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The feasibility of virtual reality as exercise therapy for axial spondyloarthritis in a home and a physiotherapy setting

A mixed methods study
From a multi-discipline perspective

Myrthe Franke, s2736071
Department of Health Sciences, Science and Technology, University of Twente
Master Health Sciences, Personalized Monitoring & Coaching

First supervisor: Dr. C. Bode
Second supervisor: MSc. E.S. Slatman
External supervisor: Prof. dr. H.E. Vonkeman

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Abstract

Background

Non-pharmacological treatment, such as exercise therapy, is an important key point in the treatment of axial spondyloarthritis. Physical activity helps to maintain axial flexibility and has been shown to improve physical function, pain, fatigue, and quality of life. However, disease-related symptoms, lower the motivation to exercise, leading to an adherence rate of only 30%. Introducing virtual reality (VR) as an innovative solution could boost motivation to exercise. The use of an immersive VR as exercise therapy for axial spondyloarthritis is relatively new and research is required to demonstrate its feasibility in home and a physiotherapy setting.

Objective

This study aimed to identify the feasibility of VR as exercise therapy for patients with axial spondyloarthritis. Firstly, the study identifies the acceptability of VR in a home and physiotherapy setting. Secondly, it explores the anticipated demand for VR as exercise therapy in a home and physiotherapy setting.

Methods

This study was performed in a mixed methods design and included patients with axial spondyloarthritis and healthcare professionals: physiotherapists experienced in treating axial spondyloarthritis, physiotherapists experienced in VR, and rheumatologists. Participants performed exercises in the Walk in Nature program with VR in a laboratory setting. The quantitative outcomes were related to the acceptability of VR: VAS-pain score, motion sickness, presence, and user experience. Additionally, the qualitative outcomes were related to the demand: the perceived demand for the Walk in Nature program and the intention to use VR.

Results

In total, 17 participants (8 patients and 9 healthcare professionals) were included. Firstly, although some participants experienced slight symptoms of motion sickness, VR seems acceptable as both groups had a positive evaluation of the user experience and a high level of presence in the virtual environment. Secondly, although there is a low perceived demand, healthcare professionals perceive more potential in developing the Walk in Nature program as exercise therapy compared to patients. Besides, patients prefer to use VR in a physiotherapy setting while healthcare professionals would like to implement VR at home.

Discussion

Similar to other research, VR enhances both intrinsic and extrinsic motivation and has the potential to decrease pain. This implies that the technology could address the low adherence rates to physical activity, as it seems acceptable both at home and in a physiotherapy setting. Yet, VR is currently not easy to use and does not provide feedback to the patient, leading to a low perceived demand. Nevertheless, incorporating various features of the Persuasive System Model could boost the demand for the Walk in Nature program and the intention to use VR. However, to gain a comprehensive understanding of the feasibility, further research should emphasize real-life contexts and involve a more diverse sample size.

Conclusion

The results show that VR has the potential to function as exercise therapy at home and in a physiotherapy setting. Further investigation into the perspectives of utilizing VR both at home and in the physiotherapy practice settings is essential to gain a comprehensive understanding of the possibilities and challenges associated with integrating VR into clinical practice for this population.

Introduction

Non-pharmacological management such as exercise therapy is a key element in treating axSpA (1). While sedentary behavior is associated with reduced exercise capacity and poor quality of life, physical activity is associated with better function, exercise capacity, and spinal mobility (2).

Concerning non-pharmacological management, the patient can perform exercises with guidance: exercise therapy or physical therapy, or without the guidance of a healthcare professional, such as home-based exercises (2). Yet, the non-adherence to HBTs (home-based physical therapy programs) can reach up to 70% (3) Therefore, it is important to explore exercise programs that could address the non-adherence to physical activity.

1.1 Axial Spondyloarthritis

1.1.1 Definition

Spondyloarthritis covers a family of chronic inflammatory diseases that can be classified as axial spondyloarthritis (axSpA) or peripheral spondyloarthritis (pSpA). The term ankylosing spondylitis (AS) also refers to r-axSpA, but both terms are used interchangeably (4). PSpA affects the peripheral skeleton (joints of the limbs) and extra-musculoskeletal organs, such as the skin, gut, and eyes (5). AxSpA, also popularly referred to as Bechterew's disease in the Netherlands, predominantly affects the sacroiliac joints (SIJ) and the spine (axial). There are two stages of axSpA, non-radiographic axSpA, or nr-axSpA, identifies as an earlier stage of the disease in which regular x-rays of the SIJ and spine are still normal, while radiographic axSpA or r-axSpA means structural damage is visible with radiography (6). In both non-radiographic and radiographic-axSpA, inflammation may be visible on the SIJ and spine's Magnetic Resonance Imaging (MRI). There is a possibility that nr-axSpA develops into r-axSpA, but this does not happen for all patients (7).

1.1.2 Prevalence

The affected global population of axSpA ranges between 0.1 to 1.4% (10). This range may be explained by differences in study designs but also differences in the prevalence of HLA B27 (9,10). For patients with r-axSpA, the ratio of men to women is 2:1, while those with nr-axSpA have an equal distribution of patients by sex (8). Generally, symptoms of axSpA start in the third decade of a patient's life, which is a very active period in job-related, economic, and social domains (9). Consequently, axSpA is related to a high burden of the disease because of the reduced physical functioning (10). About 66% of the actively employed patients with axSpA have work-related issues which leads to direct and indirect societal costs (11). Boonen et al.'s study (12) revealed that, among the 529 patients in the Netherlands who were employed before diagnosis, five percent were on work disability after one year, 21% after ten years, and 31% after twenty years. This signifies a considerably elevated risk of workforce exit compared to individuals of the same gender and age. It suggests that individuals with axSpA may face significant symptoms, leading to substantial social and financial burdens, including unemployment. Providing treatment options to alleviate axSpA symptoms is crucial to minimizing these social, financial, and employment challenges.

1.1.3 ASAS classification

The ASAS 2009 classification criteria, developed by the Assessment of SpondyloArthritis International Society, aid rheumatologists in diagnosing axSpA in clinical settings (13). ASAS recognizes two stages of axSpA, namely nr-axSpA and r-axSpA. Additionally, the inclusion of MRI in the ASAS criteria has improved the diagnostic process for axSpA by allowing direct visualization of inflammation, whereas radiography identifies structural damage to the sacroiliac joints or spine (14). Despite the advantages of MRI in identifying the disease at an earlier stage, there remains a significant delay in diagnosis (15). Several factors and challenges contribute to this delay, such as difficulties in imaging, the absence of clear diagnostic criteria, misleading biomarkers, and more (16). As a result, patients frequently do not receive appropriate pharmacological care until an accurate diagnosis is established (8). This underscores the potential impact of non-pharmacological management during this stage

1.1.4 Risk factors

Determining the impact of risk variables on the development of the disease is still challenging. Several studies have evaluated that musculoskeletal inflammation in axSpA may occur because of IL-23, a pro-inflammatory cytokine that plays an important role in the protective immune response. The increased expression of the IL-23 can be explained by three hypotheses, the presence of HLA-B27, the biomechanical stress at the enthesis, and the gut microbiome. These hypotheses are considered the risk factors for the initiation of the disease processes. First, studies have estimated that genetic factors are responsible for 80% to 90% of the affected patients developing axSpA. It is well known that the disease is strongly associated with the HLA- (human leukocyte antigen) B27 gene and therefore occurs familial. While this gene is present in 8-10% of the general population, it is found in 80-90% of patients with r-axSpA. Secondly, the development of enthesis in axSpA is caused by interactions between biomechanical factors and natural immune responses. And lastly, the development of the captured immune response is influenced by the gut microbiome. Small variations in the diversity of gut microbiome may contribute to the development of axSpA (12).

1.1.5 Symptoms

The most common symptoms of axSpA are chronic pain (lasting more than 3 months), spinal stiffness, and fatigue. Other often presenting symptoms are peripheral manifestations such as enthesis and arthritis (5). Considering chronic pain, the symptom often presents itself in daily back pain (CLBP). Inflammatory back pain (IBP) is the most prevalent type of back pain in AxSpA, which means that the pain occurs due to inflammation of the spine and sacroiliac joints. Peripheral symptoms are about thirty percent common; they usually affect the lower limbs and manifest as one or more painful, swollen joints (13). They come along with pain, tenderness, and stiffness. Axial inflammation, notably synovitis, and enthesis's, causes irreversible structural damage that limits spinal movement. However, this usually manifests at a later stage of the disease (14,15). Additionally, mechanical back (an image-based diagnosis of a damaged spinal structure (16)) pain is another type that occurs in one-third of the patients with axSpA (17). Morning stiffness is another typical symptom. It can occur in any level of the spine, but this symptom is most common in the lower back, affecting the hips and spine. Lastly, fatigue is the third most prevalent concern as more than half of the patients experience major fatigue. It is correlated with stiffness and pain. Patients frequently experience disrupted sleep caused by inflammatory pain (18,19). This increases fatigue and leads to decreased function, which worsens pain and stiffness (20). In general, axSpA symptoms can be severe, meaning that treatment of aSpA is important to lower the risk of developing these severe symptoms.

1.1.6 Monitoring

Physical function, spinal stiffness, patient global assessment, spinal mobility measurement, pain, fatigue, entheses, and acute phase reactants (CRP value) are among the core outcome sets for anti-rheumatic medications and physical activity (21). Although there are several ways to track axSpA disease activity, physical examination is still the most difficult method because of the deep anatomical systems involved. As a result, instruments depend on imaging, results from lab tests, and patient-reported outcomes (22). In clinical practice, it is optimal to assess disease activity using composite indices.

One useful method for tracking disease activity is the Ankylosing Spondylitis Disease Activity Index (BASDAI). It includes questions about peripheral pain inflammation, fatigue, axial pain, morning stiffness duration, and global disease activity. It is ideal for axSpA monitoring to include a serologic marker of inflammation, such as the CRP (c-reactive protein) value in mg/L. The BASDAI has been employed in studies to identify disease activity, with high values associated with work disability. In a study involving 103 AS patients (mean age of 37 years, disease duration of 12 years), twenty percent were unable to work due to their condition (23).

1.2 Treatment of axSpA

Treatment is divided into non-pharmacological- (physical activity and yoga) and pharmacological management (NSAIDs, conventional synthetic DMARDs, and biologic DMARDs) (24).

1.2.1 Pharmacological management

Compared to non-pharmacological management, pharmacological management is immediately effective. For axial presentations of axSpA, there are several treatment options accessible, and they may include one or more prescription pharmaceutical kinds. The first option is NSAIDs. Both cyclo-oxygenase-2 (COX-2) and traditional nonsteroidal anti-inflammatory drugs, in full dose, have demonstrated efficacy in reducing the symptoms of axSpA. However, several things must be considered, such as pregnancy, comorbidities, other medical conditions, medication pharmacokinetics, and possible adverse effects. The second option is biological disease-modifying antirheumatic drugs (bDMARDs). It consists of two classes: tumor necrosis factor inhibitors (TNFi) and interleukin-17 inhibitors (IL-17i). Treatment of bDMARDs is only indicated after four weeks of treatment with NSAIDs. When the treatment target is not achieved after at least four weeks of receiving two different types of NSAIDs, treatment of bMARDs can start. Additionally, patients must meet at least one of the following criteria: inflammation observed on radiographic evidence or MRI or elevated C-reactive protein (CRP levels). A more recent pharmacological treatment option is synthetic disease-modifying antirheumatic drugs (tsDMARDs).

1.2.2 Physical activity

Besides pharmacological treatment, physical activity is an important key point in the treatment of axSpA. This can be provided as exercises with guidance (physiotherapy or exercise groups) or without the guidance of a healthcare professional (home-based exercises). In general, physical activity helps to maintain axial flexibility and has been shown to improve physical function, pain, fatigue, and quality of life. Firstly, it costs less and has fewer side effects than pharmacological management (25). Secondly, high physical activity is associated with improved functional capacity, spinal mobility, and exercise capacity, while sedentary behavior is associated with a decrease in exercise capacity, and quality of life (26). Thirdly, IBP can be relieved with physical activity but be worsened by rest. Finally, inflexibility of the spine is related to reduced pulmonary function while physical activity improves pulmonary function (27). Regarding the importance of physical activity for patients with axSpA, the EULAR (European Alliance of Associations for Rheumatology) has set the following recommendations about physical exercise: flexibility-, resistance-, strength-, aerobe-, cardiorespiratory, and neuro-exercises. They recommend performing regular life-long exercise. However, no exercise program fits every patient (28). Providing different exercise programs increases the chance of finding an exercise program that works for patients. Meaning that it also could increase the adherence rates to physical activity.

Determinants for being physically active in the general population include self-efficacy, health status, motivation for exercise, and history of physical activity during adulthood (29). People who were highly motivated (driven by pleasure), also referred to as intrinsic motivation, benefited the most from activity and physical activity (30). This indicates that when patients think exercises contribute to their health and find them enjoyable, patients are more motivated to complete them. Therefore, there should be a focus on providing an exercise program to improve intrinsic motivation. Besides intrinsic motivation, extrinsic motivation also plays an important role in the motivation of performing exercises. When exercises are made more fun, the patient is more motivated to perform exercises (31).

Overall, patients can perform exercises with or without the guidance of a healthcare professional. Physical therapy provided by physiotherapists focuses on physical activity promotion, education, and exercise rehabilitation (1). The exercises are planned, structured, and with a treatment goal in mind, such as improving spinal flexibility (32,33). However, referring the patient to physical therapy or home-based exercises alone may not lead to improved exercise or function since overall adherence to exercise is too low. (34). Only 29% of the patients with axSpA are adherent to the advised physical activity (33). Additionally, the motivation for home-based exercises is also too low. As a systematic review found adherence to HBTs (home-based physical therapy programs) is also only 30% (3).

Low adherence rates were explained by disease-related barriers such as fatigue, pain, and stiffness (35). Disease-related barriers lower the motivation to be physically active, which results in non-adherence to exercise programs. Yet, a home-based exercise program (7 days a week for 12 weeks, n=43) along with typical pharmacological management, has found to be significantly reduce fatigue levels, compared to pharmacological management alone (36). This suggests that while patients see fatigue as a barrier to exercising, exercise does reduce fatigue (38, 39).

1.2.3 Yoga

Complementary medicine, like yoga, describes healthcare methods that were created outside the purview of traditional Western or conventional medicine and are applied in addition to it. Yoga can be used as therapy and was created to attain a good balance in the mental, emotional, physical, and spiritual domains (37).

A considered effective form of yoga therapy for AxSpa is Tai Chi. Tai Chi is originally a physical art form from China and involves calming and slow exercises that provide a physical challenge to the body and serve as a form of meditation for the mind. Tai Chi is often referred to as "meditation in motion" because it involves performing exercises with concentration (65). Research shows that Tai Chi reduces pain and improves back mobility. Additionally, an RCT by Lee et al. (38) confirmed a significant improvement in disease activity, flexibility, and depression compared to no treatment. Tai Chi can be a valuable exercise program for patients with axSpA as Tai Chi helps to reduce the disease activity of axSpA.

1.3 Virtual Reality

Recent years have seen significant advancements in technology. In addition, the COVID-19 pandemic of 2020 fundamentally altered healthcare. In the international REUMAVID study conducted by Garrido-Cumbrera et al. (39), 45 percent of the 1,707 patients with rheumatic musculoskeletal illnesses from 15 European countries who participated in the study reported a deterioration in their health during the pandemic. Of these, 45.7 percent had an axSpA diagnosis. The pandemic worsened the health of axSpA patients, but it also created a new digital service for the monitoring and treatment of patients with axSpA. Both healthcare professionals and patients quickly adapted to these changes, and new partnerships between researchers and healthcare practitioners emerged. This unique situation facilitated a digital service that relieved the pressure from healthcare providers. A study by Barnett et al. (39) suggests a combination of online and in-person physical therapy in the future. However, it is important to evaluate the feasibility of digital interventions before implementing them, to ensure their accessibility, acceptability, and efficacy, and specifically, how they compare in terms of effectiveness when compared to in-person rehabilitation.

Exercise therapy is more pleasurable, entertaining, and convenient for the patient when it incorporates physical training stimulation and recreates an environment that is stimulating. Virtual Reality (VR) provides a stimulating way of performing exercises and shows promising results as exercise therapy. Consequently, the technology could address the low adherence rates of performing physical exercise. There are also several advantages of VR reported by healthcare professionals. For example, improvements in motor functions and cognitive elements, improvements in balance, physical function, and an improved quality of life (40).

According to prior studies VR "relies on complete immersion into the computer-generated world through a head-mounted display" (41). Immersion is increased by incorporating muli-sensory (visual, auditory, and tactile) sensations into the simulation through the use of technology, such as a head-mounted display (HMD) (42). Many studies call therapy with some computer-generated material, virtual reality. But a study by Milgram et al. (43), provides more clarity about what is considered the reality/virtuality continuum; 'on one end is pure reality and at the other is VR, in which the 'real' environment is entirely replaced by a computer generated one'. The technology is available in a range of immersion levels, from minimal to complete immersion (53). Besides VR, there are other advancements in information technology creating new ways for users to experience reality. Three terms describe how these technologies create or alter reality: Extended Reality (XR), Mixed Reality (MR), and Augmented Reality (AR) (44).

1.3.1 Constructs of VR

Besides immersion, a review by Trost et al. (45), describes presence, interactivity, and embodiment as the user experiential factors of VR about pain, as shown in Figure 1.

The first experiential factor is immersion. The concept can be understood as a technological attribute of VR systems. This implies that different VR technologies can offer varying degrees of immersion, depending on a factor such as the number of sensors employed (46). Other researchers define immersion as a personal psychological experience that involves feeling drawn into and consumed by the virtual environment (47). Secondly, presence is described as 'the feeling of being or acting in a place, even when one is physically situated in another location' (48,49). Then, another experiential factor is virtual embodiment which refers to 'user's sensation of ownership over a virtual body when immersed in a virtual world'. And lastly, interactivity is described as 'the degree to which users of a medium can influence the form or content of the mediated environment' (50). This may be different for each person. For example, the expertise with VR, a particular influence on the shape or content of an environment may be regarded as more or less participatory (51).

The constraints related to user experience are interconnected and function as moderators of the VR experience as a whole. They also serve as mediators of the changes in emotional, cognitive, behavioral, social, and physiological outcomes that are the main targets of pain-related therapy. For example, to engage people in virtual games that encourage desired lumbar motion while distancing them from fear-related thoughts, it may be necessary to combine immersion, interactivity, and embodiment. This will help patients with back pain and a fear of movement enhancing their lumbar flexion as they are distracted from fear-related cognitions (45).

