,26]. These elements make CBM a promising intervention principle for treating fatigue symptoms.

The CBM training in the current study targets two different biases, namely attentional bias, i.e., hypervigilance; having more attention for symptoms, and self-identity bias, i.e., using symptoms to identifying oneself (e.g., “I am a tired person”). To correct a self-identity bias, an Implicit Association Task paradigm can be used (IAT [27]) and changed into a training paradigm [28]. Patients are trained to pair positive stimuli (good, happy) with ‘self’ (I, me) and negative stimuli (bad, disaster) with ‘other’ (they, them). By a series of quick response tasks, the novel associative links are established within memory and gradually automatized. Similarly, in the Attentional CBM, participants are guided to – against their habit – ignore the threatening cues, and instead direct their attention to positive cues. Based on the Visual Probe Task paradigm (VPT [29]) participants see two words appearing simultaneously on the computer screen; a positive or neutral word and a threatening word. The target that participants have to respond to after each pair of words disappears, systematically appears in the location of the positive stimulus, training participants to ignore the threatening words and direct their attention to positive cues [30].

Because of these simple computer tasks CBM is expected to be an attractive intervention for multiple patient populations. However, very little is known about patients’ actual CBM experience. To the best of our knowledge, only one qualitative study exists: Beard, Weisberg, and Primack [31] revealed mixed reactions from socially anxious primary care patients using CBM. Although most participants were positive about the rationale behind CBM and identified with the negative bias described, some were sceptical and not convinced of the relevance, purpose, and benefit of the specific tasks. Moreover, some disliked the repetitive and boring nature of CBM [31]. Thus, even though participants seem willing to accept the idea of CBM, the very

simplicity that makes CBM such a promising intervention, appeared at the same time a barrier for participants to engage in and complete CBM treatment.

Furthermore, although good examples can be found [32,33], implementation of eHealth interventions can be problematic, despite promising results in clinical trials, often due to lack of digital skills or knowledge of the eHealth application in patients and health care professionals [34,35]. Therefore, in eHealth development, it is important to take users' perspectives into account as it improves usability, prevents the design from having unnecessary features, prevents resistance and drop-out, and subsequently, can prevent spending money on poorly fitting designs [36,37]. Thus, although neglected by most studies on CBM, patients and health care professionals' perspectives are important factors to take into account in the development of CBM interventions as it can improve acceptability, usability, and successful implementation [38,39].

Acceptability and successful implementation have been receiving more attention in health psychology lately [40]. Until recently, though, no definition of acceptability was included [41]. Therefore, Sekhon, Cartwright and Francis [42] used their review to develop the Theoretical Framework of Acceptability (TFA) and defined acceptability as "a multi-faceted construct that reflects the extent to which people delivering or receiving a healthcare intervention consider it to be appropriate, based on anticipated or experiential cognitive and emotional responses to the intervention" (p. 8). Moreover, they identified seven components: (1) affective attitude, i.e., how participants feel about the intervention, (2) burden, i.e., the amount of effort perceived to be required for intervention participation, (3) ethicality, i.e., whether the intervention has a good fit with the participant's values, (4) intervention coherence, i.e., whether the participant understands the intervention and its mechanisms, (5) opportunity costs, i.e., whether profits, benefits, or values have to be sacrificed to engage in the intervention, (6) perceived effectiveness, i.e., whether the intervention is perceived to be likely to achieve its purpose, and (7) self-efficacy, the participant' confidence about performing the behaviour(s) required for intervention participation [41,42].

Moreover, multiple frameworks recognize the user-perspective and acceptability as important factors in their aim for long-term implementation of interventions and focus on sustainability. The Dynamic Sustainability Framework [43], for instance, emphasizes sustainability with three focus points: (1) ongoing learning and problem solving, (2) a focus on the fit between interventions and the multi-level contexts they are

to be implemented in and a continuous adaptation to that fit, and (3) a change in expectations in researchers from accepting diminishing outcomes over time, to expecting ongoing improvements. Building on that, the CeHRes Roadmap [44] provides a framework for an iterative development process for eHealth applications taking into account the human, contextual and technological factors increasing the chance of an intervention being a good fit and reaching its goals [45]. By emphasizing a dynamic and iterative development process that takes into account multiple perspectives and contexts, these frameworks aim for more sustainable and successful interventions. In line with these frameworks, the current study used a longitudinal, iterative process to develop a CBM training targeting fatigue. This training was evaluated by multiple stakeholders, namely Chronic Kidney Disease (CKD) patients and their health care professionals. We selected patients with advanced kidney disease, but not yet dependent on dialysis (CKD stage 4-5) and patients dependent on chronic haemodialysis (CKD stage 5D).