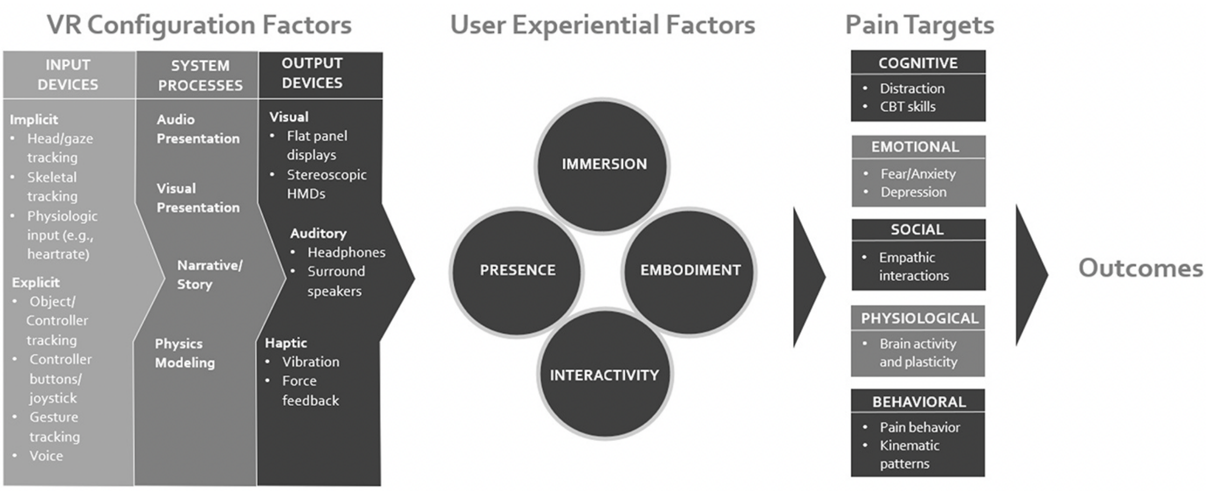

Figure 1: Heuristic model for virtual reality pain research

1.3.2 VR and chronic pain management

In recent years, more research has been conducted on VR about pain management. For instance, a systematic review by Goudman et al. (52) found that VR reduces both acute and chronic pain and improves physical functioning.

A study by Li et al. (53) describes two categories of pain in VR applications: experimental pain, and VR & neurobiology. Firstly, experimental pain refers to when various mechanical and thermal modalities have been used to administer experimental pain, such as a blood pressure cuff and cold pressure cuff. VR has generally been shown to be beneficial in lowering pain intensity, emotional distress, and unpleasantness of pain while also raising pain threshold and tolerance. Secondly, VR & neurobiology refer to VR reducing pain. Since it has been discovered that virtual reality reduces pain; this phenomenon is known as 'VR analgesia'. Pain reduction by VR is related to an increased reduction in brain activity in regions that are commonly activated by pain stimulation. Functional MRI (fMRI) findings demonstrate this decreased brain activity.

Moreover, it has been shown that other distracting cognitive tasks reduce the amount of activity in the classic pain circuitry during the activation of experimental pain. Despite the influence of distraction tasks on pain transmission, the neurobiological mechanisms underlying VR's effects remain somewhat mysterious. Thus far, research has linked cognitive analgesic effects apart from attentional diversion to cognitive task loading (54), expectancy (55), mood (56), and perceived controllability (57). Traditional cognitive tests often fall short in replicating the complexity of cognitive and emotional variables manipulable in a virtual environment. Consequently, the analgesic effect of VR could result from something more than these traditional mechanisms. For instance, it is commonly recognized that a virtual environment can induce a 'transported' presence independent of any concurrent cognitive tasks the user is engaged in. To understand the brain mechanisms behind VR analgesia, more complex experimental designs that can isolate the role of transferred presence are needed (53).

Next to the distraction mechanism, the level of presence in a virtual environment seems to influence pain. Since a high level of presence is related to a higher pain tolerance (58). Brown et al. (58) tolerated a painful stimulus on average fifteen percent longer in the active intervention versus the control intervention. Two frequently employed methods regarding chronic pain management are virtual embodiment and fear avoidance (45). More information about each will be provided, along with how it relates to the WN program.

Virtual embodiment

Trost et al.'s study (45) notes that while the distraction mechanism of VR is employed in treating acute pain, most studies on chronic pain do not prioritize distraction as a primary target. Virtual embodiment capabilities are the leading treatment goal in more than half of the current chronic pain studies. Through its immersive nature, VR's virtual embodiment capability can affect user's impressions of their bodies, even though they are 'embodied' in the virtual body (41,45). Due to the multi-sensory stimulation that incorporates a 'reality' in which a healthy simulation replaces the painful body, deflecting attention away from processing pain. A higher level of immersion enables the VR system to distract more successfully (76). The effects of virtual embodiment are seen in CRPS (complex regional pain syndrome) and PNI (peripheral nerve injury). Studies have shown that perceiving a virtual body can develop a feeling of identification with an avatar. Even though the virtual body is not comparable to a human body. This identification is referred to as 'body transfer'. Homuncular flexibility indicates that users can learn to manipulate bodies other than their own. When movements of the real world are remapped in movements in the virtual body, and when, for example, leg motions are more appropriate for the task, participants move their legs more than their arms (59).

Besides Trost et al. (45), a review by Ahmadpour et al. (60) describes current trends in underlying mechanisms for managing acute and chronic pain through VR applications. This review implies that besides the distraction mechanism, focus shifting, and skill-building are in nine studies (published 2013-2017) important VR mechanisms in the treatment of chronic pain. Distraction and the feeling of presence are important characteristics of the VE, focus shifting is referred to as user interaction, establishing cognitive priorities, and directing player attention from one virtual object to another. For example, distraction and focus-shifting therapy were used for a range of conditions, including lumbar spine pain and hip pain (61). Considering focus shifting, it is comparable with a virtual embodiment, described in the review by Trost et al (45), as the player focuses on a virtual object instead of his or her own body.

Finally, skill-building can assist patients in developing the abilities needed to control their reaction to painful stimuli and act as agents in their care. For example, the training of relaxation in VR was defined as a skill-building exercise by Botella et al. (62)

Fear-avoidance

Next to virtual embodiment, fear avoidance is also a common approach of VR therapy for patients with chronic pain (45). The interactive features of VR can lower the fear of performing exercise. Concerning axSpA patients, CLBP patients may experience compensatory alterations in their spinal musculature, which raises the chance of chronicity (63). This can lead to greater anxiety and fear of painful movements. Virtual graded exposure therapy (VR-GET) is a cognitive-behavioral intervention that can address the avoidance of physical activity. It includes encouragement and positive reinforcement to participate in activities despite their pain. Behavioral and psychological elements may be beneficial for people with chronic pain (64). Distraction is one of the reported benefits that VR-GET offers, which shifts cognitive attention away from pain and toward the simulation (65). For example, Jones et al. (66) evaluated a diverse population of people with chronic pain (including CLBP). In a 5-minute, partially immersive VR session provided to 30 participants, allowing head direction changes without body movement and controlled interaction by pressing a button, a 60% decrease in numerical pain scores was observed during the intervention. Additionally, 30% of the patients reported complete disappearance of pain while experiencing virtual reality (76).

1.4 Walk in Nature program

According to research, enjoyment can emerge as a pleasant emotion and is crucial for encouraging physical activity (67). Since it is a frequently mentioned justification for exercising, enjoyment of exercise has been proven to have a substantial relationship to exercise participation (68). For instance, the happy feelings brought on by using VR as exercise therapy could heighten the benefits of exercise, encouraging more activity (69). To boost user engagement, there has been an increasing interest in applying gaming principles to non-game environments. The concept of 'gamification' aims to add features to games or activities that are thought to be difficult, boring, or monotonous to make them more entertaining. Gamification could increase the extrinsic motivation to exercise as it is anticipated that people are more encouraged to participate when they find the activity more enjoyable (31).

At the University of Twente (UT), a restorative virtual environment (VE) was created, called the Walk in Nature program (WN program) using a head-mounted display (HMD). Bareišytė (70) originally developed the program to improve subjective vitality among international students at the University of Twente. The WN program consists of physical and psychological stimulations translated into three exercises: 'breathing tree', 'butterfly task', and 'social yoga'.

1.4.1 The Forest Nature Environment

Figure 2 shows the first VE of the WN program. All figures from the VE are from a study by Korporaal (71). The WN program's exercises are all executed in a forest nature environment. The participant will be transferred to this forest using an HMD and be hearing ambient natural noises, such as bird sounds. It is an open area of a forest where the user can explore to get accustomed to the VE by moving around and using the controllers. The fact that the participant is hearing natural noises and can walk around in a forest, is increasing the level of presence.

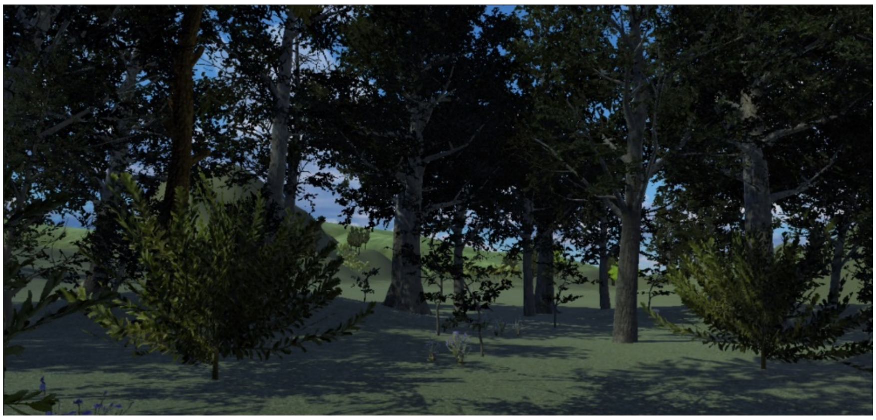

Figure 2: The forest nature environment

1.4.2 Breathing tree exercise

The first exercise is the breathing tree, as shown in Figure 3. Where the patient is instructed to perform a psychological well-being task: a breathing exercise. The patient performs this exercise in a nature VE where a tree is animated to move automatically to a bigger and smaller size. The duration of becoming bigger and smaller can be modified to a longer or shorter period. The patient is instructed to perform a breathing exercise of inhaling for 5 seconds, then hold their breath for 5 seconds, and exhale for 5 seconds. After each cycle, the color of the leaf's changes slightly more from grey to light green. A seating position is recommended for a breathing exercise since this is a more relaxing position. The sitting position would allow patients to unwind and concentrate just on their breathing. However, only the headset and controllers have sensors, which means that only hand movements are seen in the VE. Additionally, VR interferes with one's sense of depth, causing one to overestimate their distance to an object (72). To avoid injuries, it is recommended to perform the exercises while standing. Breathing techniques have been proven to reduce symptoms of axSpA and are part of the recommendations for non-pharmacological management (73). As it helps to improve the posture and improves pulmonary function (27) Secondly, the participant can focus on the tree getting bigger and smaller, transferring to virtual embodiment or body transfer. Body transfer can manipulate the participant's body as they are performing breathing exercises. The participant may be able to breathe in deeper than usual.

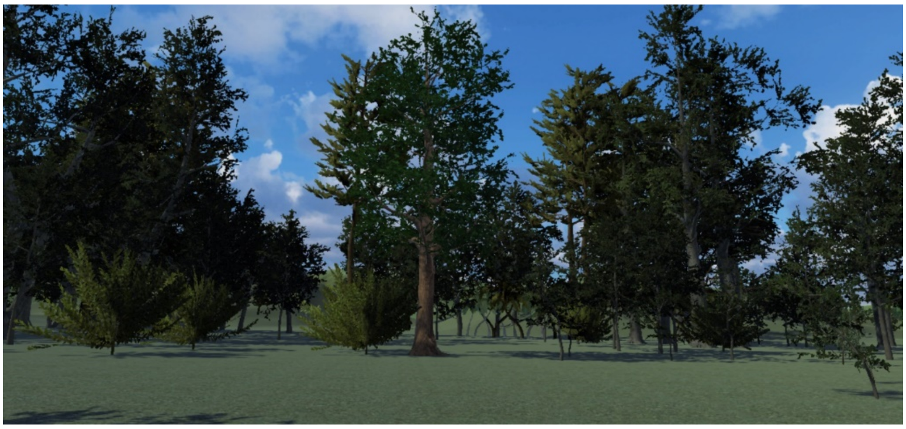

Figure 3: Breathing exercise

1.4.3 Butterfly exercise

The second exercise is a physical well-being task: the butterfly exercise. Patients are encouraged to examine nature, find various sizes and colors of butterflies, and cause them to fly away, as shown in Figure 4. The location of the butterflies must be determined, so a tunnel was constructed using green garden arches. To ensure that participants would not run into a wall while moving around, the tunnel was made just slightly smaller than the room where the research was conducted. After the butterflies were touched, they were animated to fly out of the tunnel. Using the controller to touch a butterfly involved placing it there and then pressing a button to cause it to fly away, as shown in Figure 5. To locate and touch each butterfly that was dispersed across the room and at various heights of the arch, participants had to physically move across the space. The butterfly exercise is an interactive physical exercise, where the patient needs to stretch to catch the butterflies. This could help to improve the mobility and function of the spine (2). Secondly, the interactivity motivates participants to engage in the exercise. This could address fear avoidance, as the exercise's distraction mechanism redirects attention away from pain or other symptoms (45).

Figure 4: The butterfly task

Figure 5: Grabbing the butterflies

1.4.4 Yoga exercise

The final activity is an updated version of the yoga by Bareišytė (74), called social yoga, which entails holding a small yoga class outdoors. The updated yoga version was created by Korporaal (71) in a study about the effect of added exercises to VR nature on feelings of subjective vitality, energy, tension, and stress in students. Social yoga is a physical and psychological exercise, where a yoga instructor is placed in front of the patient. Additionally, there are two other instructors, standing on both sides of the patient, as shown in Figure 7. The exercise was originally designed to boost subjective vitality and lower stress since it includes features that improve both physical and psychological well-being. Besides, a breathing exercise has been introduced to enhance psychological well-being. With a precise breathing pace of five seconds in and out, the breathing bubble combines these both visually and audio, as shown in Figure 6. Yoga reduces disease activity, potentially increasing physical activity, as high disease activity is related to sedentary behavior (38). Additionally, the virtual embodiment characteristics of this exercise enhance participants' flexibility beyond their usual level, as they concentrate on performing the yoga poses demonstrated by the virtual instructor.

Figure 6: The virtual yoga instructor with breathing bubble

Figure 7: The virtual yoga instructor with one of the two co-participants

The VE could address the low adherence rates of physical activity, by increasing the intrinsic and extrinsic motivational aspects of patients. First, to improve intrinsic motivation, VR guides patients through home-based exercises, which can be more stimulating than prescribed exercises. This is explained by the immersive features of the VE (75). Additionally, patients with axSpA experience disease-related symptoms, such as chronic pain, stiffness, and fatigue, as a barrier to performing exercises (35). VR's capability to manage pain could address barriers to performing exercises. Virtual embodiment and fear avoidance could help the patient focus more intently on executing the exercises and less on axSpA symptoms (45). Secondly, gamification increases extrinsic motivation, since gamification influences behavior in terms of an increase in exercise activity, as well as attitudes toward and enjoyment of exercise (31).

1.5 Feasibility

There is a need to test how interventions align with real-world settings and their suitability within them. Feasibility studies are based on 'providing a series of findings that help determine whether an intervention should be recommended for an effectiveness study' (76).

The WN program is still a prototype, and its effectiveness is only tested on students. However, it showed promising results in increasing subjective vitality (74). Testing the feasibility of VR and the WN program is recommended because this is the first time VR and the WN program will be tested as exercise therapy for patients with axSpA. A preliminary investigation into the feasibility of VR and the WN program as exercise therapy for patients with axSpA helps determine whether and where the intervention can be further tested or developed. Therefore, a feasibility study identifies the intention to use VR and if the WN program needs modifications to work as exercise therapy. Particularly, this study tests the feasibility of a home and physiotherapy setting, to examine where it is appropriate to further test the technology as exercise therapy to develop VR as exercise therapy.

1.5.1 Multi-discipline

It is essential to involve all relevant disciplines in testing the feasibility to ensure the study reflects a real-world setting (76). Included disciplines are patients with axSpA, physiotherapists with experience in treating axSpA, physiotherapists with experience in VR, and rheumatologists.

Patients, physiotherapists experienced in treating axSpA, and rheumatologists are included as they are involved in establishing and implementing a treatment plan for patients with axSpA. Physiotherapists experienced in VR are included because VR isn't currently used as a treatment in everyday practice. Although it is a new technology, most physiotherapists have not yet been exposed to it, due to several challenges in implementing the technology, such as the high costs and finding appropriate games (40). This means that not many physiotherapists are familiar with VR as a treatment. Roger's diffusion of innovations hypothesis (77) states that it is crucial to involve those who have successfully implemented the innovation to provide believable assurances that any attempt at change will not end in embarrassment, embarrassment, financial loss, or lost time. Individuals possessing expertise in virtual reality are the innovators in question. The perspective of physiotherapists with experience in VR will help to assess if and how the technology itself is feasible as exercise therapy for patients with axSpA. This means the disciplines are divided into two groups: the patients with axSpA and the healthcare professionals.

1.5.2 Concepts of Feasibility

Bowen et al. (76) describe eight areas of focus for feasibility studies, these are acceptability, demand, implementation, practicality, adaptation, integration, expansion, and limited-efficacy testing. Table 1, as shown below, shows the eight topics for feasibility studies and potential results of these areas.

Area of focus	The feasibility study asks . . .	Sample outcomes of interest
Acceptability	To what extent is a new idea, program, process or measure judged as suitable, satisfying, or attractive to program deliverers? To program recipients?	● Satisfaction ● Intent to continue use ● Perceived appropriateness ● Fit within organizational culture ● Perceived positive or negative effects on organization
Demand	To what extent is a new idea, program, process, or measure likely to be used (i.e., how much demand is likely to exist?)	● Actual use ● Expressed interest or intention to use ● Perceived demand
Implementation	To what extent can a new idea, program, process, or measure be successfully delivered to intended participants in some defined, but not fully controlled, context?	● Degree of execution ● Success or failure of execution ● Amount, type of resources needed to implement ● Factors affecting implementation ease or difficulty ● Efficiency, speed, or quality of implementation
Practicality	To what extent can an idea, program, process, or measure be carried out with intended participants using existing means, resources, and circumstances and without outside intervention?	● Positive/negative effects on target participants ● Ability of participants to carry out intervention activities ● Cost analysis
Adaptation	To what extent does an existing idea, program, process, or measure perform when changes are made for a new format or with a different population?	● Degree to which similar outcomes are obtained in new format ● Process outcomes comparison between intervention use in two populations
Integration	To what extent can a new idea, program, process, or measure be integrated within an existing system?	● Perceived fit with infrastructure ● Perceived sustainability ● Costs to organization and policy bodies
Expansion	To what extent can a previously tested program, process, approach, or system be expanded to provide a new program or service?	● Fit with organizational goals and culture ● Positive or negative effects on organization ● Disruption due to expansion component
Limited efficacy	Does the a new idea, program, process, or measure show promise of being successful with the intended population, even in a highly controlled setting?	● Intended effects of program or process on key intermediate variables ● Effect-size estimation ● Maintenance of changes from initial change

Table 1: Key areas of focus for feasibility studies and possible outcomes

Outcomes of interest

Each area involves different outcomes. Acceptability and demand, the first in the table, are also the primary areas in this study. This is attributed to the study being the initial experience of the virtual environment for patients with axSpA and the disciplines involved in the treatment of axSpA.

The outcomes of interest for acceptability are satisfaction, intention to continue use, perceived appropriateness, fit within organizational culture, and perceived positive or negative effects on an organization. In this study, we focus on satisfaction, perceived appropriateness, and perceived positive or negative effects. Satisfaction is measured by the user experience (78), perceived appropriateness is measured by presence (79), and perceived positive or negative effects are measured by motion sickness and VAS pain score (80,81)

Additionally, the outcomes of interest for demand are actual use, expressed interest or intention to use, and perceived demand. This study analyzes the perceived demand and intention to use. Answers related to the suitability of the exercises measure the perceived demand of the technology. Secondly, answers related to the UTUAT-model by Venkatesh (82) measure the expressed intention to use.

Measuring the outcomes of interests

This research is conducted using mixed methods. Both groups quantitively measure the acceptability of the technology and the WN program by the level of motion sickness, presence, and expressed user experience of a home and physiotherapy setting. Additionally, the perceived level of disease activity before and after using the VE is gathered by patients only.

Secondly, in both groups, there are questions about how the exercises can be made more suitable as exercise therapy, assessing the perceived demand of the Walk in Nature program. In addition, the expressed intention to use technology is qualitatively measured in an interview based on the UTUAT model. An important difference between these two subjects is that questions about the suitability of the exercises are related to the WN program and questions about the intention to use technology are related to the technology.

1.5.3 Research questions

Patients and healthcare professionals (physiotherapists and rheumatologists) evaluate the technology from their perspectives. Therefore, different research questions are formulated for both groups.

For the patient, the first and second research questions are:

1. To what extent is Virtual Reality acceptable as exercise therapy for axial spondyloarthritis in a home and physiotherapy setting?
2. What is the anticipated demand for Virtual Reality as exercise therapy for axial spondyloarthritis in a home and physiotherapy setting?

For the healthcare professional, the first and second research questions are:

1. To what extent is Virtual Reality acceptable as exercise treatment for axial spondyloarthritis in a home and physiotherapy setting?
2. What is the anticipated demand for Virtual Reality as exercise treatment for axial spondyloarthritis in a home and physiotherapy setting?

2. Methods

2.1 Study design

Ethical considerations are examined in this research, which is why transcripts about these matters are not included in the Appendices. Questions related to this action can be answered by the faculty of Health and Technology of the University of Twente. Beforehand, a non-WMO (‘Wet medisch-wetenschappelijk onderzoek’) declaration was necessary. Therefore, the Board of Directors from MST and the ethical committee from the University of Twente (UT) submitted and approved the study protocol. The corresponding study protocol and patient information form (PIF) of MST can be found in Appendix 2. The ethical approval of the UT can be found in Appendix 3.

2.1.1 Study population

A prospective, observational study is performed monocenter in Medisch Spectrum Twente (MST). This study focuses on the patients and the healthcare professionals separately. As the patients asses the WN program from their perspective and the healthcare professionals from a treatment perspective. This includes that both groups have different research questions and a different research process. This means that there are two groups, and they will be discussed individually throughout this research report.

Table 2: Included disciplines

Patients	**Healthcare professionals**
8 patients with axSpA	3 physiotherapists with experience in VR
	3 physiotherapists with experience in axSpA
	3 rheumatologists

The group of patients includes patients with axSpA, as shown in the table above. Healthcare professionals include physiotherapists and rheumatologists. Physiotherapists are divided into two specialties: physiotherapists with experience using VR as a form of treatment and physiotherapists with experience treating axSpA. The expectation is that physiotherapists with experience in VR evaluate the feasibility from a technological perspective, as they have experience with implementing such technologies as part of a therapy. This positions them to assess the facilitators and barriers to integrating VR into a home and physiotherapy setting. In addition, physiotherapists experienced in treating axSpA evaluate the program from a physiotherapy perspective, based on their knowledge of providing exercises and guidance to axSpA patients. This allows them to assess the suitability of VR for patients and how well the program's exercises align with the target group. Additionally, rheumatologists assess the feasibility as part of a treatment plan. Meaning that they assess the potential of VR and the program as exercise therapy.

2.1.2 Inclusion criteria

For both groups (patients and healthcare professionals), an affinity with technology is determined. According to M. Rogers (77) innovations are adopted by innovators, ‘a group of people interested in new gadgets and are the first to acquire them.’ However, participants without any affinity with technology are not excluded from investigating the hypothesis by M. Rogers.

Patients

Patients were chosen by rheumatologists based on their anticipated interest in participating in the research. Patients were provided with a Patient Information Form (PIF). The informed consent forms were signed during the patient's visit to the UT for study participation. After a minimum of seven days, they were contacted by phone to express their interest in participating in the study.

Different patient characteristics are included to reflect a real-world setting. Therefore, variabilities in patient characteristics were defined. Although, there is a slightly higher prevalence of axSpA among men compared to women this study included an equal distribution of male and female patients (8). It is important to involve both male and female patients because they could evaluate the feasibility of the Walk in Nature program differently.

Besides, it is anticipated that patients with a higher disease activity evaluate the WN program differently than patients with a low disease activity because disease symptoms are related to low adherence rates (35). To include a variety of disease activity, the BASDAI monitor tool was used (8).

Healthcare professionals

The healthcare professionals included different expertise to reflect a better understanding of the feasibility of VR (76). Initially, three physiotherapists with prior VR experience were included to identify potential implementation challenges in using VR for exercise therapy. Subsequently, three physiotherapists experienced in treating axSpA were added to assess the program's suitability. Their experience helps to determine the value of the exercises in the WN program and how these exercises can be improved (2). Finally, three rheumatologists were included to evaluate the additional value of VR in a treatment plan.

Physiotherapists were contacted by phone to discuss the study. They also received the informed consent form by e-mail, which was signed before the study at the UT. Additionally, rheumatologists were approached face to face. Before participation, the work experience is defined, by the levels junior 0-2 years, medior 2-5 years, and senior 5> years.

2.1.3 Exclusion criteria

Exclusion criteria that are considered for both groups are having any of these conditions: dizziness, limited cognition, psychiatric history, balance disorders, and claustrophobia. These conditions can be worsened by the VR experience.

2.2. Pilot

The WN program was only tested on international students. This means that the program was in the English language. Since all participants are Dutch, it is anticipated that not all would have a strong understanding of the English language. That is why the WN program has been translated into the Dutch language. This included the written instructions before starting every exercise and all the audio with instructions to perform exercises. The program is translated because doing so will enable each participant to evaluate its feasibility.

To modify the WN program, a computer has been reserved at the UT via the BMS lab. Each audio fragment has been translated using the microphone of a laptop. With the help of the software Audacity, the length and loudness of the old audio fragment could be analyzed was crucial to ensure that the new audio fragment was as long as the old one to maintain synchronization with the visual experiences in the VR.

After the translation, a pilot was conducted to assess the Dutch translation. The pilot was conducted on the 14th and 15th of August 2023. Two participants were included, one participant is a nurse and student of the Master Psychology at the university, and the other one was selected out of a social network. Given that the Master's student is a nurse, she was able to put herself in the shoes of a healthcare professional. That is why the Master's student assessed the WN program from a healthcare professional perspective and the other participant from the patient's perspective.

There were no major changes made after the pilot. One of the modifications is that the directions for one yoga pose were incorrect. The virtual yoga instructor demonstrated moving the left foot forward as the voice lesson described moving the right foot forward. Additionally, the written instructions that were provided before each exercise were rewritten to a more clearly understandable instruction. Lastly, to make the instructions flow more naturally into one another, some audio segments were recorded a little faster after another. However, during the pilot, the tree of the breathing exercise didn't become bigger or shrunk. Unfortunately, it was not possible to improve the breathing tree. This acquired hours of software development, and this was not possible within this project.

2.3 Procedure

After completing the pilot, both groups carried out their research process, as shown in Figure 8. The data were collected between the 28th of August 2023 and the 2nd of October 2023 in the ManouVR room at the UT in the Cubicus building. Figure 8 demonstrates the enrolment, research activities, and measuring instruments of both groups. Prior study activities will be discussed first, followed by a description of the global procedure for both groups. Finally, the research methodology for each group will be explained in more detail.

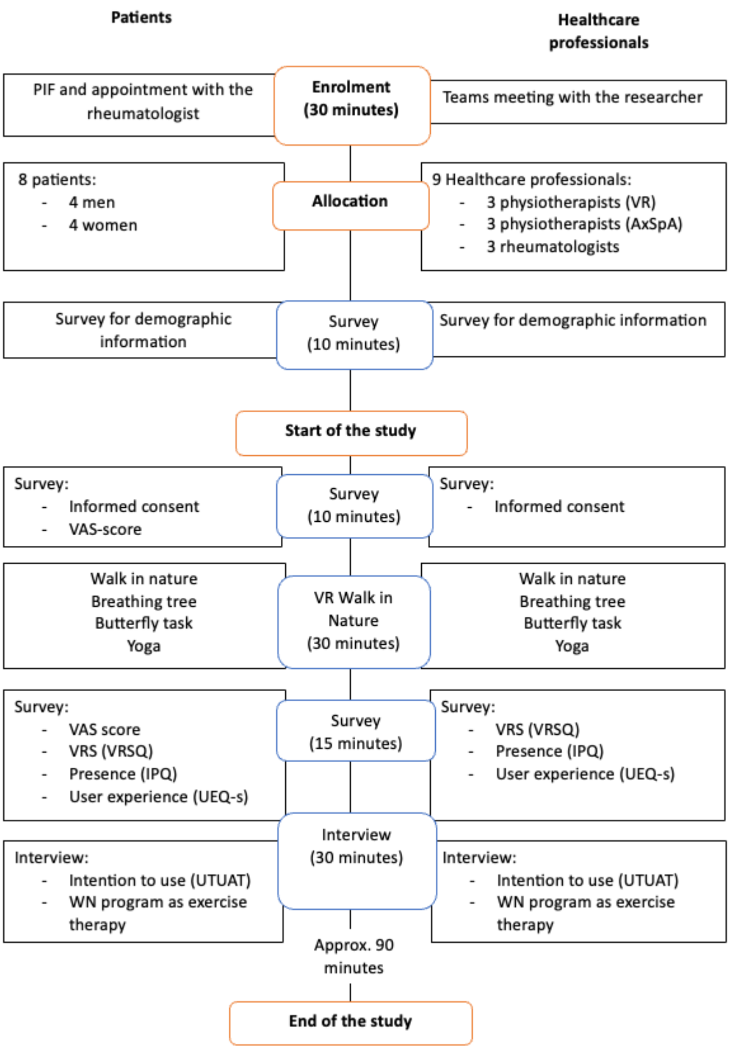

Figure 8: Study design

The research procedure involved seventeen participants. Unfortunately, one patient (participant 5) did not complete all the exercises as she stopped at the beginning of the yoga exercise. The patient was suffering from pain in her knees, making her unable to stand for any longer. That is why the researcher stopped the yoga exercise for this patient. Eventually, all participants, even participant 5, completed the questionnaire and interview.

Firstly, the researcher scheduled a meeting for a one-time use of the VR glasses or head-mounted display (HMD) with each participant. Each participant received an e-mail with information about the appointment and a link to a sociodemographic questionnaire with a research number so the data could be anonymized. The e-mail can be found in Appendix 2. c. Before meeting with a participant, the researcher prepared the ManouVR room by starting the VR equipment and the WN program. At the visit, each participant had to sign the informed consent form before the data collection could begin. Afterward, a declaration form for travel expenses was given to each participant. This declaration form can be found in Appendix 2.d. Before the participant began using VR, the researcher explained once more the procedure of the data collection and instructed the participant how to use the HMD. Also, the various buttons of the controllers were explained.

Due to the Oculus Rift S being connected to the computer with a cable, there was a risk of participants tripping over the cable. Besides, the participant needed to walk and perform physically demanding exercises. The participant could get unbalanced while they performed exercises in the VE. During the exercises, the researcher monitored and controlled the exercises from the game computer while observing participants performing the exercises safely.

The participants could start with the WN program when the researcher asked them to close their eyes. This was questioned in between each exercise because switching to another VE could cause flickering images. Then the participant was immediately taken to the forest nature environment, where the participant walked around in this forest environment, to get comfortable in the virtual environment. The first exercise was the breathing tree exercise. The participant was led through the task through verbal instructions. The tree served as a metaphor for the participant’s lungs; it was supposed to grow larger upon breathing and shrink upon exhaling. The voice tells breathe in time with the movements of the trees. Unfortunately, the tree did not become larger or smaller, but each participant was able to follow the verbal instructions.

After completing this breathing exercise, the participant performed the butterfly task, where the participant reached for butterflies causing them to fly away. The participant walked around to catch the butterflies. Some participants were not able to catch all the butterflies.

The last exercise was the social yoga exercise. As mentioned before, one patient was not able to complete the yoga task but got an idea of the exercise.

After completing all the exercises, the participant was instructed to remove the controllers and headset and return them to the researcher. The researcher instructed the participant to fill in a questionnaire. The questionnaire was completed on the laptop of the researcher in the ManouVR room. To avoid influencing the survey participant’s responses, the researcher left the room. After finishing the questionnaire, an interview with each participant was conducted.

2.4 Materials

2.4.1 VR

This research was conducted at the UT because the set-up can currently not be moved to another location. This is because the HMD is connected to a game computer as the WN program is too heavy to transfer to an HMD alone. Also, the WN program depends on its boundaries' settings, to walk around in the VE. This means that a space of at least 2 by 3 meters must be available. The BMS Lab has equipped the ManouVR room with all the tools required to operate the WN program. For this research, the software program Unity was used to run the WN program. Additionally, the computer connects to the Oculus Rift S and has the software required to operate the HMD. Before the start of the data collection, the ManouVR room was reserved via the website of the BMS lab. The figure below demonstrates the Oculus Rift S with a game computer to collect the data.

Figure 9: Oculus Rift S glasses and monitor utilizing the WN program

2.4.2 ManouVR room

The ManouVR room is a room provided by the BMS lab at the UT. BMS facilitates software and hardware for researchers. Figure 10 demonstrates the ManouVR room. It also demonstrates an idea of how much space was necessary to run the WN program. The second Figure demonstrates a participant using VR to perform the yoga exercise. The participant granted consent for the use of this picture for research purposes.

Figure 10: ManouVR room

Figure 11: Patient using VR

2.4.3 Questionnaires

Appendices 1. c and 1.d contain the Dutch translations of the questionnaires completed by the two groups.

Socio-demographic

The socio-demographic characteristics were based on variables that were considered to have an impact on the study's findings. The characteristics will be explained for each group and can be found in Appendix 1. a and 1. b. For patients, the socio-demographic information gathered before participating in the study were age, gender, nationality, level of education, year of axSpA diagnosis, prevalence of other diseases, use of medication, earlier VR experience, affinity with technology, and BASDAI score.

Age is quantified in years and gender is divided into male or female. Nationality was an open question where the patient could choose their nationality. Level of education was categorized into primary education, VMBO, HAVO, VWO, Bachelor (HBO/WO), Master (HBO/WO), or Doctor/PhD. Patients could fill in their year of diagnosis and if they have other diseases (yes or no). The question to define medication use is a multiple-choice question. Available options were paracetamol, NSAIDs, or biologicals. The BASDAI score is used to classify the disease activity of each patient and is determined by using the BASDAI questionnaire (83). The questionnaire consists of six questions related to the most important symptoms of axSpA (fatigue, swollen or painful joints, general pain, and stiffness). Moreover, previous experience with VR is categorized as 'yes' for those with experience and 'no' for those without. And lastly, affinity with technology is categorized as ‘yes’ and ‘no’. Answering ‘yes’ means that the patient has an affinity with technology and ‘no’ means the patient does not. Earlier experiences with VR of each healthcare professional are questioned during the interview. It is expected that earlier positive experiences with VR could influence the intention to use technology (77).

For the healthcare professionals, the socio-demographic information gathered were age, gender, nationality, level of education, function, work experience length, earlier experience with VR, and affinity with technology. All variables were categorized in the same way as for the patients, except for two different variables ‘function’ and ‘work experience length’. Function defines the expertise of the healthcare professional and work experience length is categorized as junior 0-2 years, medior 2-5 years, or senior ≥5 years.

Patients

Outcomes measuring the acceptability for patients are perceived positive or negative effects (VAS, and VRSQ), perceived appropriateness (UEQ-s), and satisfaction (IPQ). The VAS pain score, VRSQ, IPQ, and UEQ-s are the outcomes included in the questionnaire for patients. The VAS pain score is the only measurement tool that distinguishes the two groups as VR could increase patient disease activity. The researcher asked about the VAS pain score before and after using VR. The patient was instructed to give the same VAS pain score when the pain did not elevate after using VR. The score before using VR also indicates if the patient needs guidance from the researcher in fulfilling the research process. Disease symptoms, for example, stiffness and low back pain can make it more difficult to perform exercises.

Healthcare professionals

Outcomes measuring the acceptability for healthcare professionals are perceived positive or negative effects (VRSQ), perceived appropriateness (UEQ-s), and satisfaction (IPQ).

VRSQ

There are multiple questionnaires available to monitor motion sickness. The VRSQ questionnaire is a simple and effective tool to monitor motion sickness (80). The VRSQ questionnaire is divided into general symptoms containing eight questions about general symptoms, and eye symptoms containing six questions about eye symptoms (84). As this questionnaire aims to monitor any discomfort of using VR, this questionnaire is modified to two questions which can be answered by ‘none’, ‘slightly’, ‘moderate’, or ‘severe’: one question about general symptoms and one question about eye symptoms.

VAS pain-score

Secondly, the patient was asked to describe the disease activity before and after using VR. A Visual Analogue Scale (VAS) is a measurement tool that tries to measure pain related to the disease activity of axSpA after using VR (81). The VAS score was scored on a Likert scale from 0 to 10. Where 0 means that the patient is not feeling any pain, and 10 means a lot of pain. As pain cannot easily be directly measured and is a nonspecific measurement. The patient is using the same score as before using VR when the disease activity has not changed after using VR.

IPQ

The IPQ questionnaire has been used to measure the presence experienced during the use of VR. There are different tools available to measure the level of presence when participating in a VE. The IPQ is a reliable tool to measure the level of presence (85). The IPQ questionnaire is available in different languages, for this study, the Dutch version is used (86). There are 14 questions, these can be answered by a 7-point Likert scale. The IPQ values have a range from 0 to 6. Where 0 means ‘not agree’ and 6 means ‘agree’.

UEQ-s

Lastly, the level of satisfaction while experiencing VR is related to the user experience in a home and physiotherapy setting. The User Experience Questionnaire (UEQ) is a popular survey tool for measuring consumer satisfaction on the subjective value of items. The UEQ-s is a short version of the UEQ which allows basic measurement of higher-level meta-dimensions (78). The questionnaire consists of a pair of 8 items which can be answered by a 7-point Likert scale. The answers are scaled from -3 (fully agree with the negative term) to +3 (fully agree with the positive term).

2.4.4 Interview Scheme

The Dutch version of the semi-structured interview scheme consisted of 32 open- and closed-ended questions (Appendix 1. a). The UTUAT model by Venkatesh (82), as shown in Figure 12, was used as a framework for the interview scheme. Where patients answered the questions from a patient perspective, healthcare professionals answered questions from a treatment perspective. This means that for each group, the same interview scheme was used. However, questions are formulated from a different perspective. Secondly, the outcome related to the qualitative study is demand which is measured by the expressed intention to use (interview questions related to the UTUAT model) and perceived demand (questions related to the suitability of the exercises). Thirdly, questions are formulated in a home and a physiotherapy setting. And lastly, the use of open-ended questions encouraged participants to come up with examples.

UTUAT-model

The first concept of the UTUAT-model is performance expectancy. This describes the extent to which a person thinks that making use of the system will enable him or her to improve job performance. It is the most reliable indicator of the intention to use technology. The second construct is effort expectancy, describing the level of ease involved in using the system. The third one, social influence, is the degree to which a person believes that significant others think they should use the new method. Facilitating conditions is the fourth construct. It describes the degree to which a person feels that an organizational and technological infrastructure exists to facilitate the use of the system. The first three constructs connect to behavioral intentions, meaning that these constructs influence the intention to use technology. Subsequently, the intention to use is positively impacted by facilitating conditions. Additionally, a user’s attitude refers to how they feel – whether positively or negatively – about the intention to use. The attitude to use technology is not included in the original UTUAT. However, a meta-analysis of 21 empirical studies has demonstrated that attitude has a significant effect on behavioral intentions and use behavior (87). The study also showed that, when attitude was present as a construct, the most powerful predictor of use behavior was found to be facilitating conditions. Additionally, attitude is the last concept, describing a user's positive or negative feelings about displaying the intended behavior. As a result, the model suggests that usage behavior is directly and significantly influenced by facilitating conditions. The strength of predictors on intention is defined by the moderating effects of age, gender, experience, and voluntariness of use. All constructs, except for attitude, are influenced by age. Besides, relationships between effort expectancy, performance expectancy, and social influence are influenced by gender. The intensity of the linkages between facilitating conditions, social influence, and effort expectancy is influenced by experience. Only the relationship between social influence and behavioral intention is influenced by voluntary use (82).