The primary aim of the current study was to evaluate the CBM training targeting fatigue with CKD patients and nephrology professionals. The interviews were conducted at two development stages; at the prototype stage (expectations) and after a 8 to 9weeks study with the CBM training (experiences). With the combination of multiple stakeholder perspectives and developmental stages, the current study aimed to provide a comprehensive evaluation of the CBM training. Specifically, acceptability and applicability in the clinical setting were evaluated and obstacles and possible solutions were discussed.

Method

Participants

At the prototype phase, included were Dutch-speaking adult CKD patients, nephrologists, nurse practitioners, dialysis nurses, and social workers. At the evaluation phase, Dutch-speaking adult CKD patients were included who had reported moderate to severe fatigue and had adequate visual capabilities to operate a computer and basic internet skills. Excluded were patients scheduled for receiving a kidney transplantation within 3 months, or patients with any somatic or psychiatric comorbidity that may impede patient adherence to the study protocol. At the prototype phase, all invited patients participated. At the evaluation phase, six of

the invited patients (n = 24) did not agree to participate in the interviews because of hearing problems (n=2), lack of energy (n=1), working full-time (n=1), having a hectic time during the COVID-19 pandemic (n=1) or the preference to ask others first because of other commitments (n=1).

At the prototype phase, 21 interviews were conducted with 10 professionals (4 nephrologists, 2 nurse practitioners, 2 dialysis nurses and 2 social workers) and 11 patients (5 CDK 4-5, 6 CKD 5D). Patients' age ranged from 27 to 80 years (mean 65 years), 8 patients were female and half of them reported to have fatigue symptoms. At the evaluation phase, 24 interviews were conducted with the 6 involved professionals (2 nephrologists, 3 nurse practitioners and 1 dialysis nurse) and 18 patients (8 CKD 4-5, 10 CKD 5D, of which 3 peritoneal dialysis patients). At the evaluation phase, the patients' age ranged from 45 to 83 years (mean 64) and 8 patients were female. In Table 1, for the two timepoints, the number and characteristics of participants are depicted.

Table 1

Number and Characteristics of Participated Patients and Health Care Professionals (HCP) at the prototype phase and evaluation phase

Group	Patients	Patients	HCP	HCP
Phase	Prototype	Evaluation	Prototype	Evaluation
N	11	18	10	6
CKD 4-5:5D[a]	4:6	8:10 (3)		
n fatigued (4-5:5D)	6 (3:3)	18		
Male : Female	3:8	10:8	3:7	1:5
Hospital 1: Hospital 2	5:6	9:9	5:5	4:2
Age[b]	65 (14.8) [27-	64 (9.9) [45-		
Profession[c]			4:2:2	2:3:1

[a]CKD 4-5 patients have advanced kidney disease but do not yet undergo dialysis treatment, 5D patients undergo haemo- or peritoneal dialysis treatment

[b]Mean (SD) [range]

[c]nephrologists : nurse practitioners : (peritoneal) dialysis nurses : social workers

Material

The interviews started with an introduction, then, at the prototype phase, patients' fatigue, their opinion about the rationale of the current study (e.g., attentional and self-identity bias), a demo of the computer tasks, and the study concept and design were discussed. At the evaluation phase, patients and professionals were asked to evaluate the intervention study, contact with the researcher and applicability of the training in their medical setting. The translated interview guides for all interviews can be found in Appendix B.

Intervention

Both the self-identity bias and the attentional bias CBM trainings were an adaptation of the original test versions. Instead of the 50/50% ratio between bias congruent and incongruent tasks in the IAT and the VPT measurements, the training sessions contained 100% bias incongruent tasks. This means that in the IAT, participants only had to pair 'Vitality' together with 'Me' and 'Fatigue' with 'Other'. In the VPT, the dot would only appear at the vitality words. The training sessions took around 5 to 10 minutes.