Attitude is an addition to the UTUAT model. Since the original UTUAT does not include attitude as one of the variables influencing users' intentions. Yet, a meta-analysis by Or (87) with 21 empirical studies has shown that attitude has a significant effect on both behavioral intention and use behavior. The study also revealed that facilitating conditions emerged as the strongest predictor of use behavior in the presence of attitude as a construct. However, the study did not address how a person's attitude influences their intention to use technology.

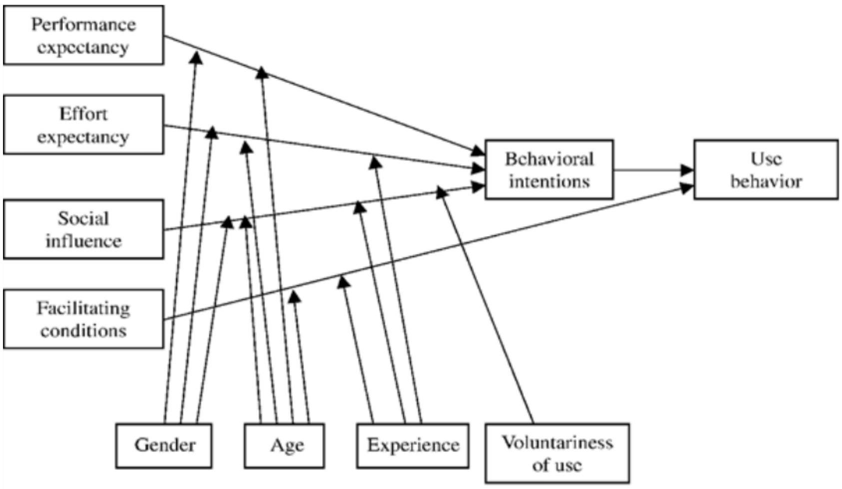

Figure 12: UTUAT-model

2.5 Data analysis

2.5.1 Quantitative analysis: acceptability

Firstly, the sample characteristics are presented in Table 3, the quantitative data of patients are shown in Table 4, and the quantitative data of healthcare professionals are shown in Table 5.

Secondly, the mean and standard deviation of all quantitative data were determined using IBM SPSS (version 28.0.1.0, Chicago, USA). The first step to calculate the BASDAI score was to add the average of questions 5 and 6 to the total of questions 1 through 4 (of the BASDAI questionnaire). The final BASDAI score, which ranges from 0 to 10, is obtained by dividing the total score by 5. The VRSQ is divided into two categories 'none', 'slightly', 'moderate', or 'severe'.

The VRSQ questionnaire consists of two questions, one about general symptoms and one about eye symptoms. These are categorized as 'none,' 'slightly,' 'moderate,' or 'severe.'

The NPRS (VAS-pain) scores of each patient before and after using VR are shown in Table 3. Questions of the IPQ are categorized by the items' names: SP= spatial presence, INV= involvement, or REAL= experienced realism. The outcomes were calculated by reversing questions SP2, INV3, and REAL1. Then the mean values of SP, INV, and REAL were computed ranging from 0 to 8. The last step of calculating the IPQ was to take, of each participant, the mean and standard deviation of all three categories.

Data of the UEQ-s outcomes were automatically calculated using a provided data analysis tool in Excel. This has been done for the UEQ-s score of a home and a physiotherapy setting separately. The first step was to transform the collected data from -3 to 3, into 1 to 7. The ‘Data’ tab was used to calculate the data. The last step was to collect the results under the tab ‘DT’ which refers to the transformed data. Here, the overall mean values of each participant could be found.

2.5.2 Qualitative analysis: demand

The software program Amberscript helped to transcribe all recorded interviews into text, but the researcher manually adjusted the files. After transcribing all interviews, the transcripts were coded in ATLAS. ti (version 23.3.0, Berlin, Germany) using a mixed coding method of inductive and deductive thematic analysis (88). This approach includes six stages that are beneficial for health and well-being research and is used to describe the demand for VR (89). This method is comparable to the one described by Fereday et al. (90).

The first step of thematic analysis was to get familiarized with the data, the second phase was to produce initial codes from the data and the third phase was to search for themes. The codebook is constructed using the structure of the interview questions. This means questions related to the demand are based on the WN program and exercises. Also, the intention to use is based on the concepts of the UTUAT model, these are performance expectancy, effort expectancy, social influences, facilitating conditions, and the additional theme attitude. Next, codes are divided into facilitators and barriers, making it easier to obtain results in the last stage of thematic analysis. In addition, both groups mentioned improvement suggestions. These can be found in appendix 1. h and 1. i.

In the fourth stage, transcripts were processed to the first codebook to use the template analytic technique to identify significant textual units (90). The first interview of patients and healthcare professionals has been coded three times, the rest is coded twice. In total, the codebook consists of 764 codes. Each code is linked to a category. There is one referring to the demand of the WN program as exercise therapy, one referring to the intention to use VR at home, and the last one referring to the intention to use VR in a physiotherapy setting. Codetables of both groups can be found in Appendix 1. f and the description of codes can be found in Appendix 1. g. Where the number of interviews a quote was mentioned is categorized as N_{int} and the number of times a code was mentioned is categorized as N_{tot}.

The fifth stage involves connecting the codes and identifying the themes. Firstly, it is important to analyze phrases according to the code groups while making the distinction between patients and healthcare professionals. Secondly, themes are related to a home and physiotherapy setting.

During the sixth step, cluster topics related to the intention to use were determined to connect overlapping themes relevant to analysis (88). Firstly, subthemes are related to themes of the UTUAT model. Some themes have more subthemes. For example, motivation and personal preferences both relate to the theme of performance expectancy. Subthemes are mentioned in order of the most mentioned subtheme to the least mentioned subtheme.

Patients

To analyze the large code table, a quantitative examination of qualitative data was used. Using a simple and efficient procedure, which determined that 20% of the participants should at least mention the subcodes. This means that at least two patients mentioned a subcode, as 20% is 1,6 patients. This led to sixteen codes about the WN program as exercise therapy, 29 of the intention to use in a home setting, and twelve of a physiotherapy setting.

Themes about home and a physiotherapy setting related to performance expectancy are personal preferences and motivation. Secondly, themes about effort expectancy are comfort and ease of use. Thirdly, the themes related to social influences are guidance by the physiotherapist and in addition to physical therapy. Fourthly, space, high costs, and safety are related to facilitating conditions.

Healthcare professionals

The healthcare professionals' data is analyzed using the same approach. Given that 20% of the healthcare professionals had to mention a subcode. This indicates that at least two healthcare professionals needed to mention a subcode as 20% is 1,8 healthcare professionals. This led to 22 about the WN program as exercise therapy, 34 of the intention to use in a home setting, and 20 in a physiotherapy setting.

Themes of home and physiotherapy settings related to performance expectancy are motivation, personal preferences, and efficiency. Secondly, themes about effort expectancy are comfort and ease of use. Thirdly, themes about social influences are guided by the physiotherapist in addition to physical therapy. Fourthly, themes about facilitating conditions are safety, high costs, electrical energy, internet connection, time, defect, and space.

3. Results

One physiotherapist with experience in VR, did not respond to the inventation for the study after giving consent to the study. However, another physiotherapist with this expertise could be included out of own network. This means that seventeen participants: eight patients and nine healthcare professionals, completed the study.

3.1 Descriptive characteristics

3.1.1 Sample characteristics

Patients are relatively young as more than half are younger than 50 years. Besides, most patients have a high level of education as six of the eight patients have a Bachelor's degree or a higher level of education.

Also healthcare professionals are relatively young as eight are aged 35 years or younger. There is also an almost equal distribution between men and women among healthcare professionals and most have work experience for at least two years or more (medior or senior). Besides the three physiotherapists with experience in VR, four other healthcare professionals have used VR before.

Further sample characteristics can be found in Table 3.

Tabel 3: Sample characteristics

Patients	**N=8**	**Healthcare professionals**	**N=9**
N (%)			
Age		***Age***	
18-50	5 (62,5)	18-25	1 (11,1)
50>	3 (37,5)	26-35	7 (77,8)
		36-45	1 (11,1)
Gender		***Gender***	
Male	4 (50,0)	Male	4 (44,4)
Female	4 (50,0)	Female	5 (55,6)
Other	0 (0)	Other	0 (0)
Nationality		***Nationality***	
Dutch	7 (87,5)	Dutch	9 (100)
Russian	1 (12,5)		
Education		***Function***	
Primary education	0 (0)	Physiotherapist VR	3 (33,3)
VMBO	1 (12,5)	Physiotherapist axSpA	3 (33,3)
HAVO	1 (12,5)	Rheumatologist	0 (0)
VWO	0 (0)	Rheumatologist in training	3 (33,3)
Bachelor (HBO/WO)	2 (25,0)		
Master (HBO/WO)	3 (37,5)		
Doctor, PhD	1 (12,5)		
AxSpA diagnosis since		***Work experience***	
1970-2000	2 (25)	Junior	2 (66,7)
2001-2010	2 (25)	Medior	4 (44,4)
2011-2020	4 (50)	Senior	3 (33,3)
Other disease			
Yes	4 (50)		
No	4 (50)		
Medication use*			
Paracetamol	1		
NSAID's	6		

Biologicals	3		
Earlier VR experience Yes No	 3 (37,5) 5 (62,5)	***Earlier VR experience*** Yes No	 7 (77,8) 2 (22,2)
Affinity with technology Yes No	 8 (100) 0 (0)	***Affinity with technology*** Yes No	 (100) (0)
	Mean (SD)		
BASDAI	4,2 (2,5)		

*Note. *multiple answers per patient is possible*
Age= in years
Work experience= junior 0-2 years, medior 2-5 years, senior ≥5 years

3.2 Quantitative results: acceptability

Patients

Table 4: Acceptability outcomes N=8

N	Age*	Sex	BASDAI	Eerlier VR experience	Technical skills	VRSQ general	VRSQ eye	VAS before	VAS after	IPQ	UEQ-s Home	UEQ-s Physio
1	77	M	2,1	No	Yes	Slightly	Slightly	2	2	5,81	1,75	0,88
2	64	M	6,1	Yes	Yes	None	None	5,5	6	5,77	2,38	2,50
3	38	M	1,2	Yes	Yes	None	Slightly	2	1	3,63	2,00	0,50
4	32	M	4,2	No	Yes	None	None	4	4	5,71	2,00	1,50
5	53	F	8,1	No	Yes	None	Slightly	8	10	6,44	1,13	3,00
6	42	F	4,2	No	Yes	Slightly	None	3	3	5,13	0,13	1,50
7	34	F	6	No	Yes	None	Slightly	4	4	5,77	1,75	1,88
8	32	F	1,1	Yes	Yes	None	None	0	0	5,73	1,38	1,00
M* (SD)	47 (17)		4,2 (2,5)					3,6 (2,4)	3,8 (3,2)	5,50 (0,83)	1,57 (0.70)	1,60 (0,84)

*Note. *M = mean*
**age is in years*
VRSQ= Motion sickness questionnaire
VAS= VAS pain-score
IPQ= Presence questionnaire
UEQ-s= Short version of the user experience questionnaire

Firstly, two patients (patients 2 and 5) experienced a VAS pain score higher than 5 before participating in VR. These two patients are also the only ones who experienced a higher VAS pain score after using VR. Secondly, the level of presence ranges from 3,63 to 6,44. Patients aged older than 50 (patients 1, 2, and 5) scored the highest level of presence (≥ 5,77) and one of these patients (patient 5) scored the highest BASDAI score. Thirdly, user experience values >0,8 represent a positive evaluation. Seven patients (87,5%) positively evaluated VR of a home setting and seven patients evaluated VR of a physiotherapy setting. While three patients (patients 1, 2, and 4) had a higher user experience of a home than in a physiotherapy setting, others had a higher user experience of physiotherapy than in a home setting.

Healthcare professionals

Table 5: Acceptability outcomes N=9

N	Age*	Sex	Specialism	Work exp.	Earlier VR exp.	Tech. skills	VRSQ general	VRSQ eye	IPQ	UEQ-s Home	UEQ-s Physio
9	29	M	Physiotherapist VR	Medior	Yes	Yes	None	None	4,97	1,13	1,50
10	37	F	Physiotherapist VR	Senior	Yes	Yes	None	None	5,00	1,88	2,25
11	30	F	Physiotherapist VR	Senior	Yes	Yes	None	Slightly	6,28	1,63	1,75
12	27	F	Physiotherapist axSpA	Junior	No	Yes	Slightly	Slightly	6,47	1,25	1,88
13	30	M	Physiotherapist axSpA	Medior	Yes	Yes	None	None	5,92	1,38	2,25
14	26	M	Physiotherapist axSpA	Medior	Yes	Yes	None	Slightly	6,24	2,38	1,75
15	34	F	Rheumatologist	Senior	No	Yes	None	Slightly	5,28	2,75	-0,38
16	30	F	Rheumatologist	Junior	Yes	Yes	None	Slightly	4,36	2,00	1,50
17	31	M	Rheumatologist	Medior	Yes	Yes	None	Slightly	6,99	1,38	0,00
M* (SD)	30 3								5,72 0,86	1,75 0,55	1,39 0,94

Note. Work exp.= work experience
Earlier VR exp.= earlier VR experience
Tech. skills = technical skills

Firstly, the level of presence ranges from 4,36 to 6,99. Four healthcare professionals (healthcare professionals 11, 12, 14, and 17) who experienced the highest level of presence (≥ 6,28), also experienced slight symptoms of motion sickness. Secondly, four of the six healthcare professionals who have earlier experience with VR also experienced slight symptoms of motion sickness (patients 11, 14, 16, and 17). Thirdly, all healthcare professionals positively evaluate VR of a home setting and 7 healthcare professionals (77,8%) positively evaluate VR of a physiotherapy setting. While four healthcare professionals (healthcare professionals 14, 15, 16, and 17) had a higher level of user experience of a home than in a physiotherapy setting, others had a higher score about a physiotherapy setting compared to the home.

3.3 Qualitative results: demand

Seventeen participants (eight patients and nine healthcare professionals) completed the interview. All interviews together ranged from 12 to 38 minutes, with a median of 24.5 minutes. The length of the interviews from patients ranged from 12 to 32 minutes, with a median of 20 minutes and interviews from healthcare professionals ranged from 17 minutes to 38 minutes, with a median of 28 minutes. The code tables of both groups can be found in Appendix 1f.

Patients

To begin with, of the 29 codes, there are twelve facilitators and seventeen barriers related to a home setting. In other words, there is almost an equal distribution between facilitators and barriers. Additionally, the total number of codes about the physiotherapy setting is twelve. Seven of these codes are facilitators and five are barriers. Thus there are half as many codes mentioned of the physiotherapy setting than in a home setting. Lastly, the total number of codes mentioned about the WN program as exercise therapy is sixteen. Three are facilitators and thirteen codes are barriers. Meaning that most of these codes are barriers.

Healthcare professionals

To begin with, of the 34 codes, there are nine facilitators and 25 barriers related to a home setting. Compared to patients, healthcare professionals mentioned five more codes related to a home setting. Also, most of the codes are barriers. Secondly, of the twenty codes about the physiotherapy setting, twelve ar facilitators, eight are barriers. Thus, there are almost as many facilitators as barriers and they mentioned eight more codes than patients did. Lastly, of the 22 codes about the WN program as exercise therapy, seven are facilitators, and fifteen are barriers. Compared to patients, healthcare professionals mentioned in total six more codes about the WN program. Besides, they mentioned twice as much facilitators than patients did.

3.3.1 Facilitators influencing the demand for the Walk in Nature program as exercise therapy

Patients

Walk in Nature program

Three patients (38%) said they felt present in the Walk in Nature program. Patients described it as a feeling of being in a different world or virtual world. Two patients specifically said the background sounds create a higher level of presence.

Butterfly exercise

The butterfly exercise is a fun exercise, according to three patients (38%).

Yoga exercise

Two patients (25%) said the yoga exercise can cause relaxation resulting in stress relief.

Healthcare professionals

Walk in nature program

Five healthcare professionals (56%) said they felt present in the Walk in Nature program, describing Secondly, two healthcare professionals (22%) said the Walk in Nature program could distract the patient from pain, making it easier to perform exercises with VR. Thirdly, four healthcare professionals (44%) said the Walk in Nature program could increase the mobility of the patient. They refer it to the physical activity in the yoga exercise. Finally, participant 10, mentioned that VR could enable patients to enhance their function more effectively than without it: *'I have had the experience where VR allowed me to move in different ways. I had to pay attention to the direction of approaching cars during one of my exercises. I was able to move my neck more than I could have without the HMD. Therefore, I believe that VR could help people with axSpA enhance their mobility' – (participant 10)*

Butterfly exercise

According to four healthcare professionals (44%), the butterfly exercise is enjoyable and valuable in the exercise program. They noted its significance in enhancing spine mobility as it involves bending and stretching to catch butterflies in various positions.

Yoga exercise

Four healthcare professionals (44%) find the yoga exercise valuable in the program. One appreciates the patient's ability to practice yoga in VR, as it's not typically used in physiotherapy. Additionally, three (33%) noted the added value of the breathing exercise within the yoga routine, because of the importance of a good breathing technique in yoga.

3.3.2 Points of improvements influencing the demand for the Walk in Nature program as exercise therapy

In addition to addressing the research questions, both groups provided recommendations on how to improve the demand for VR of a home and physiotherapy setting. Results of the full analysis can be found in Appendix 1.i Suggestions on improving the demand.

Patients

Table 6: Patients' suggestions to improve the demand for the Walk in Nature program

Exercise	Number	Improvement suggestion
Walk in Nature	1	More variation in exercises
	3	Adjust the intensity of the exercises to the disease activity of the patient
Breathing exercise	4	Let the patient focus more on the visuals instead of the verbal counting
	5	Improve the visualization of the tree
Butterfly exercise	6	Provide an instruction video how to use the controllers
Yoga exercise	7	Skip instructions of the poses
	8	Add a mirror to enable the patient to observe and enhance their posture

Overall, patients prefer personalized exercises aligned with the intensity of their axSpA symptoms. In the breathing exercise, the intended visualization of the three is overshadowed by a focus on verbal counting; patients expressed a desire for more focus on visualizations. For the butterfly exercise, clarity is lacking on button usage, as they would like an instructional video. Lastly, for the yoga exercise, patients suggested removing explanations for left-side poses, as this reduces wait times between pose explanations and performance.

Healthcare professionals

Table 6: Healthcare professionals' suggestions to improve the demand for the Walk in Nature program

Exercise	Number	Improvement suggestion
Walk in Nature	1	Add the possibility of performing the exercises seated
	2	Add pain education
	3	Further development of the program, such as removing bugs
	4	Make the exercises shorter
Breathing exercise	5	Add the possibility of executing the exercise while lying down

	6	Add the possibility of performing the exercise seated
	7	Improve the visualization of the tree
Butterfly exercise	8	Add different levels to challenge the patient
	9	Add stopwatch
	10	Add scoring system
Yoga exercise	11	Add different levels
	12	Remove errors and bugs

Overall, program development is needed to address existing bugs in the whole program. Healthcare professionals recommended adapting exercises for patients with high disease activity by allowing patients to be seated while performinig the exercises. Secondly, they also recommend to make the exercises shorter. Thirdly, pain education is crucial to express the importance of exercising despite pain.