The demo at the prototype phase was made with Inquisit 4 [46]. Based on the feedback received at the prototype phase, the computer tasks were adapted. For instance, break screens were included to offer participants the option to take a break during the tasks. At the evaluation phase, the IAT-training consisted of 120 trials [27] with two break screens (after 40 trials). The VPT-training consisted of 102 trials with four break screens (after 20 trials). At the evaluation phase, the assessment and training tasks were offered via a combination of Qualtrics software and the Gorilla Experiment Builder (Gorilla.sc [47]). Due to the different features in Qualtrics and Gorilla.sc, it was decided to contact, instruct and ask research questions to the

participants via Qualtrics and for the assessment or training tasks they are directed to Gorilla.sc.

In our intervention study, participants first went through a baseline phase with multiple (three to six) baseline bias measurements. This was followed by the two-weeks training phase with a training session on 6 of the 7 days, combined with again one bias measurement per week. In the first training-week participants either had the IAT-training or the VPT-training. In the second week they had both training paradigms. Then, a four weeks post-training phase followed with a weekly bias measurement (one per week).

Procedure

In this study, 5 patient partners have systematically been involved. They contributed to various matters of the project, gave feedback on the information form and consent form and helped piloting the interviews. For the interviews at the prototype phase, patients were approached by their own nephrologist or nurse practitioner. During a dialysis check-up or a regular visit at the outpatient department, the care provider gave a brief description of the study and when interested, provided the patient with the informed consent form which was constructed according to Good Clinical Practice (GCP) regulations.

Most recruited health care professionals (recruited equally among the two hospitals) were recruiting patients for the study (except the social workers), however, they had limited knowledge of the CBM training used in the study. After sign-up, the researcher contacted the participant to schedule an appointment for the interview at a time and place that was convenient for the participant. For patients, this was scheduled during haemodialysis sessions or at their homes, for health care professionals, at their office. Before the interview participants filled in a questionnaire regarding demographic characteristics (Appendix A). The interviews for the prototype phase were conducted between June 2019 and October 2019.

The feedback received at the prototype phase was used in the development of an intervention study to quantitatively evaluate the effectiveness of the CBM training. The first participants started the intervention study January 20, 2020. The intervention study took 8 to 9 weeks. For the interviews at the evaluation phase, patients were informed about the interviews in the information letter for the intervention study. Participants were informed that they could also choose to only do the intervention study. When participants were in the final weeks of the intervention study, the researcher started contacting them to ask if they were interested in

participating in the interviews. The interviews with patients were scheduled after the last measurement for the intervention study (March and April 2020). The professionals at the evaluation phase were all involved in the project and their interviews took place from April until May 2020. Unfortunately, due to COVID-19 restrictions, the interviews at the evaluation phase had to be conducted via a phone call instead of face-to-face. These phone calls were conducted by calling participants via Teams on the computer and recorded via the recording function on a smartphone.

All interviews (Appendix B) were semi-structured and were recorded and transcribed verbatim. The number of participants was based on earlier experiences with similar studies and for the patients and health care professionals at the prototype phase we believed that data saturation was reached because no new concepts were introduced in the last interviews [48]. At the evaluation phase, all professionals who were involved in the intervention study, were interviewed. Participants received a small gift after the interview which was approved by all ethical committees (see Ethical Statement below).

Data analyses

The interviews were recorded, transcribed verbatim, coded, and analysed thematically [49] (see Appendix C for the code schemes). To code and analyse the interviews Atlas.ti and Excel were used. At the prototype phase, needs and requirements were identified and applied to the intervention study. At the evaluation phase, the intervention study and the adjustments made at the prototype phase were evaluated. At both timepoints, the training's acceptability and its applicability within clinical care were evaluated.

The codes in this study were close to the data. Especially regarding acceptability, answers were brief, therefore, the results are described more quantitatively. For instance, the code *"Did the training help? No"* (n=17) has this quote *"I: Do you think the training sessions had influence on you? P: No. I: No? Nothing changed, you did not notice anything? P: No. I: And did you have the feeling that the training sessions helped you? P: No. I: No, okay, so no improvements that you have noticed. P: No."* (P. 1), adding these quotes was not thought to add much to the interpretation of the data. The data comparing the timepoints and evaluating applicability in the clinical setting are richer

and have more quotes.