For the breathing exercise, healthcare professionals recommended the option for patients to ly down, followed by seated options. They also suggested enhancing visualization with an improved tree. For the butterfly exercise, they proposed adding difficulty levels and incorporating a stopwatch or scoring system. Lastly, for the yoga exercise, healthcare professionals suggested incorporating different levels to make patients able to perform the exercise with different disease activity levels.

3.3.3 Facilitators influencing the intention to use VR in a home setting

Themes linked to the UTUAT model will be discussed, outlining facilitators and barriers for each concept (performance expectancy, effort expectancy, social influence, facilitating conditions, and attitude) along with the percentage of patients or healthcare professionals referencing each sentence.

Patients

Performance expectancy

Personal preferences

Four patients (50%) said using VR as exercise therapy could be interesting for patients who prefer doing exercises with VR. Three patients (38%) said this depends on whether using VR has added value as exercise therapy. While acknowledging the potential benefits of personal preference for using VR, patients question its effectiveness for their own needs. Improving health is considered a significant value by patients. If it was enjoyable, as was mentioned by participant 6: *'I would not use VR when it has no added value to my exercise routine. I am quite headstrong about my exercises and know what works for me. So, using VR is not something for me because I have my workout routine'*

Motivation

Two patients (25%) mentioned that using VR could enhance their motivation to perform exercises, because of the effective guidance provided by VR for exercise performance. Participant number 8 explained this guidance as follows: *'Well, you have an example of how the exercises need to be performed. This is quite handy when you do not remember how to perform a certain exercise because VR helps you' – (participant 8)*

Additionally, two patients (25%) noted that using VR could enhance focus during exercise, in contrast to performing exercises without VR. Patients feel immersed in the virtual environment, as VR guides the patient through the exercises. Another factor related to the increasing motivation is the gaming elements. Two patients (25%) said that the playful and entertaining way of performing exercises could increase the motivation to use VR.

Effort expectancy

Comfortable

Half of the patients indicate that having the freedom to use VR whenever they want to could boost their intention to use it. Additionally, two patients (38%) stated the importance of feeling more comfortable using VR in their home rather than in a physiotherapy setting. This is explained by participant number 5: *'Many people find it difficult to cope with the noise in a physiotherapy practice. This can irritate people who wish to work out on their own. VR allows you to perform exercises in your home which is a more comfortable setting'*

Social influences

Guidance by the physiotherapist

Three patients (38%) said they could use VR without the guidance of a healthcare professional. This is linked to their prior experience with VR, as those without experience prefer an introduction. All patients who said they could use it independently had an earlier experience with VR.

Facilitating conditions

Space

The WN program requires that a space of approximately two by three meters for performing its exercises is needed. Consequently, individuals undergoing the program should have this amount of space available in their homes. Six patients (75%) said they have enough space to use VR in their homes.

Attitude

Positive

Five patients (63%) have a positive attitude regarding VR in the home environment. Patients relate this to VR being exciting, new, and contributing to health. Additionally, four patients (50%) specifically said having an earlier experience with VR influenced their positive attitude toward using VR. For example, participant 2: *'I already use VR for flight simulations so using VR as exercise therapy is easy for me'*

Healthcare professionals

Performance expectancy

Motivation

Six healthcare professionals (67%) specifically said that using VR could increase the patient's motivation to perform exercises. Five healthcare professionals (56%) expressed that the guidance provided by virtual reality was a motivating factor for patients to engage in exercise. They described VR as exciting and/or new. Lastly, VR could be a clear reminder of performing exercises, as mentioned by participant 11: 'I think it is a good and clear reminder to do exercises as you have the HMD in your home. You otherwise have instructions for exercises, for example, somewhere on your smartphone. Thus, you see the HMD in your home which motivates the patient to do exercises'

Increasing motivation to perform exercises is also explained by the gaming elements. Six healthcare professionals (67%), including participant 9, mentioned that the games available in VR could enhance motivation for engaging in exercises: 'It is stimulating to do exercises since you are in a different world. You have a feeling that you are playing instead of performing exercises' – (participant 9)

Personal preferences

Five healthcare professionals (56%) find VR appealing to patients interested in using it for exercise therapy, as there is no program suitable for all patients. Yet the patient's preferences depend on the technical skills to use technology. In addition, patients should have a positive attitude toward VR, as explained by participant 9: 'We live near the border with Germany, meaning that most patients are stubborn about improving their health. Most of them think 'oh I do not need this'. Because people in the West of the Netherlands are more open to technology than people here, I believe it is easier to implement new technology in the West of the Netherlands – (participant 9)

Effort expectancy

Comfortable

Three healthcare professionals (33%) said that the possibility of using VR whenever the patient would like increases the intention to use it. This contrasts with the physiotherapy setting, as explained by participant 17: 'The physiotherapist can provide feedback to the patient, but the patient needs to visit a physiotherapy practice. The patient can easily do exercise with VR at home as the patient can use it whenever he wants to'

Facilitating conditions

Space

Twenty-two percent of healthcare professionals mentioned that patients indeed have sufficient space in their homes to use VR, either utilizing the living room or rearranging furniture to create the necessary space.

Attitude

Eight healthcare professionals (89%) have a positive attitude toward VR at home and this is explained by VR as a motivator to perform exercises: 'I am positive about VR at home. Imaging that most of the patients are not adhering to the exercises, I think VR is a nice way of performing exercises. Even when some patients do not have the technical skills to use it. You can provide VR for a group that can use VR. – (participant 14)

Furthermore, six healthcare professionals (67%) expressed positivity about using VR at home, particularly for young patients with the necessary technical skills. Additionally, three healthcare professionals (33%) see potential in VR as exercise therapy for patients with axSpA: 'I am optimistic about the prospects of VR since I believe it is beneficial to use VR. Besides, there are many possibilities to use VR and that sounds promising' – (participant 9)

3.3.4 Barriers influencing the intention to use VR in a home setting

Patients

Performance expectancy

Motivation

Three patients (38%) said they would not have enough motivation to use VR at home, which can be related to having slight or no symptoms: *'Yes, exercising consistently is very important. If I have a few symptoms, I might not be motivated to do exercises' – (participant 1)*
Secondly, three patients (38%) noted that not all patients have sufficient technical skills for using VR. Thirdly, as previously mentioned, the perception of value in exercising with VR is a crucial facilitator; the absence of added value results in a lack of motivation. For instance, one patient expressed a preference for visiting a physiotherapist over using VR.

Effort expectancy

Comfortable

Firstly, half of the patients said that they worry that the technology could malfunction, which is a barrier for these patients. Secondly, two patients (25%) said that the cable attached to the HMD was not comfortable while wearing the HMD. Moreover, the HMD's weight made it uncomfortable to wear. In addition, one patient mentioned that using the HMD could lead to neck pain.

Facilitating conditions

Space

As mentioned before, having enough space to use VR is seen as an important facilitator. However, two patients (25%) said they do not have enough available space to perform the exercises.

High costs

The costs related to buying the new technology is seen as one of the barriers of the facilitating conditions. Three patients (38%) said buying the technology comes at a steep expense, leading to high costs.

Safety

Three patients (38%) said the patient's safety is in danger when using VR at home. This can be explained by the patient performing exercises in a virtual environment which means the patient is not able to see the real world. One patient mentioned the possibility of walking into a wall, and another patient, participant 5, has a fear of falling: *'Safety is important. Axial spondyloarthritis causes me a lot of pain, that is why I cannot stand for that long. This means that I could fall while using VR'*

Healthcare professionals

Performance expectancy

Motivation

Five healthcare professionals (56%) said patients have a lack of motivation to use VR, because patients generally lose motivation to perform exercises. Other reasons are moving furniture to create enough space, not feeling comfortable, or feeling anxious about using VR at home. Moreover, the lack of variation in exercises could lead to decreased motivation.

Effort expectancy

Ease of use

Five healthcare professionals (56%) emphasized the importance of VR being easy to use to enhance the intention to use. Besides, seven healthcare professionals (78%) said the patient's lack of technical skills is an important barrier to use VR, as the patient should have technical skills to use VR or want to learn how to use VR. For example, a healthcare professional suggested: *'Patients older than 75 years have more trouble using HMD than younger patients. Since more younger patients do have the technical skills. This means younger patients find it easier to use VR' – (participant 9)*

In addition, six healthcare professionals (67%) said the elderly have more trouble using VR as they lack in technical skills.

Comfortable

Three healthcare professionals (33%) said the patient might not feel comfortable using VR at home. Two healthcare professionals said patients could feel anxious using VR as they are transferred to a virtual environment. Lastly, one of the healthcare professionals said the patient could feel anxious as the patient cannot see where he is in the real world.

Facilitating conditions

Safety

The safety of the patient is an important barrier, which was confirmed by seven healthcare professionals (78%). They said the safety of the patient could be in danger when the patient uses VR at home. Four healthcare professionals (44%) said this is related to not having enough space to use VR.

Other concerns are the risk of falling over furniture, the risk of falling over pets, and the risk of falling over the cable of the HMD. Besides, one healthcare professional said the elderly have a higher risk of falling. Another concern raised by two healthcare professionals (22%) is related to insurance. They question who is responsible for the costs when the patient falls at home.

High costs

Another barrier to facilitating conditions are the high costs. Three healthcare professionals (33%) mentioned this as a barrier when purchasing the technology.

Electrical energy

Secondly, two healthcare professionals (22%) mentioned the patients need electrical energy to use VR.

Internet connection

Lastly, two healthcare professionals (22%) said the patient probably needs an internet connection. According to healthcare professionals, most patients possess energy and an internet connection, but these factors should be considered when implementing VR.

Attitude

Three healthcare professionals (33%) have reservations about patients utilizing VR in their homes due to patients' limited technical skills in using VR and their resistance to adopting VR as a form of exercise therapy: *'Well, it depends on the type of patient. Most patients I treat have been doing the same exercises for ten to fifteen years. They are stubborn farmers. They are not willing to try new exercises, let alone exercises with VR' – (participant 12)*

Lastly, a healthcare professional clarified that the reason for his negative attitude is that the program does not give the patient feedback or explain the importance of completing exercises.

3.3.5 Points of improvement influencing the intention to use VR in a home setting

In addition to addressing the research questions, both groups provided recommendations on improving the intention to use VR in the home environment. Results of the full analysis can be found in Appendix 1.h Suggestions on improving the intention to use.

Patients

Table 6: Patients' suggestions to improve the intention to use VR of a home setting

Theme	**Number**	**Improvement suggestion for the home environment**
Motivation	1	Add variation in exercises
	2	Providing feedback about the exercises
Ease of use	3	Use VR under supervision of a physiotherapist
	4	Provide instructions on how to use VR
Comfortable	5	Make the HMD less heavy
	6	Provide a helpdesk
In addition to physical therapy	7	Discuss the progress with a physiotherapist
	8	Using VR for the first few weeks in a physiotherapy setting

Healthcare professionals

Table 6: Healthcare professionals' suggestions to improve the intention to use VR of a home setting

Theme	**Number**	**Improvement suggestion for the home environment**
Personal preferences	1	Patients should decide to use VR at home
Motivation	2	Add variation in exercises
	3	A physiotherapist should explain how VR contributes to the health of the patient
	4	The exercise program needs to fit the patient
Ease of use	5	Make an automatic internet connection
	6	Provide instructions on how to use technology
	7	Provide the program in the HMD
	8	Operate VR without using controllers
In addition to physical therapy	9	The physiotherapist should provide feedback to the patient
	10	The physiotherapist needs to discuss the progress with the patient
Safety	11	Ensure the safety of the patient

3.3.6 Facilitators influencing the intention to use VR in a physiotherapy setting

Patients

Performance expectancy

Efficiency

Of the eight patients surveyed, 38% said incorporating virtual reality (VR) into exercise therapy could enhance efficiency. According to two of these patients, VR allows physiotherapists to attend to multiple patients simultaneously, leading to increased treatment capacity. The remaining patient suggested that this efficiency boost arises from the physiotherapist's ability to attend to another patient while the current one engages with VR.

Social influences

Guidance by the physiotherapist

The guidance of a physiotherapist is important while using VR. Seven patients (88%) said it is nice to know how you performed the exercises and four patients like to receive guidance to use the technology correctly. Additionally, three patients like to receive feedback on how they performed the exercise by their physiotherapist. Moreover, one patient said she would not use VR without guidance due to a fear of falling.

Facilitating conditions

Three patients (38%) did not see barriers related to the facilitating conditions. One participant, participant 8, connected this aspect to the available space within the physiotherapy facility: *'I don't see any barriers to implementing VR in the physiotherapy setting. Because I think that when the physiotherapist would like to introduce VR, they have enough space to use VR. Otherwise, they can create enough space.'* The other two patients said VR can easily be implemented into the physiotherapy setting since the physiotherapist guides the patient in how to use the technology.

Space

Two patients (25%) said there is enough space to use VR in a physiotherapy setting: *'I have been to different physiotherapists, and they always have enough space. I think it is easier to have the required amount of space in a physiotherapy setting than at home' – (participant 1)*

Attitude

Two patients (25%) have a positive attitude toward the use of VR in a physiotherapy setting. One patient relates this to the guidance the physiotherapist offers and prefers using it in a physiotherapy setting instead of at home. Another patient said it is easier to introduce VR in the physiotherapy setting because patients can get used to VR, before implementing it at home.This means that the patient's attitude towards VR is related to the guidance the physiotherapist offers to the patient.

Healthcare professionals

Performance expectancy

Motivation

Six healthcare professionals (67%) said using VR in the physiotherapy setting increases the motivation to perform exercises. Two healthcare professionals explained this by the technology as it is more fun to perform exercises with VR. Yet, four healthcare professionals related this to the physiotherapists. Two healthcare professionals said patients have already paid for their consult, increasing their motivation to visit the physiotherapist: *"I believe the patient is driven to participate as they have a scheduled session with the physiotherapist. The therapist will lead the patient through exercises, ensuring active engagement. Because the patient is there and will listen to the therapist and the patient already paid for the consult. Additionally, the physiotherapist will offer feedback on the exercise performance." – (participant 17)*

Efficiency

Two healthcare professionals (22%) said the technology can be used to treat more patients, which increases efficiency.

Social influences

Guidance by the physiotherapist

Over 50% of healthcare professionals find the physiotherapist's guidance on using technology and executing exercises correctly to be a crucial motivator. About 44% of the healthcare professionals related it to the perceived complexity of current VR technology. Another 44% noted the importance of the physiotherapist in correcting patients to ensure proper exercise performance. Additionally, as explained by participant 16, 33% of the healthcare professionals associated the facilitator with ensuring patient safety: *'Well, I think that when there is a physiotherapist next to the patient, the patient is more secure. You can watch the patient, so the patient performs the exercises correctly and does not fall. So, I think that it is only easier to use VR in the physiotherapy setting'.*

Finally, four healthcare professionals (44%) suggested that incorporating VR into physiotherapy practices is a nice way of introducing the technology to patients. All four emphasized the potential for implementing VR at home once patients have been introduced to it*: 'I think that patients could use VR at home after an introduction to VR. Patients must be able to practice with the technology in the physiotherapy setting and need to know how to use and start the technology, so they can use it at home' – (participant 9)*

Facilitating conditions

Space

Most healthcare professionals said there is enough space to use VR in a physiotherapy setting. Because five healthcare professionals (56%) said there is enough space to introduce VR in a physiotherapy setting. Furthermore, 44% of respondents noted that physiotherapists often have dedicated rooms exclusively for installing and using VR. Additionally, two healthcare professionals suggested that VR could be employed in shared exercise rooms.

Safety

The majority of healthcare professionals (56%) assured patient safety in physiotherapy setting. Three professionals linked it to the availability of enough space for using VR, while the other two linked it to the guidance provided by the physiotherapist: *'The patient has a lower risk of falling because the physical therapist can intervene and prevent a fall – (participant 9)*

Attitude

Four healthcare professionals (44%) expressed a positive attitude toward integrating VR into a physiotherapy setting, with two suggesting an initial use in a physiotherapy setting before implementing it to home. They emphasize the value of the physiotherapist guiding patients in a physiotherapy setting.

3.3.7 Barriers influencing the intention to use VR in a physiotherapy setting

Patients

Social influences

Guidance by the physiotherapist

While the majority of patients view the physiotherapist's guidance as a facilitator, it's also perceived as a barrier. Three patients (38%) believe VR already provides sufficient guidance, making the physiotherapist's guidance unnecessary. Two patients question the physiotherapist's role and see no value in attending physiotherapy sessions. Another patient, participant 3, expressed the lack of motivation to use VR in a physiotherapy setting, due a perceived lack of additional value from the physiotherapist: *'No, I do not like going to a physiotherapist to use VR. I do not see the value of performing exercises using VR as I already receive guidance by VR. The therapist does not have added value for me, as I will find it difficult to stay motivated to go to a physiotherapist to use VR. I think it is too much to ask. Overall, I'm not enthusiastic about this concept'*

Facilitating conditions

Space

Two patients (25%) find exercise room noise disruptive due to physiotherapists guiding patients and others using various machines, making it challenging to concentrate on exercises in the virtual environment. Additionally, they express discomfort using VR when observed by other patients: *'It is fine that a physiotherapist is watching me performing exercises with VR, but I currently go to a physiotherapist where I perform exercises in an exercise room. I don't anticipate feeling at ease using VR in a crowded exercise room; it would make me uncomfortable.' – (participant 4)*

Healthcare professionals

Effort expectancy

Comfortable

Two healthcare professionals (22%) noted a potential barrier: some patients may feel awkward using VR in a shared room where others can observe them.

Social influences

Guidance by the physiotherapist

Four healthcare professionals (44%) find no added value in using VR in physiotherapy, citing that patients already receive exercise guidance through VR. Additionally, two healthcare professionals express a preference for not using VR in a physiotherapy setting but recommend it for patients to use at home.

Facilitating conditions

Space

Two healthcare professionals (22%) identified noise in a physiotherapy setting as a barrier. Specifically, participant 16, noted that the guidance provided by the physiotherapist distracts the patient from the virtual environment: '*You will get distracted when someone provides feedback while you are performing exercises in a virtual environment'*

High costs

High costs are seen as a barrier to implementing VR. Seven healthcare professionals (78%) stated purchasing the technology comes at a steep expense, leading to high costs.

Time

Two healthcare professionals (22%) mentioned that physiotherapists require a considerable amount of time to initiate the technology before patients can start exercising.

Defect

Two healthcare professionals mentioned the chance the technology does not work is as a barrier.

Attitude

Attitude physiotherapist

Three healthcare professionals (33%) mentioned that the physiotherapist's enthusiasm about the technology is essential to motivate patients to use VR.

3.3.8 Points of improvement influencing the intention to use VR in a physiotherapy setting

In addition to addressing the research questions, both groups provided recommendations how to improve the intention to use VR of a physiotherapy setting. Results of the full analysis can be found in Appendix 1.h Suggestions on improving the intention to use.

Patients

Table 6: Patients' suggestions to improve the intention to use VR of a physiotherapy setting

Theme	**Number**	**Improvement suggestion for the physiotherapy practice**
Ease of use	1	Remove the cable of the HMD
Guidance by the physiotherapist	2	The physiotherapist can add other relevant exercises outside the virtual environment
	3	The physiotherapist can correct the patient
Space	4	Use VR in a dedicated room
	5	Use VR in an exercise room

Healthcare professionals

Table 6: Patients' suggestions to improve the intention to use VR of a physiotherapy setting

Theme	**Number**	**Improvement suggestion for the physiotherapy practice**
Efficiency	1	Treat patients with other treatment goals
	2	The possibility of leaving a patient to treat other patients
Space	3	Use VR in a dedicated room

4. Discussion

This study aimed to examine the feasibility (i.e. acceptability and demand) of VR as exercise therapy for axSpA. The feasibility of VR and the Walk in Nature program in a home and a physiotherapy setting were tested by both patients and healthcare professionals.