Ethical Statement

The authors have abided by the Ethical Principles of Psychologists and Code of Conduct as set out by the BABCP and BPS. This study has been evaluated by the Committee of Human Research [Commissie Mensgebonden Onderzoek, CMO] that decided that the law medical-scientific research with people [Wet medisch-wetenschappelijk onderzoek met mensen, WMO] did not apply to this research and redirected the study to a local ethical committee (file number 2019-5816). This study has been approved by the local ethical committees of the two hospitals and the university (file numbers 191020, 191193, 19-26).

Results

The current study evaluated the CBM training with chronic kidney disease patients and health care professionals. Besides a general evaluation of the training, acceptability, applicability in the kidney care setting, and the two design iterations were explored. Acceptability was evaluated with the seven components of the TFA [42]. Applicability was assessed by exploring obstacles and possible solutions for implementation in the kidney care setting. Lastly, the design process of the CBM training was assessed by comparing patients' and health care professionals' opinions after a first introduction with CBM and after the intervention study.

General evaluation of the training

The evaluation of the training showed a two-faced picture. On the one hand, at both timepoints, most patients (72%) and professionals were positive about the training. On the other hand, none of the patients reported to experience benefit from the training. Specifically, none of the patients thought that the training helped them or noticed a positive change during the study. Actually, one patient noticed the opposite effect, she experienced more fatigue during the training weeks. However, four patients recognized the implicit and/or longitudinal nature of the study and indicated that it could still have an effect that they just did not notice yet. Furthermore, many patients still thought the computer tasks were useful, for instance, making them more aware of their fatigue (n =

2), e.g., *"I: did you think the training helped you in one way or another? P: Yeah, […] being a bit more aware about thoughts [...] when I fill in 'I am lazy', or 'I am vital', or 'I am tired', etc. then I think that I should do something about that, what can I do about it, what are causes […]. I: And did you think the training was useful? P: Yes, it has contributed, yes, especially in the awareness process."* (P.7), bringing distraction (n=2), confirming capabilities (n=1), and "brain-training" (n=1). Similarly, 11 out of 18 patients thought the study was fun, indicating for instance that they saw it as a way to learn about themselves (n=3), a new way to pass time (n=2), or as a game (n=2). Health care professionals were positive about the training because it could be helpful for participants (n=4), because the set-up is charming and not burdening for patients (n=1), and because it is important to find something that could help against fatigue as it is a frequent symptom in patients (n=1).

Although around a third of participants had complaints about the computer tasks, others praised that it was quick and easy. Specifically, they liked that the training took less than 15 minutes (n=14), they did not mind the daily training sessions (n=9), they thought the training was not difficult (n=3) and that everyone could do them (n=2). The most frequently reported complaint was the monotony: Seven participants mentioned 14 times that there was too much repetition and that this made the training boring, especially as the tasks were always the same (mentioned 12 times by six participants). Remarkably, only two of the 18 patients had noticed the difference between the measurement and the training sessions (even though this was mentioned in the emails and the instructions), which may have amplified this complaint. Furthermore, although 11 participants thought the study in general was clear, four participants mentioned that the purpose of the study was not clear to them and nine participants said that they just did whatever the researcher sent them without thinking much about the content. Thus, mixed results are found regarding the understanding of and affinity with the training.

Applicability

Most patients and health care professionals were positive about applicability, indicated by willingness of all health care professionals and most patients to participate again in a similar study (n = 14), and their support for wider implementation of the training (n = 13). Fourteen patients would continue with the training,

either in its current form (because it could still help, n=3, to help the researchers, n=2, and for evidence, n=1), after confirmation (when evidence is found, n=2), or adjustment (with different frequency, n=2). Fourteen patients would also recommend the training to others, with different reasons: (1) because even though it did not work for them, it could still work for others (n=3), (2) because it should be tried out on more people (n=1), and (3) because it is simple (n=1). Others would recommend the training but not to elderly (n=2) or only after more evidence is found (n=2). Not having improved themselves was the biggest reason not to recommend the training to others (n=3).