While the acceptability in a home and a physiotherapy setting was high, the demand differs between both environments and groups. Physiotherapists have a higher intention to use VR at home than patients. While most patients would first like to use virtual reality in a physiotherapy setting. Furthermore, both groups said the Walk in Nature program has the potential to function as exercise therapy for axSpA, despite the low demand at this moment.

4.1 The acceptability in a home and a physiotherapy setting

User experience

Firstly, the satisfaction of using VR at home and in the physiotherapy setting is high among patients and physiotherapists. However, during interviews, most patients positively preferred the physiotherapy setting over their home. Their primary explanation is that VR is challenging to use and lacks adequate feedback. In contrast, rheumatologists have a low level of satisfaction using VR in the physiotherapy setting. A crucial question posed to rheumatologists was whether VR holds value as part of a treatment plan. During interviews, they said that the guidance provided by a physiotherapist adds no extra benefit to the patient, as sufficient guidance is already provided within the virtual environment. Moreover, they suggested that VR could act as a motivator to exercise at home, as engaging in home-based exercises without VR demands a highly motivated patient. In contrast, VR has the potential to serve as a motivator by providing an enjoyable reminder to perform exercises. Conversely, physiotherapists appreciated using VR in both settings, acknowledging its capacity to treat a larger number of patients simultaneously in a physiotherapy setting.

Results are in line with prior studies on the acceptability of virtual reality in a home or physiotherapy setting. To begin with, Groenveld et al. (91)found that during an intervention period of six weeks, A satisfaction rate of 67% was reported among patients using virtual reality for home exercises, and 78% expressed a desire to use VR again for rehabilitation if needed. Additionally, in Zanatta et al. (93), healthcare professionals offered positive feedback, indicating the potential of VR for personalized interventions due to its high clinical applicability across various diseases. This implies that VR seems acceptable in both environments, yet according to rheumatologists, VR seems more valuable at home.

Motion sickness

Both groups experienced slight symptoms of motion sickness. Patients and healthy participants (healthcare professionals) reported comparable levels of motion sickness. During interviews, no one reported symptoms affected by VR. Similarly, Groenveld et al. (91) assessed the tolerability of VR exercises in patients with post-COVID-19, by measuring motion sickness. Although most patients initially reported dizziness, 25% experienced motion sickness by the end of the intervention period. This finding may be explained by dizziness also being a symptom of post-COVID-19. The dropout rate due to motion sickness was low at 15%.

Yet, another feasibility study by Hoeg et al. (92) showed VR has no impact on motion sickness. The difference can be explained by the fact that only three male patients participated in the study by Hoeg et al. This suggests that the perceived motion sickness is acceptable, given the minimal effects and the absence of complaints in the interviews.

Presence

A strong presence was expected to be beneficial, as prior research shows VR's capability of virtual embodiment and fear avoidance could distract patients from pain (45). A prior study of the Walk in Nature program (74) showed a high level of presence in the virtual environment among students, this study included heterogeneous groups where the level of presence was high among both groups. Besides, in this study, both groups said they felt present in the virtual environment, as they described it as a feeling of being in a virtual or different world. Additionally, healthcare professionals indeed said that the feeling of presence in the virtual environment could reduce pain. Similarly, 47 percent of the patients in a feasibility study by Dy et al. (93) said VR distracted them from pain.

It was also anticipated that virtual embodiment could make the patient able to move body parts more than without VR. A physiotherapist experienced in VR shared her personal experience of increased head rotation capabilities while playing a VR game. She believes that immersive nature of the exercise could potentially enhance the spine flexibility of patients with axial spondyloarthritis. The patient focusses on the game, which may serve as a distraction from pain, facilitating easier bending or stretching. This is in line with prior research, as body transfer, which refers to the distraction mechanism of VR, can increase the mobility of the patient in the virtual environment (59). These findings suggest that that the perceived appropriateness of VR is high, as the virtual environment is associated with a high level of presence and pain management mechanisms of VR may have the potential to reduce pain.

VAS-pain

Two patients had a VAS pain score of ≥ 5 and were the only ones who experienced an elevated pain score after using VR. Nevertheless, the limited sample size prevents making assumptions about an increased pain score after VR use. Furthermore, patients with mild motion sickness may experience increased disease symptoms, as observed in Groenveld et al. (91), where dizziness was primarily associated with post-COVID-19 symptoms.

4.2 The perceived demand for the Walk in Nature program as exercise therapy

Walk in Nature program

It was expected that VR's program could increase adherence and distract patients from pain, increasing the perceived demand for the program. According to the qualitative results, patients did not specifically say the Walk in Nature program improves adherence or could function as pain management. However, healthcare professionals said the program could motivate patients to exercise and distract patients from pain. This implies that patients have a low perceived demand, while healthcare professionals have a high perceived demand.

Firstly, physiotherapists experienced in the treatment of axSpA tested the suitability of the Walk in Nature program as exercise therapy and stated that the breathing exercise was too difficult, as patients might not be able to stand for that long. In addition, they suggested making the exercise shorter, as the verbal counting was too fast and long. Moreover, adding the possibility of completing the exercises while lying down or seated is preferred, as this makes it easier to perform the breathing technique. This is in line with Brady et al. (94), because physiotherapists also recommended a sitting position, they related it to ensure the safety of the patient. Although healthcare professionals in this study believe patient safety is very important, most physiotherapists linked it to exercise's difficulty.

Secondly, both groups enjoyed the exercise due to its challenging aspects but stated that it is currently too easy. Healthcare professionals suggested that incorporating gaming elements could enhance its difficulty. Additionally, they noted that the exercise could enhance spine mobility, given that patients need to bend in various directions to catch the butterflies. It was expected that patients could enhance mobility through the avoidance of fear. Similarly, Yeo et al. (95) reported that games in a virtual environment improves mobility in patients with spinal cord injury (SCI). They related it to performing tasks such as reaching for objects below their waist level. Skills acquired from the games were potentially integrated into motor patterns and real-life functions.

Thirdly, some patients found the exercise difficult, as they need to combine the breathing task with the yoga poses. Others felt impatient, as they needed to wait to perform a pose during the exercise. Besides, although none of the patients said the yoga exercise could increase flexibility, healthcare professionals emphasized the significance of the breathing component within the context of yoga. In addition, patients did express the exercise led to stress relief, as they experienced a heightened sense of relaxation. It was anticipated that virtual embodiment could make the participant feel more relaxed. This is in line with prior research, as a 9-week yoga intervention on neck pain compared to a home-based exercise program is more effective (96). Additionally, a study indicates that engaging in a specific breathing exercise proves more efficacious in alleviating pain compared to a standard breathing pattern (96).

Persuasive System Design model

In interviews, participants provided suggestions to enhance the program's perceived demand. Firstly, transitioning the Walk in Nature program from the computer to the HMD would reduce user effort, enabling them to operate it directly in the HMD. In addition, an automatic internet connection and the option to use VR without controllers decrease effort. Other points of improvement are related to bringing patients closer to their target goal, by providing feedback on how to improve each exercise. Moreover, offering a scoring system or dashboard provides patients with a comprehensive view of their progress. To increase the ease of use, both groups said th ey would like instructions on how to start the technology, switch between exercises, and use the controllers properly. Additionally, incorporating the ability to skip parts of verbal instructions for yoga poses would accommodate impatient users. Besides, providing a help desk for technical issues offers personalized service. To use the program to a broader range of patients with axSpA, incorporating various levels will enable patients using the program with varying disease activities. In addition, more variation in exercises is preferred. Patients made suggestions to adjust the intensity of the exercises to the level of pain. Moreover, physiotherapists experienced in axSpA suggested performing the breathing exercise while lying down or seated as not all patients can stand for that long.

Secondly, adding different levels and gaming elements could make the butterfly exercise more challenging. Such as adding a stopwatch that reflects the time the patient takes to complete the task and adding a scoring system, motivating the patient to improve the highest score.

Lastly, according to physiotherapists experienced in axSpA, patients need to understand why it is important to exercise while experiencing discomfort. That is why the program should include pain education to explain how pain relates to physical activity. Besides, further enhancement of the Walk in Nature program such as removing bugs, would enhance its credibility.

All these suggestions refer to areas of the persuasive system model. The PSD model is a comprehensive framework designed to help with the design and evaluation of systems that have the potential to affect users' attitudes or actions (99). Persuasive technology elements are divided into four areas in this model: primary task support, dialogue support, system credibility support, and social support. Using this model could help increase adherence to exercise with VR, as its features are persuasive and could encourage patients to use the technology. Nevertheless, three out of the four areas are emphasized, as social support features were not discussed in interviews. Most features relate to primary task support. This might be explained as this is the first time the program has been tested for patients with axSpA. Most features relate to tailor the program to its target group.

4.3 The intention to use virtual reality in a home and a physiotherapy setting

Personal preferences

Most patients said VR could be beneficial for patients who like using VR as exercise therapy. Patients relate their personal preferences to the added value of VR. For example, VR should increase patient's health and be fun to use. Yet, the patients who said VR could be beneficial, also questioned if exercising with VR could work for themselves. These results are in line with a study by Dy et al. (93). The study tested the usability barriers and facilitators of using VR for chronic pain management, by using the Technology Acceptance Model (TAM). They found that individual preferences are a reason why 27 percent of the patients were uncertain about VR's potential as a replacement therapy. This implies that providing VR might be the preference for patients who enjoy using it for exercise, while other patients might prefer alternative options, such as their personalized exercise program or physiotherapy.

Motivation

According to patients, VR guides and helps to focus on the exercises because the patient feels immersed in the virtual world, making them less distracted by the real world. Besides, healthcare professionals also said the guidance could increase the motivation to perform exercises, as patients often lose interest in exercising. Patients confirmed this, as they said prescribed exercises can sometimes feel repetitive. In contrast, engaging in exercises with VR provided a playful and entertaining approach to exercising. Although disease-related symptoms are related to a decreased motivation to exercise, patients said a lack of symptoms could decrease the motivation to exercise. Three patients with earlier experience in VR were more skeptical, as performing the same exercises for weeks could lead to non-adherence. On the other hand, both groups said the challenging way of performing exercises increases motivation. In addition, both groups related the guidance of a physiotherapist as a motivator to exercise.

Motivation is distinguished between intrinsic and extrinsic motivation (97). Providing an exercise program with VR could increase both intrinsic and extrinsic motivation. Firstly, a study about physiotherapists' beliefs and perspectives on VR by Brady et al. (94) described immersion as a key factor in distraction and makes the patient able to focus on the exercises in the virtual environment. Secondly, similarly to Groeveld et al. (91), patients described VR as fun and stimulating. In addition, physiotherapists in a study by Brady et al. (94) suggested providing exercises with VR could motivate the patient more than providing exercises on paper. Thirdly, although disease-related symptoms are a barrier to exercise regularly, motivation declines when symptoms are not pronounced enough. This indicates that both excessive and insufficient symptoms lead to a low motivation to exercise. Fourthly, a prior study by Dilanchian et al. (98) showed that gamers become more easily bored with VR, as it is not as entertaining anymore. That is why patients with experience in VR suggested adding variation in exercises could increase motivation. This is in line with Groenveld et al. (99), as they said younger patients could become more easily bored with VR due to their gaming experience. Lastly, research shows that an immersive environment with gaming elements level attracts to play and stay in the environment because the player receives an incentive for completing a challenge (100). Additionally, the guidance of a physiotherapist functions as an extrinsic motivator, making it even easier to use VR in the physiotherapy practice.

Ease of use

Patients prefer to use VR at home because they would have the freedom to use VR whenever they want. In contrast, patients said they would feel uncomfortable in the physiotherapy practice, as other patients could watch.

Overall, the head-mounted display (HMD) is comfortable to wear. However, both groups said the glasses were too heavy, causing neck pain. Before using the technology in their homes, patients preferred to use VR under the supervision of a physiotherapist. This is attributed to the greater ease of using VR in a physiotherapy setting compared to home, where physiotherapists can guide patients. Providing instructions before implementing VR at home is also important, as patients may otherwise be unfamiliar with how to use the technology. Additionally, half of the patients said the chance technology does not work is a barrier but introducing a helpdesk could make VR easier to use at home. Besides, physiotherapists evaluated the user experience of both settings as high. Yet, during interviews, both physiotherapists with experience in VR and those with experience in axSpA identified obstacles to implementing VR at home. These highlighted the current preference for using VR in physiotherapy practices. Moreover, healthcare professionals, particularly physiotherapists with VR experience, emphasized that VR should be made more user-friendly to effectively use it at home. This is crucial as not all patients possess the technical skills required to operate the technology. They also made a couple of suggestions on how to improve the ease of use, such as providing an instruction video. Physiotherapists with expertise in axSpA also associated challenges with patients' technical skills in using VR but primarily attributed difficulties to the complexity of the exercises for patients.

The results imply that VR could be made less heavy to wear and could be applied at home, when it becomes more user friendly. In addition, a helpdesk works as a significant value when implementing VR at home. Firstly, Dy et al. (93) used a VR-headset and a hand-held controller and showed the HMD was comfortable but a little heavy to wear. Besides, physiotherapists in Brady et al.'s study (97) noted that heavy headsets can rapidly fatigue neck and head muscles. In addition, both studies stated that removing the cable will make the HMD more comfortable to wear. Secondly, a study about patients' perceptions of VR therapy in the management of chronic cancer pain by Garret et al. (101), mentioned they need good support when using VR at home. Patients linked it to the complexity of the VR equipment and the current stage of VR development. Thirdly, another feasibility study by Groenveld et al. (91) implemented VR at home and offered a helpdesk where patients could receive help regarding technical issues. Patients applied 40 technical problems to this helpdesk. All referred to the usability of VR. Yet, most of the problems could be solved remotely by the study staff. This implies that a helpdesk could address the majority of issues remotely.

In addition to physical therapy

Both groups said they would like to use VR in addition to physiotherapy. Patients would like to discuss their progress, receive feedback, and relate their motivation to the guidance of a physiotherapist. In addition, healthcare professionals stated the patient can exercise with VR at home and visit the physiotherapy practice for additional guidance. For example, to provide different exercises or feedback to the patient. Besides, healthcare professionals related the guidance to ensuring the safety of the patient, as patients could fall while using VR.

Both groups expressed a desire to incorporate VR in addition to physical therapy to stay motivated. This clarifies the patients' preference for guidance from a physiotherapist, who provides support and motivation during exercises. Healthcare professionals expressed their preference for using VR in a physiotherapy setting to ensure patient safety. Firstly, this is in line with Dy et al. (93), as 60 percent of the patients stated they were more open to using VR as a supplement to their existing pain management strategies. The reasons included the need for extended use and the personal preferences of the patients, both reasons are also the motivational aspects in our study. Besides, according to physiotherapists in the study by Brady et al. (94), supervision is an important factor that could prevent injury and accidents.

Facilitating conditions at home

There are fewer barriers related to a physiotherapy setting, compared to home. For instance, using VR requires a certain amount of space, not having enough space is seen as a barrier by both groups. While less than half of patients said safety is a barrier, healthcare professionals stated it as the most frequently mentioned barrier. They relate it to falling over furniture, pets, and over the cable of the HMD, as patients are immersed in the virtual environment. Besides the safety concerns, physiotherapists also questioned what the insurance covers when a patient falls while using VR. Purchasing the technology is also a barrier. While less than half of patients said costs are a barrier, more than half of the healthcare professionals said this is an obstacle when implementing VR in clinical practice. Other barriers mentioned by physiotherapists with experience in VR are electrical energy and an internet connection.

The findings indicated various challenges in implementing VR at home, with healthcare professionals expressing the greatest concern about patient safety. This is in line with Dy et al. (94), as patients could injure themselves while being in the virtual environment. In addition, physiotherapists in Brady et al. (97), expressed concerns about insurance coverage in the event of a patient falling. While the HMD required the user to draw a safe boundary before using VR, physiotherapists said patients could fall over something, as the patient is not able to see the real world. The study related a high level of immersion with safety, as patients can get caught up in the virtual environment. The quantitative results in this study show that participants experienced a high level of presence in the virtual environment, implying that the Walk in Nature program is an immersive environment. However, immersion is associated with the feeling of presence, which is a key factor in VR's capability of pain management. This means that immersion is also seen as a facilitator in VR. Besides, some patients in Garett et al. (102) noted that the current price could be a barrier, and physiotherapists in the study by Brady et al. (94) said costs are a significant factor when implementing VR.

Facilitating conditions in a physiotherapy setting

An important facilitator about the physiotherapy practice is that both groups said there is enough space to implement VR. Besides, healthcare professionals would like to implement VR in the physiotherapy practice is that they can guarantee the safety of the patient. Although the guidance of a physiotherapist is seen as an important facilitator in the physiotherapy practice, it is also a barrier. The quantitative results show that the program is associated with a high level of presence, causing a highly immersive environment. In addition, both groups said the noise of other patients or physiotherapists in the exercise room distract the patient from the virtual environment. For example, one patient said the physiotherapist needs to consider how to approach the patient in the virtual environment, because any distraction from the real world will negatively influence the level of presence in the virtual world. Conversely, some patients reported no barriers to integrating VR in a physiotherapy setting, related to the space and the guidance provided by physiotherapists. However, physiotherapists identified more barriers, as they need time to set-up the VR equipment, leading to less treatment time. They also said the chance the technology does not work is an obstable.

The results indicate that space is a facilitator to use VR in a physiotherapy setting, and healthcare professionals prefer a physiotherapy setting for ensuring safety. Yet, the noise in a physiotherapy setting is a barrier, as it declines focus and VR's pain management. Similarly, physiotherapists in Brady et al. (94) considered supervision of a physiotherapist as they would like to guarantee the patient's safety. They also stated that the immersive quality of VR is a key factor, because it distracts the patient from pain and reduces fear to move the painful shoulder. This implies that, while this is less an issue at home, it's crucial to consider guidance concerning immersion when implementing VR in physiotherapy practices.

Safety

According to healthcare professionals, ensuring patient safety at home is very important, though it is considered less critical in the physiotherapy practice where the therapist could monitor the patient. Notably, no patients experienced falls while using VR. Similarly, Groenveld et al. (91) assessed the tolerability of VR exercises in patients with post-COVID-19, by measuring motion sickness and safety of the patient, including falls. Patient safety was a significant consideration in Groenveld et al. (91) 's study, with two reported falls among 47 patients. The falls were linked to low oxygen levels associated with post-COVID-19 symptoms. Importantly, no falls were attributed to the virtual environment immersion. This implies that, despite safety concerns being highlighted as a significant barrier to using VR at home, the current study indicates that VR is safe, as there are no reported incidents of patients falling

Attitude

Most patients have a positive attitude toward using VR in both settings. In addition, patients with prior experience in VR are more positive about using VR at home, as they know how to use the technology. Besides, healthcare professionals have a positive attitude toward VR in both settings. Yet, rheumatologists are negative about using VR in a physiotherapy setting, related to the insufficient guidance of a physiotherapist. Moreover, healthcare professionals are more positive about young patients using the technology, as they relate the elderly with not having the technical skills to use VR. In previous research by Kim et al. (102), attitude emerged as the key determinant of the intention to use the system. More importantly, the attitude toward using the system fully mediates the impact of performance expectancy and effort expectancy.

4.4 Strengths and limitations

A strength is that this study included a broad view of the feasibility of VR as exercise therapy. Firstly, the study included multiple perspectives (i.e. therapists and patients) and outcomes (acceptability and demand). Secondly, participants tested both the feasibility of VR and the Walk in Nature program of home and physiotherapy settings.

Other limitations concerning the study's reliability will be discussed, with the most impactful one explained first. Firstly, prior research indicates that motion sickness is impacted by both earlier experiences with VR and gender (103,104). It was anticipated that besides the VAS-pain score, sex, age, and disease activity could influence both the intention to use and the demand influence the feasibility. Furthermore, certain studies have demonstrated that presence is influenced by both gender and prior VR experience (105,106). However, the small sample size prevented the questionnaires from gathering sufficient data to test hypotheses regarding the acceptability of VR.

Secondly, the researcher tried to reduce interview bias by not asking suggestive questions. It is essential to note that throughout the data analysis, one researcher conducted all interviews, transcribed them, and carried out the coding process. To enhance the study's reliability, it would have been beneficial to involve two researchers in the coding process and compare their outcomes. To address this limitation and increase reliability, the transcripts underwent multiple rounds of coding. However, it's noteworthy that code saturation was not achieved for healthcare professionals. This is attributed to the group's composition, which consisted of three participants from each discipline: physiotherapists experienced in VR, physiotherapists experienced in axial spondyloarthritis, and rheumatologists. The lack of a sufficient number of healthcare professionals in the same discipline prevented the achievement of code saturation in this particular group. Resulting in an incomplete feasibility study, as there might be more important facilitators or barriers related to the demand for VR as exercise therapy.

Thirdly, according to Rogers (77), participants with an affinity with technology are more likely to adopt the innovation. The inclusion criteria encompassed participants both with and without this affinity. However, all participants did possess an affinity with technology. This might impact the results, as those without an affinity with technology could potentially perceive more barriers to implementing VR at home, while participants with an affinity are more positive about implementing VR.

Lastly, the Walk in Nature program consisted of several bugs and limitations influencing the functioning of the exercises. First, the breathing tree did not expand and shrunk with each breath. In addition, the tree would occasionally disappear while certain participants were performing the exercise. Second, about two butterflies were positioned beyond the defined boundaries of the virtual environment. As a result, participants were unable to catch the butterflies that were situated outside the border. Unfortunately, the software developer could not spend enough hours on the project to fix these errors.

4.5 Theoretical and clinical implications

The results of our study suggest several clinical and theoretical implications. Firstly, according to the quantitative results, VR is acceptable as exercise therapy. Yet, to improve the acceptability, further research should include different patient characteristics, to investigate the acceptability. For instance, varying levels of disease activity could be explored to study motion sickness after using VR, and the connection between presence in the virtual environment and VR's pain management.

Secondly, while healthcare professionals envision more potential in developing the Walk in Nature program as exercise therapy compared to patients, there is currently a low perceived demand for the Walk in Nature program. According to the Persuasive System Model, additional research into the feasibility of the Walk in Nature program should mainly concentrate on primary task support, like reducing the effort required to use the technology and offering feedback on exercise performance. Furthermore, future research should prioritize a comprehensive inclusion of features from all areas of the Persuasive System Model to thoroughly engage and persuade users.

Thirdly, the intention to use VR in a home and physiotherapy setting is high. VR could function as a motivator to exercise, targeting the low adherence rates to physical activity in patients with axSpA. Most patients currently prefer using VR in the physiotherapy practice for guided usage, this is mainly due to VR's perceived complexity. However, with a proper introduction, most patients become capable of using VR at home. In contrast, healthcare professionals prefer implementing VR at home, as VR already guides the patient, making the guidance of a physiotherapist insufficient. Besides, both groups said VR can work as exercise therapy in addition to physical therapy. This is related to the physiotherapist being able to motivate the patient to exercise and provide feedback regarding the exercises. A physiotherapist can also ensure the safety and help the patient while using the technology. However, enhancing VR and the Walk in Nature program could address these issues, particularly by incorporating features aligned with the Persuasive System Model to enhance usability. An example would be adding an instructional video to the program. Yet, it is recommended to examine the influence of these features to comprehensively indicate if VR can be used as a stand-alone treatment, or is still recommended to use in addition to physical therapy.

Lastly, there are several barriers to implementing VR. While there appear to be more barriers to implementing VR at home, the noise in a physiotherapy setting is considered a significant obstacle. At home, insufficient space is the primary barrier for patients, whereas patient safety is the primary concern for healthcare professionals. Nevertheless, the results and prior research indicate that there are no falls related to using VR. However, this study offers initial insights into the facilitators and barriers. To enhance the reliability of the findings, further research should be conducted in real-world contexts, considering that feasibility testing was carried out in a laboratory setting rather than in actual homes and physiotherapy settings. Additionally, it is advisable to conduct small-scale clinical trials to assess preliminary clinical effectiveness and feasibility before progressing to large-scale Randomized Controlled Trials (RCT).

5. Conclusion

This study aimed to explore the feasibility of VR as exercise therapy for patients with axial spondyloarthritis in home and physiotherapy settings, by including patients' and healthcare professionals’ perspectives. The results show that VR has the potential to function as exercise therapy at home and in a physiotherapy setting. Further investigation into the perspectives of utilizing VR both at home and in the physiotherapy practice settings is essential to gain a comprehensive understanding of the possibilities and challenges associated with integrating VR into clinical practice for this population. This exploration will inform the future development of VR as a form of exercise therapy. Findings from this study highlight the importance of future research.

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Appendices

Appendix 1 Questionnaires

1.a Socio-demographic questionnaire patients

Deelname aan het onderzoek: VR en Bechterew - patiënt

Start van blok:

Vraag 1 U bent door uw reumatoloog uitgenodigd om mee te doen aan een onderzoek naar de toepasbaarheid van Virtual Reality als oefentherapie voor patiënten met Bechterew. Het onderzoek wordt door Myrthe Franke uitgevoerd, een Master student van de studie Gezondheidswetenschappen aan de Universiteit Twente.
U heeft een informatieformulier ontvangen, heeft de onderzoeker telefonisch gesproken en geeft aan mee te willen doen aan het onderzoek.

Als participant gebruikt u eenmalig de Virtual Reality, vult u na de tijd een vragenlijst in en wordt er een interview gedaan. Voor deelname komt u zelf naar de Universiteit Twente (op de campus in Enschede). De onderzoeker is tijdens het onderzoek aanwezig om u continu te begeleiden bij de Virtual Reality.

Heeft u vragen over het onderzoek? Stuur dan gerust een mail naar myrthe.franke@mst.nl
De onderzoeker streeft ernaar binnen 24 uur antwoord te geven op uw vraag en zou ook telefonisch contact met u op kunnen nemen om meer duidelijkheid te scheppen.

Met deze vragenlijst worden demografische gegevens (leeftijd, geslacht, nationaliteit etc.) uitgevraagd. Daarnaast wordt de ziekteactiviteit in kaart gebracht. Dit is belangrijk, omdat de toepasbaarheid van Virtual Reality zou kunnen verschillen tussen patiënten.

U heeft informatie over het onderzoek op papier van uw reumatoloog meegekregen. De laatste pagina bevat een toestemmingsformulier. Als u deze ondertekent kunt u deelnemen aan het onderzoek. Mocht u het formulier kwijt zijn, deze kunt u ook tijdens de afspraak op de Universiteit ondertekenen. Heeft u bovenstaande informatie gelezen en gaat u akkoord?

○ Ja (1)

○ Nee (2)

Einde blok:

Start van blok: Demografische gegevens

Vraag 3 Wat is uw geslacht?

- ○ Man (1)
- ○ Vrouw (2)
- ○ Niet-binair/derde geslacht (3)
- ○ Ik zeg dat liever niet (4)

Pagina-einde

*

Vraag 4 Wat is uw geboortedatum?

____

Vraag 5 Wat is uw nationaliteit?

____

Vraag 6 Wat is uw hoogst behaalde diploma?

- ◯ Basisonderwijs (1)
- ◯ VMBO (2)
- ◯ HAVO (3)
- ◯ VWO (4)
- ◯ Bachelor (HBO / WO) (5)
- ◯ Master (HBO / WO) (6)
- ◯ Doctor, PhD (7)

Einde blok: Demografische gegevens

Start van blok: Ziekte activiteit in kaart brengen

Vraag 7 Om de ziekte activiteit van Bechterew in kaart te brengen.
Zou u op een schaal van 0 (geen klachten) tot en met 10 (veel klachten), de ernst van de klachten over de afgelopen 7 dagen willen aangeven?

0	1	2	3	4	5	6	7	8	9	10

Hoe moe was u? ()	
Hoeveel pijn in de nek, rug of heupen had u als gevolg van de ziekte van Bechterew? ()	
Hoeveel pijn en zwelling had u in andere gewrichten dan de nek, rug en heupen? ()	
Hoeveel last had u van plaatsen op uw lichaam die gevoelig zijn bij aanraken of druk? ()	
Hoeveel last had u van ochtendstijfheid vanaf het moment dat u opstond? ()	

Vraag 9 Hoe lang duurde de ochtendstijfheid vanaf het moment dat u opstond?

	0	15	30	45	60	75	90	105	120
In minuten ()									

Einde blok: Ziekte activiteit in kaart brengen

Start van blok: Medische gegevens

Vraag 10 Heeft u naast Bechterew een andere lichamelijke aandoening?

○ Ja (1)

○ Nee (2)

*

Vraag 11 Sinds welk jaar bent u gediagnosticeerd met de ziekte van Bechterew?

____

Vraag 12 Gebruikt u medicijnen voor Bechterew?

- ▢ Nee (1)
- ▢ Paracetamol (2)
- ▢ NSAID's: bijvoorbeeld ibuprofen en/of naproxen (3)
- ▢ Conventionele synthetische DMARDs: bijvoorbeeld methotrexaat (4)
- ▢ Biologic DMARDs: bijvoorbeeld Anti-TNF therapie zoals etanercept (5)

Einde blok: Medische gegevens

Start van blok: Includeren onderzoek

Vraag 13 Heeft u ernstige audiovisuele beperkingen?

- ○ Ja (1)
- ○ Nee (2)

Vraag 14 Heeft u een van de volgende aandoeningen?: duizeligheid, psychiatrische voorgeschiedenis, evenwichtsstoornissen, en/of claustrofobie?

- ◯ Ja (1)
- ◯ Nee (2)

Vraag 15 Kunt u overweg met technologie, zoals een smartphone, tablet of computer?

- ◯ Ja (1)
- ◯ Onzeker (2)
- ◯ Nee (3)

Einde blok: Includeren onderzoek

1.b Socio-demographic questionnaire healthcare professionals

V2. Deelname aan het onderzoek: VR en Bechterew - zorgprofessional

Start van blok:

Vraag 1 U bent door een onderzoeker uitgenodigd om mee te doen aan een onderzoek over de toepasbaarheid van Virtual Reality als oefentherapie voor patiënten met Bechterew. Het onderzoek wordt door Myrthe Franke uitgevoerd, een Master student van de studie Gezondheidswetenschappen aan de Universiteit Twente.

Als participant gebruikt u eenmalig de Virtual Reality, vult u na de tijd een vragenlijst in en wordt er een interview met u gedaan. Voor deelname komt u zelf naar de Universiteit Twente (op de campus in Enschede). De onderzoeker is tijdens het onderzoek aanwezig om u continu te begeleiden bij de Virtual Reality.

Heeft u vragen over het onderzoek? Stuur dan gerust een mail naar myrthe.franke@mst.nl
De onderzoeker streeft ernaar binnen 24 uur antwoord te geven op uw vraag en zou ook telefonisch contact met u op kunnen nemen om meer duidelijkheid te scheppen.

Met deze vragenlijst worden demografische gegevens uitgevraagd. Daarnaast wordt uw ervaring als zorgprofessional uitgevraagd. Dit is belangrijk, omdat de toepasbaarheid van Virtual Reality zou kunnen verschillen tussen zorgprofessionals.

U bent door de onderzoeker geïnformeerd over het onderzoek. Ook bent u ervan op de hoogte dat er een informed consent getekend moet worden. Als u deze ondertekent, kunt u deelnemen aan het onderzoek. Dit formulier kan tijdens de afspraak op de Universiteit ondertekent worden (voorafgaand het gebruik van de VR).
Daarnaast is het mogelijk om de reiskosten te declareren. Het declaratie formulier krijgt u mee tijdens uw afspraak voor de VR.
Heeft u bovenstaande informatie gelezen en gaat u akkoord?

○ Ja (1)

○ Nee (2)

Einde blok:

Start van blok: Demografische gegevens

Vraag 2 Wat is uw onderzoeksnummer?

____

Vraag 3 Wat is uw geslacht?

- ○ Man (1)
- ○ Vrouw (2)
- ○ Niet-binair/derde geslacht (3)
- ○ Ik zeg dat liever niet (4)

Pagina-einde

Vraag 4 Wat is uw geboortedatum?

____

Vraag 5 Wat is uw hoogst behaalde diploma?

○ Bachelor (HBO / WO) (1)

○ Master (HBO / WO) (2)

○ Doctor, PhD (3)

Einde blok: Demografische gegevens

Start van blok: Zorgprofessional

Vraag 6 Wat is uw huidige functie?

○ Fysiotherapeut (1)

○ Reumatoloog (2)

Vraag 7 Hoe lang bent u werkzaam in uw huidige functie?

○ 0 t/m 2 jaar (1)

○ 2 t/m 5 jaar (2)

○ 5 of meer jaar (3)

Vraag 8 Heeft u ervaring in het gebruik van Virtual Reality?

- ○ Ja (1)
- ○ Nee (2)

Einde blok: Zorgprofessional

Start van blok: Includeren onderzoek

Vraag 9 Heeft u een van de volgende aandoeningen? U kunt meerdere antwoorden selecteren.

- ▢ Duizeligheid (1)
- ▢ Psychiatrische voorgeschiedenis (3)
- ▢ Evenwichtsstoornissen (4)
- ▢ Claustrofobie (5)
- ▢ Geen van bovenstaande aandoeningen (6)

Vraag 10 Kunt u overweg met technologie, zoals een smartphone, tablet of computer?

- ○ Ja (1)
- ○ Onzeker (2)
- ○ Nee (3)

Einde blok: Includeren onderzoek

1.c Questionnaire after VR patients

Vragenlijst na het gebruik van VR - patient

Start van blok: Data verwerken

Q14 Wat is uw onderzoeksnummer?

____

Einde blok: Data verwerken

Start van blok: VAS

Q4 Om inzicht te krijgen in de hoeveelheid klachten die u op dit moment van Bechterew ervaart, wordt er een score van 0 tot 10 uitgevraagd. Als u geen verschil in klachten voelt vergeleken voor het gebruik van Virtual Reality, vult u hetzelfde getal als voor gebruik in.
Daarbij is een score van 0 (geen klachten) en een score van 10 (veel klachten).

	0	1	2	3	4	5	6	7	8	9	10
Kunt u een cijfer geven voor de hoeveelheid klachten die u op dit moment ervaart? ()											

Einde blok: VAS

Start van blok: VRSQ

Q1 Het kan zijn dat u zich onwel voelt door de VR bril.
Ervaart u een algemeen ongemak door het gebruik van Virtual Reality? (zoals vermoeidheid, hoofdpijn

of misselijkheid)

- ◯ Geen (1)
- ◯ Licht (2)
- ◯ Matig (3)
- ◯ Ernstig (4)

Q2 Ervaart u vermoeide ogen door het gebruik van Virtual Reality?

- ◯ Geen (1)
- ◯ Licht (2)
- ◯ Matig (3)
- ◯ Ernstig (4)

Einde blok: VRSQ

Start van blok: IPQ

Q6 Door de VR bril voelt het alsof u in een virtuele wereld bent. Dit wordt het gevoel van aanwezigheid in de virtuele wereld genoemd.
Onderstaande vragen gaan over het beoordelen van het gevoel van aanwezigheid bij het gebruik van Virtual Reality. Hierbij kunt u een score van 0 (helemaal mee oneens) tot 8 (helemaal mee eens) gebruiken.

	0	1	2	3	4	5	6	7	8

Ik had het gevoel aanwezig te zijn in de computerwereld ()	
Ik had het gevoel omgeven te zijn door de virtuele wereld ()	
Ik had het gevoel slechts plaatjes te aanschouwen ()	
Ik had het gevoel in de virtuele ruimte aanwezig te zijn ()	
Ik had meer het gevoel bezig te zijn in de virtuele ruimte, dan dat ik het gevoel had iets van buitenaf te bedienen ()	
Ik voelde me aanwezig in de virtuele ruimte ()	
Hoe bewust was u zich van de echte omgeving (bv. geluiden van buiten, kamertemperatuur), terwijl u zich bevond in de virtuele ruimte? ()	
Ik was me niet bewust van mijn echte omgeving ()	
Ik lette nog op de echte omgeving ()	
Ik ging volledig op in de virtuele wereld ()	
Hoe echt kwam de virtuele omgeving op u over? ()	
In hoeverre kwam uw ervaring in de virtuele omgeving overeen met uw ervaringen in de echte wereld? ()	
Hoe werkelijk kwam de virtuele wereld op u over? ()	
De virtuele wereld kwam echter op mij over dan de werkelijke wereld ()	

Einde blok: IPQ

Start van blok: UEQ-s

Q7 De gebruikerservaring van de VR bril als oefentherapie bij Bechterew wordt tweemaal uitgevraagd: de gebruikerservaring in de thuissituatie en in de fysiotherapiepraktijk.
De volgende 8 vragen gaan over de gebruikerservaring van de VR bril als oefentherapie in de thuissituatie. De vragen gaan dus niet over de ervaring van de oefeningen die u met de VR bril doet, maar over de gebruikerservaring van de VR bril.
U beslist welke van de twee keuzes het meest belangrijk voor u zijn door de schuifer te verslepen. U kunt uw keuze verdelen, door de schuifer niet helemaal naar links of rechts te verslepen. Zo geeft u aan hoe belangrijk een keuze is ten opzicht van de andere keuze.

Zou u oefentherapie met de VR bril in de thuissituatie als belemmerend of ondersteunend ervaren?

	Belemmerend	Ondersteunend
	-3 -2 -1 0 1 2 3	
Antwoord ()		

Q10 Zou u oefentherapie met de VR bril in de thuissituatie als complex of eenvoudig ervaren?

	Complex	Eenvoudig
	-3 -2 -1 0 1 2 3	
Antwoord ()		

Q11 Zou u oefentherapie met de VR bril in de thuissituatie als inefficiënt of efficiënt ervaren?

Inefficiënt Efficiënt

	-3	-2	-1	0	1	2	3
Antwoord ()							

Q12 Zou u oefentherapie met de VR bril in de thuissituatie als verwarrend of overzichtelijk ervaren?

	Verwarrend					Overzichtelijk	
	-3	-2	-1	0	1	2	3
Antwoord ()							

Q17 Zou u oefentherapie met de VR bril in de thuissituatie als vervelend of spannend ervaren?

	Vervelend					Spannend	
	-3	-2	-1	0	1	2	3
Antwoord ()							

Q18 Zou u oefentherapie met de VR bril in de thuissituatie als oninteressant of interessant ervaren?

	Oninteressant					Interessant
-3	-2	-1	0	1	2	3

Antwoord ()

Q19 Zou u oefentherapie met de VR bril in de thuissituatie als conventioneel (ouderwets) of origineel ervaren?

	Conventioneel					Origineel
-3	-2	-1	0	1	2	3

Antwoord ()

Q20 Zou u oefentherapie met de VR bril in de thuissituatie als gebruikelijk of nieuw ervaren?