The most mentioned obstacle for delivering CBM to kidney patients were patients' computer skills (mentioned by all professionals at the evaluation phase). The involved health care professionals estimated that about 50 to 60% of all CKD patients were interested in the intervention study but that 40 to 66% of them could not participate because of low digital literacy or not having a laptop. The intervention study offered the participants the option to borrow a laptop. The two participants who borrowed a laptop, however, stopped the intervention study because they lacked the skills to interact with the borrowed laptop, amongst other reasons.

In contrast to the previous observation however, the complex procedure with the two programs (Qualtrics and Gorilla.sc) in the intervention study, to our surprise, was not reported as an obstacle by patients. Actually, they were positive about the two programs (n = 17) and the transition (n = 9). Furthermore, of the participants that completed the study, 15 out of the 18 patients were able to do the tasks without help. Participants reported that they had to take a good look the first time, but after that knew what to do and had no problems with it. Possible solutions mentioned for the lack of computer skills is providing the training on an app; four patients preferred the training on a tablet instead of the computer and three health care professionals agreed that an app is more accessible. Other recommendations included making an instruction video (n=2), providing it online (n=2), clear instructions for health care professionals (n=2), e.g., *"I would first explain to the specialists, the nurse practitioners and the nurses that it exists and how it works and what patients have to do for it."* (HCP.5), clear instructions for the participants (n=2), a helpdesk (n=2), and adding an information leaflet (n=1).

Interestingly, another obstacle for delivering the training to patients was a discrepancy

between the patients' and the professionals' views on patients' fatigue severity (mentioned by three professionals), e.g., *"I was also quite surprised that at first you think that someone is eligible but then indicates that they do not suffer from fatigue and that we were really surprised like, oh, okay, you know, they do give those complaints back but then you really come to the core and then you ask them you know, if they want to be a participant for the study and then, well, they turned out to be not as tired as we had thought they were. Not tired enough to want to participate in this"* (HCP.3). Moreover, because of the fluctuating nature and the subjective experience of fatigue, it can be hard for professionals to interpret patients, e.g., *"Look, in any way, we quickly have an opinion, […] but I am also aware that that is not always the truth so to say, there are people that complain bitterly in the moment that they sit in my office but when you bump into them at the mall, then you think, well, actually he functions fine and he is chatting with everyone, he seems to be alright, and the other way around as well, people that say here, 'yes doctor, alright doctor, everything is fine', but next, at home actually do not get off the couch because they are actually not able to anymore, so that is something that I ask about actively but still, people do not always show everything, so that is not, it is a certain impression that I get of that, that does not have to be the truth, you try to get a picture, that is what it comes down to."* (HCP.20). One patient proposed adding physical tests to measure fatigue, suggesting a desire for more objective measurements of fatigue and possible improvement. Thus, the fluctuating nature and subjective experience of fatigue impedes communication between health care professionals and patients and could also be a barrier for recruitment for and adherence to future fatigue interventions.

About applicability of the training at the nephrology department, two professionals mentioned that a clear plan for the integration of the training in regular treatment is important, e.g., *"I think if you only give it to someone and just let that person go, you don't do anything with it, then I don't know if that will work. I think they do need some support, […] I think it is good to have someone that they can fall back to and who asks how it is going and whether they have encountered*

issues." (HCP.4). Also, professionals thought that dialysis nurses (n=3), social workers (n=1), or family (n=1) could help. However, one professional mentioned the willingness of nurses as an obstacle and three professionals recommended using representatives among the nurses, e.g., *"at the dialysis hall, there I would already from the top of my head make one or two nurses responsible that they make sure that the conditions at the hall, for instance the laptop etcetera, that that is taken care of."* (HCP.5) Thus, for further implementation it is important to have a clear plan for the training's introduction at the hospital, both regarding the health care professionals' roles, and in interaction with already existing treatment offered to patients. The professionals also gave suggestions for other delivery ways; via patient associations (n=2), at peer meetings (n=1), and by presenting at theme nights (n=1).

Acceptability

The evaluation of the CBM training provides a mixed picture of acceptability. The generally positive evaluation suggests positive reflections on affective attitude (how participants feel about the intervention), ethicality (whether the intervention has a good fit with the participants' values), and opportunity costs (whether benefits, costs, or values have to be sacrificed to engage in the intervention). Furthermore, the high number of patients and health care professionals recommending or being interested in continuing the training also suggests a positive assessment of opportunity costs. However, as no participant experienced direct effect from the training, perceived effectiveness (whether the intervention is perceived to be likely to achieve its purpose) is evaluated negatively.

The other components received mixed evaluations. For instance, burden (the amount of effort perceived to be required for intervention participation): As some participants complained about the tasks being repetitive and boring, those participants may have perceived the training as a burden, however, others liked that the tasks were simple and quick. Similarly, although most participants thought the study and its explanation was clear, only two of them had understood the difference between the training and measuring tasks and nine just did the study without thinking much about the content. Therefore, the picture of intervention coherence (whether the participant understands the intervention and how it works) also is mixed.

Lastly, large individual differences were found regarding self-efficacy (the participant's confidence about performing the behaviour(s) required for intervention participation) with computer skills being the most mentioned obstacles for current and future recruitment but also participants being positive and not needing help with the computer tasks.

Developmental process

As can be expected, changes in the design that were applied following the prototype stage were confirmed as improvements at the second evaluation after training. However, when comparing the results from both iterations more closely, some surprising inconsistencies were found. For instance, some suggested changes that were applied after the first phase received negative feedback at the evaluation phase (e.g., break screens; n=12) and some that were not applied were not missed at the evaluation phase (e.g., sounds, pictures, colours). Actually, the simplicity of the computer tasks was valued positively (n=17) at the second evaluation, e.g., *"I think when you're tired that it is nice that it is very simple and that there are not too many bells and whistles added because you do have a certain tiredness so then that is nice because it is very clear"* (P.3). Furthermore, video-instructions were advised at the prototype phase, but not missed at the evaluation phase. Actually, most participants were explicitly positive about the written instructions. Still, two professionals again recommended video instructions to improve applicability of the training. Also, three participants mentioned that they would have liked more personal contact with the researcher and suggested calling (with video). Lastly, the two timepoints show the difference between expectations after one session and experiences with many sessions: at the prototype stage, concern was expressed towards monotony within sessions. Conversely, at the evaluation phase, participants were positive about the stimuli (n=15) and did not mind the repetition within sessions (n=12).

Discussion

The aim of the current study was to carefully design and evaluate a novel Cognitive Bias Modification training for patients with advanced chronic kidney disease by considering their needs and opinions and those of their health care professionals. In an iterative design assessed in two developmental stages, the training was

generally evaluated positively with some minor points for improvement. Acceptability (evaluated with the seven components of the TFA [42]), revealed a mixed evaluation: Effectiveness was not perceived by patients, burden, intervention coherence and self-efficacy received mixed evaluations, and affective attitude, ethicality, and opportunity costs were evaluated positively. Although applicability in clinical care was evaluated positively, barriers were also encountered, such as patients' low digital literacy, the elusiveness of fatigue challenging communication between patients and health care professionals, and perceiving effectiveness. Furthermore, challenges for applicability in the nephrology department are how the training would be integrated in regular treatment, and in what way the health care professionals would be involved. Possible solutions were assigning representatives among dialysis nurses, offering the training on an app, and offering assistance via a helpdesk. Lastly, the results showed that the evaluations at the different development stages provided very different opinions that complemented each other, showing that the iteration was useful for the design process.

The findings regarding the acceptability of the training confirm results reported by Beard et al. [31]. In both studies, participants were generally positive about the CBM training, but were also sceptical about the effectiveness and complained about the monotonous nature of the repetitive tasks. Laurens et al. [19] received similar comments about their alcohol-avoidance CBM app. Even De Voogd, Wiers, De Jong, Zwitser, and Salemink [50] who included many steps to increase compliance and engagement (e.g., a progress bar, feedback, financial compensation, and text-, e-mail- and phone reminders) in their study focused on anxiety and depression, still encourage investigating other motivating features. Laurens et al. [19] recommend educating users more about the rationales behind CBM and the repetitive tasks. Our results clearly support these recommendations: more engaging formats and explanatory content to users of CBM is needed. Such an engaging format could be gamification [51]. Promising results have already been found with a Virtual Reality set-up for interpretation bias training countering trait anxiety [52,53] and a Virtual Reality set up for attentional bias training to counter social anxiety [54].

Another solution for the complaint about monotony of the tasks is to simply reduce the frequency of sessions. In our intervention study, participants had to do at least 21 sessions during the 8 or 9 weeks study period, with most participants not distinguishing bias measurements from training sessions. Participants in the

current study suggested to make measurement sessions voluntary. Similarly, participants could be given more autonomy to personalize their training and decide their preferred frequency and length of training sessions, which may be assumed to increase acceptance and adherence. However, this may also lead to some patients not achieving the full training potential since CBM is based on the idea that by repeating the tasks, implicit associative networks are changed, which can then reflect to behaviour and cognitions. The repetitions, therefore, are an important aspect of the mechanism of CBM. In the context of alcohol related CBM, Eberl et al. [18] estimated the optimal number of CBM sessions between 6 and 12 sessions. These sessions contained 200 trials [18], however, especially regarding VPT, literature varies widely on the number of trials in sessions [55]. Thus, optimal CBM dosage, both regarding number of sessions and number of trials within a session needs further investigating. Similarly, the degrees of freedom that may be given to the participants to decide themselves on the dosage are not known.

The obstacles identified in this study are also consistent with the results of previous studies with chronic kidney disease patients. The found discrepancy between patients' and professionals' views on patients' fatigue severity confirms and underlines Jhamb, Weisborg, Steel and Unruh [56]'s claims that fatigue is an under-recognized symptom, and that health care professionals' awareness of this symptom should be improved. The authors [56] recommend developing improved methods to define, measure and screen patients on fatigue to bridge this discrepancy. The training evaluated in the current study might be able to provide or facilitate this process.

Furthermore, patients' low digital literacy were the main reason for ineligibility in Hudson et al. [57]'s feasibility study for an online CBT intervention countering psychological distress in haemodialysis patients. Although patients in Hudson et al. [57]'s trial were provided with tablets during haemodialysis, adherence was low and 25% required brief training in the use of tablets and / or the Internet [57]. In the current study, the use of an app was recommended by patients and professionals. An advantage of apps is that they can be made easy-accessible with minimal overt use of the Internet. Furthermore, our solution to offer assistance in the form of a helpdesk might make it more accessible even for people with limited Internet or tablet experience. The effects of these suggestions have to be investigated in the next iteration with this training. Furthermore, although the video-instructions recommended at the prototype phase were not missed at the evaluation phase

of the current study, offering both options was also thought to make the training more accessible for patients. Next to that, better effects are reported for eHealth interventions that are multimodal [34].

Our findings regarding the design process supported the importance of iterations and ongoing evaluation to ensure successful user-centred design and subsequent clinical implementation of the intervention, as suggested by the CeHRes roadmap [44] and the Dynamic Sustainability Framework [43]. The opinions at the different stages are valuable as the expectancies and user experiences showed how design elements of the intervention affect both adoption and continued use. Being able to anticipate, and repeatedly evaluate patients' and professionals' opinions will hopefully enhance the training's sustainability and success. The current study showed that even the use of one iteration adds demonstrably to the quality of the training. Future research is encouraged to also follow the sustainable intervention design frameworks.

A limitation of the current study is the small sample size. Although, at the evaluation phase we interviewed all professionals directly involved (n=6), inclusion of a larger sample may have yielded richer data. However, even though the group of health care professionals was small, on most of the topics data saturation was reached. Future research should further explore the applicability of the training in the nephrology settings, as well as the other previously formulated suggestions.

To conclude, the current study evaluated a Cognitive Bias Modification training countering fatigue, by involving kidney patients and health care professionals at two different stages in the developmental process: in an early stage of prototyping, and after using the training in an intervention study. Overall, the training was evaluated positively but acceptability received mixed results. Applicability of the CBM appeared positive, although barriers were identified, such as patients' low digital literacy and practical integration in the hospitals' routines. Possible solutions were offered but need further empirical testing. By following sustainable intervention design frameworks, this study provided the first steps towards bringing this CBM training countering fatigue to patients. In general, our study clearly showed the necessity of including the user perspectives in the development of Cognitive Bias Modification Interventions.

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Supplementary Files

Multimedia Appendixes

Demographics, interview questions and codeschemes.
URL: http://asset.jmir.pub/assets/cef44178a2d3c2f9567027d8c61cc9c7.docx