	Gebruikelijk					Nieuw
-3	-2	-1	0	1	2	3

Antwoord ()

Einde blok: UEQ-s

Start van blok: Blok 5

Q21 De volgende 8 vragen gaan over de gebruikerservaring van de VR bril als oefentherapie in de fysiotherapiepraktijk. De vragen gaan dus niet over de ervaring van de oefeningen die u met de VR bril doet, maar over de gebruikerservaring van de VR bril.
U beslist welke van de twee keuzes het meest belangrijk voor u zijn door de schuifer te verslepen. U kunt uw keuze verdelen, door de schuifer niet helemaal naar links of rechts te verslepen. Zo geeft u aan hoe belangrijk een keuze is ten opzicht van de andere keuze.

Zou u oefentherapie met de VR bril in de fysiotherapie praktijk als belemmerend of ondersteunend ervaren?

	Belemmerend				Ondersteunend		
	-3	-2	-1	0	1	2	3
Antwoord ()							

Q22 Zou u oefentherapie met de VR bril in de fysiotherapie praktijk als complex of eenvoudig ervaren?

	Complex				Eenvoudig		
	-3	-2	-1	0	1	2	3
Antwoord ()							

Q23 Zou u oefentherapie met de VR bril in de fysiotherapie praktijk als inefficiënt of efficiënt ervaren?

	Inefficiënt					Efficiënt
-3	-2	-1	0	1	2	3

Klik om optie 1 te schrijven ()

Q24 Zou u oefentherapie met de VR bril in de fysiotherapie praktijk als verwarrend of overzichtelijk ervaren?

	Verwarrend					Overzichtelijk
-3	-2	-1	0	1	2	3

Antwoord ()

Q25 Zou u oefentherapie met de VR bril in de fysiotherapie praktijk als vervelend of spannend ervaren?

	Vervelend					Spannend
-3	-2	-1	0	1	2	3

Antwoord ()

Q26 Zou u oefentherapie met de VR bril in de fysiotherapie praktijk als oninteressant of interessant ervaren?

	Oninteressant					Interessant	
	-3	-2	-1	0	1	2	3
Antwoord ()							

Q27 Zou u oefentherapie met de VR bril in de fysiotherapie praktijk als conventioneel (ouderwets) of origineel ervaren?

	Conventioneel					Origineel	
	-4	-3	-2	-0	1	2	3
Antwoord ()							

Q28 Zou u oefentherapie met de VR bril in de fysiotherapie praktijk als gebruikelijk of nieuw ervaren?

	Gebruikelijk					Nieuw	
	-3	-2	-1	0	1	2	3

Antwoord ()	

Einde blok: Blok 5

1.d Questionnaire after VR healthcare professionals

Vragenlijst na het gebruik van VR - zorgprofessional

Start van blok: Data verwerken

*

Q21 Wat is uw onderzoeksnummer?

____

Einde blok: Data verwerken

Start van blok: VRSQ

Q1 Het kan zijn dat u zich onwel voelt door de VR bril.
Ervaart u een algemeen ongemak door het gebruik van Virtual Reality? (zoals vermoeidheid, hoofdpijn of misselijkheid)

- ◯ Geen (1)
- ◯ Licht (2)
- ◯ Matig (3)
- ◯ Ernstig (4)

Q2 Ervaart u vermoeide ogen door het gebruik van Virtual Reality?

○ Geen (1)

○ Licht (2)

○ Matig (3)

○ Ernstig (4)

Einde blok: VRSQ

Start van blok: IPQ

Q6 Door de VR bril voelt het alsof u in een virtuele wereld bent. Dit wordt het gevoel van aanwezigheid (presence) in de virtuele wereld genoemd.
Onderstaande vragen gaan over het beoordelen van het gevoel van presence bij het gebruik van Virtual Reality. Hierbij kunt u een score van 0 (helemaal mee oneens) tot 8 (helemaal mee eens) gebruiken.

	0	1	2	3	4	5	6	7	8

Ik had het gevoel aanwezig te zijn in de computerwereld ()	
Ik had het gevoel omgeven te zijn door de virtuele wereld ()	
Ik had het gevoel slechts plaatjes te aanschouwen ()	
Ik had het gevoel in de virtuele ruimte aanwezig te zijn ()	
Ik had meer het gevoel bezig te zijn in de virtuele ruimte, dan dat ik het gevoel had iets van buitenaf te bedienen ()	
Ik voelde me aanwezig in de virtuele ruimte ()	
Hoe bewust was u zich van de echte omgeving (bv. geluiden van buiten, kamertemperatuur), terwijl u zich bevond in de virtuele ruimte? ()	
Ik was me niet bewust van mijn echte omgeving ()	
Ik lette nog op de echte omgeving ()	
Ik ging volledig op in de virtuele wereld ()	
Hoe echt kwam de virtuele omgeving op u over? ()	
In hoeverre kwam uw ervaring in de virtuele omgeving overeen met uw ervaringen in de echte wereld? ()	
Hoe werkelijk kwam de virtuele wereld op u over? ()	
De virtuele wereld kwam echter op mij over dan de werkelijke wereld ()	

Einde blok: IPQ

Start van blok: UEQ-s

Q7 De gebruikerservaring van de VR bril als oefentherapie bij Bechterew wordt tweemaal uitgevraagd: de gebruikerservaring in de thuissituatie en in de fysiotherapiepraktijk.
De volgende 8 vragen gaan over de gebruikerservaring van de VR bril als oefentherapie in de thuissituatie. De vragen gaan dus niet over de ervaring van de oefeningen die u met de VR bril doet, maar over de gebruikerservaring van de VR bril.
U beslist welke van de twee keuzes het meest belangrijk voor u zijn door de schuifer te verslepen. U kunt uw keuze verdelen, door de schuifer niet helemaal naar links of rechts te verslepen. Zo geeft u aan hoe belangrijk een keuze is ten opzicht van de andere keuze.

Zou u oefentherapie met de VR bril in de thuissituatie als belemmerend of ondersteunend ervaren?

Belemmerend Ondersteunend

-3 -2 -1 0 1 2 3

Antwoord ()

Q10 Zou u oefentherapie met de VR bril in de thuissituatie als complex of eenvoudig ervaren?

Complex Eenvoudig

-3 -2 -1 0 1 2 3

Antwoord ()

Q11 Zou u oefentherapie met de VR bril in de thuissituatie als inefficiënt of efficiënt ervaren?

Inefficiënt Efficiënt

	-3	-2	-1	0	1	2	3
Antwoord ()							

Q12 Zou u oefentherapie met de VR bril in de thuissituatie als verwarrend of overzichtelijk ervaren?

	Verwarrend					Overzichtelijk	
	-3	-2	-1	0	1	2	3
Antwoord ()							

Q17 Zou u oefentherapie met de VR bril in de thuissituatie als vervelend of spannend ervaren?

	Vervelend					Spannend	
	-3	-2	-1	0	1	2	3
Antwoord ()							

Q18 Zou u oefentherapie met de VR bril in de thuissituatie als oninteressant of interessant ervaren?

	Oninteressant					Interessant	
	-3	-2	-1	0	1	2	3
Antwoord ()							

Q19 Zou u oefentherapie met de VR bril in de thuissituatie als conventioneel (ouderwets) of origineel ervaren?

	Conventioneel					Origineel	
	-3	-2	-1	0	1	2	3
Antwoord ()							

Q20 Zou u oefentherapie met de VR bril in de thuissituatie als gebruikelijk of nieuw ervaren?

	Gebruikelijk					Nieuw	
	-3	-2	-1	0	1	2	3
Antwoord ()							

Einde blok: UEQ-s

Start van blok: Blok 4

Q23 De volgende 8 vragen gaan over de gebruikerservaring van de VR bril als oefentherapie in de fysiotherapiepraktijk. De vragen gaan dus niet over de ervaring van de oefeningen die u met de VR bril doet, maar over de gebruikerservaring van de VR bril.
U beslist welke van de twee keuzes het meest belangrijk voor u zijn door de schuifer te verslepen. U kunt uw keuze verdelen, door de schuifer niet helemaal naar links of rechts te verslepen. Zo geeft u aan hoe belangrijk een keuze is ten opzicht van de andere keuze.

Zou u oefentherapie met de VR bril in de fysiotherapiepraktijk als belemmerend of ondersteunend ervaren?

	Belemmerend	Ondersteunend
	-3 -2 -1 0 1 2 3	
Antwoord ()		

Q24 Zou u oefentherapie met de VR bril in de fysiotherapiepraktijk als complex of eenvoudig ervaren?

	Complex	Eenvoudig
	-3 -2 -1 0 1 2 3	
Antwoord ()		

Q25 Zou u oefentherapie met de VR bril in de fysiotherapiepraktijk als inefficiënt of efficiënt ervaren?

	Inefficiënt	Efficiënt
	-3 -2 -1 0 1 2 3	
Antwoord ()		

Q26 Zou u oefentherapie met de VR bril in de fysiotherapiepraktijk als verwarrend of overzichtelijk ervaren?

	Verwarrend	Overzichtelijk
	-3 -2 -1 0 1 2 3	
Antwoord ()		

Q27 Zou u oefentherapie met de VR bril in de fysiotherapiepraktijk als vervelend of spannend ervaren?

	Vervelend	Spannend
	-3 -2 -1 0 1 2 3	
Antwoord ()		

Q28 Zou u oefentherapie met de VR bril in de fysiotherapiepraktijk als oninteressant of interessant ervaren?

	Oninteressant					Interessant	
	-3	-2	-1	0	1	2	3
Antwoord ()							

Q29 Zou u oefentherapie met de VR bril in de fysiotherapiepraktijk als conventioneel (ouderwets) of origineel ervaren?

	Conventioneel					Origineel	
	-3	-2	-1	0	1	2	3
Antwoord ()							

Q30 Zou u oefentherapie met de VR bril in de fysiotherapiepraktijk als gebruikelijk of nieuw ervaren?

	Gebruikelijk					Nieuw	
	-3	-2	-1	0	1	2	3

Antwoord ()	

Einde blok: Blok 4

1.e Interview scheme

Interview patiënten

Introductie
1. Introductie van de interviewer
2. Ik neem dit interview af voor mijn scriptie van de master Gezondheidswetenschappen aan de Universiteit Twente.
3. Naast medicatie, is fysieke activiteit belangrijk om symptomen van Bechterew te verminderen. Maar een klein deel van de patiënten (29%) houdt zich aan de voorgeschreven oefeningen. Opties voor niet-medicamenteuze behandelingen zijn fysieke activiteit onder supervisie, zoals oefengroepen en fysiotherapie. Bij een vorm van fysieke activiteit zonder supervisie kan er gedacht worden aan thuisoefeningen.
4. Het doel van dit onderzoek is om te achterhalen of oefeningen met een VR-bril als oefentherapie ingezet kan worden. Daarvoor is het belangrijk om te onderzoeken hoe toepasbaar de VR bril en de oefeningen die daarbij horen, momenteel zijn. Om dit te onderzoeken wordt er onder andere een interview met u gedaan.
5. Om de toepasbaarheid van de VR bril te onderzoeken is het belangrijk dat u zich kunt inbeelden de VR bril in de thuissituatie of in de fysiotherapiepraktijk te gebruiken.
6. Het interview zal ongeveer een halfuur duren.
7. Het interview is volledig vertrouwelijk en uw data wordt alleen voor onderzoeksdoeleinden gebruikt. U kunt het interview stoppen wanneer u wil. Het interview wordt opgenomen en de opname wordt na het verwerken van de data verwijderd. Bij het ondertekenen van het toestemmingsformulier heeft u akkoord gegeven voor het opnemen van het interview. Heeft u hier nog vragen over?
8. Is het doel van het interview duidelijk? Anders leg ik het graag nog een keer voor u uit.
9. Heeft u nog andere vragen voordat het interview start?

Interview schema

Vragenlijsten/model	**Vragen**
First impression	Hoe voelt u zich nadat u de VR bril heeft gebruikt?
Data-analysis	Wat is uw onderzoeksnummer?
UTUAT, performance expectancy	
	Wat zijn volgens u de voordelen van het gebruik van de VR bril als oefentherapie in de thuissituatie?
	En hoe denkt u over de voordelen van het gebruik van de VR in de fysiotherapiepraktijk?
	Wat zijn volgens u de nadelen van het gebruik van de VR bril als oefentherapie in de thuissituatie?
	En hoe denkt u over de nadelen van het gebruik van de VR in de fysiotherapiepraktijk?
UTUAT, effort expectancy (ease of use)	Welke veranderingen zijn nodig om de VR bril gemakkelijker als oefentherapie te kunnen gebruiken?
	Kunt u een voorbeeld geven om het gebruik van de VR bril in de thuissituatie makkelijker te maken?
	Kunt u een voorbeeld geven om het gebruik van de VR bril in de fysiotherapiepraktijk makkelijker te maken?
UTUAT, social influence	Zou de VR bril zonder begeleiding van een zorgverlener in de thuissituatie gebruikt kunnen worden?
	Bij ja: Waarom denkt u dat? Bij nee: Waarbij moet de zorgverlener u begeleiden? En waarom?
	Wat voor invloed zou de fysiotherapeut kunnen hebben op het gebruik van de VR in de fysiotherapiepraktijk?
UTUAT, facilitating conditions	Wat zouden mogelijke barrières kunnen zijn om de VR bril in de thuissituatie te gebruiken?
	En hoe kunnen deze barrières worden verminderd?
	Wat zouden mogelijke barrières kunnen zijn om de VR bril in de fysiotherapiepraktijk te gebruiken?
	En hoe kunnen deze barrières worden verminderd?

	Bij de huidige VR loop je rond om de oefeningen uit te voeren, zou dit u kunnen beperken in de thuissituatie?
	En hoe?
	En zou dit u kunnen beperken in de fysiotherapiepraktijk?
	En hoe?
UTUAT, attitude towards using technology	Stel u voor dat uw reumatoloog u zou adviseren om de VR bril als oefentherapie in de thuissituatie te gebruiken. Heeft u een positieve of negatieve houding over de VR bril als oefentherapie?
	Kunt u tenminste een reden geven voor deze houding?
	Stel u voor dat uw reumatoloog u zou adviseren om de VR bril als oefentherapie in de fysiotherapiepraktijk te gebruiken. Heeft u een positieve of negatieve houding over de VR bril als oefentherapie?
	Kunt u tenminste een reden geven voor deze houding?
	En heeft u een positieve of negatieve houding over het adviseren van de VR bril als oefentherapie in de fysiotherapiepraktijk?
Suitability of the WN program as exercise therapy	De Virtual Reality biedt drie oefeningen in een natuurlijke omgeving aan: een ademhalingsoefening, een yogaoefening, en een strekoefening (vlinder oefening). Denkt u dat deze oefeningen uw symptomen kunnen verminderen?
	Waarom denkt u dat?
	Welke verbeteringen stel je voor om de ademhalingsoefening beter aan te laten sluiten als oefentherapie voor Bechterew?
	Welke verbeteringen stel je voor om de vlinder oefening beter aan te laten sluiten als oefentherapie voor Bechterew?
	Welke verbeteringen stel je voor om de yogaoefening beter aan te laten sluiten als oefentherapie voor Bechterew?
	Welke andere oefeningen zouden volgens u bij het programma passen om symptomen van Bechterew te verminderen?
	Denkt u dat de VR bril, beter in de thuissituatie of in de fysiotherapiepraktijk als oefentherapie kan worden aangeboden?
	Ziet u zichzelf de VR bril gebruiken als oefentherapie?
	Waarom denkt u dat?

Interview zorgverleners

Introductie

1. Introductie van de interviewer
2. Ik neem dit interview af voor mijn scriptie van de master Gezondheidswetenschappen aan de Universiteit Twente.
3. Fysieke activiteit is een belangrijk onderdeel van de behandeling bij Bechterew. Maar een klein deel van de patiënten (29%) houdt zich aan de voorgeschreven oefeningen. Opties voor niet-medicamenteuze behandelingen zijn fysieke activiteit onder supervisie, zoals oefengroepen en fysiotherapie. Bij een vorm van fysieke activiteit zonder supervisie kan er gedacht worden aan thuisoefeningen.
4. Het doel van dit onderzoek is om te achterhalen of de oefeningen die u zojuist met de VR bril heeft uitgevoerd, als oefentherapie ingezet kan worden. Daarvoor is het belangrijk om te onderzoeken hoe toepasbaar de VR bril en de oefeningen die daarbij horen, momenteel zijn. Om dit te onderzoeken wordt er onder andere een interview met u gedaan.
5. Het interview zal ongeveer een halfuur duren.
6. Het interview is volledig vertrouwelijk en uw data wordt alleen voor onderzoeksdoeleinden gebruikt. U kunt het interview stoppen wanneer u wil. Het interview wordt opgenomen en de

opname wordt na het verwerken van de data verwijderd. Bij het ondertekenen van het toestemmingsformulier heeft u akkoord gegeven voor het opnemen van het interview. Heeft u hier nog vragen over?

7. Is het doel van het interview duidelijk? Anders leg ik het graag nog een keer voor u uit.
8. Heeft u nog andere vragen voordat het interview start?

Vragenlijsten/model	**Vragen**
First impression	Hoe voelt u zich nadat u de VR bril heeft gebruikt?
Data-analysis	Wat is uw onderzoeksnummer?
Earlier experiences of VR	Als u eerder met VR hebt gewerkt, voor welke therapiedoeleinden heeft u het ingezet?
UTUAT, performance expectancy	Wat zouden volgens u de voordelen van het gebruik van de VR bril als oefentherapie in de thuissituatie kunnen zijn?
	Wat zouden volgens u de nadelen van het gebruik van de VR bril als oefentherapie in de thuissituatie kunnen zijn?
	En wat zouden volgens u de voordelen kunnen zijn voor het gebruik van de VR in de fysiotherapiepraktijk?
	En wat zouden volgens u de nadelen kunnen zijn voor het gebruik van de VR in de fysiotherapiepraktijk?
UTUAT, effort expectancy (ease of use)	Welke veranderingen zijn nodig om de VR bril gemakkelijker als oefentherapie in te kunnen zetten?
	Kunt u een voorbeeld geven om het gebruik van de VR bril in de thuissituatie makkelijker te maken?
	Kunt u een voorbeeld geven om het gebruik van de VR bril in de fysiotherapiepraktijk makkelijker te maken?
UTUAT, social influence	Zou de VR bril zonder begeleiding van een zorgverlener in de thuissituatie gebruikt kunnen worden?
	Bij ja: Waarom denkt u dat? Bij nee: Waarbij moet de zorgverlener de patiënt begeleiden? En waarom?
	Wat voor invloed zou de fysiotherapeut kunnen hebben op het gebruik van de VR in de fysiotherapiepraktijk?
UTUAT, facilitating conditions	Wat zouden mogelijke barrières kunnen zijn om de VR bril in de thuissituatie te gebruiken?
	En hoe kunnen deze barrières worden verminderd?
	Wat zouden mogelijke barrières kunnen zijn om de VR bril in de fysiotherapiepraktijk te gebruiken?
	En hoe kunnen deze barrières worden verminderd?
	Bij de huidige VR loop je rond om de oefeningen uit te voeren, zou dit de patiënt kunnen beperken in de thuissituatie?
	En hoe?
	En zou dit de patiënt kunnen beperken in de fysiotherapiepraktijk?
	En hoe?
UTUAT, attitude towards using technology	Stel u voor dat u aan de patiënt zou adviseren om de VR bril als oefentherapie in de thuissituatie te gebruiken. Heeft u een positieve of negatieve houding over het adviseren van de VR bril als oefentherapie?
	En heeft u een positieve of negatieve houding over het adviseren van de VR bril als oefentherapie in de fysiotherapiepraktijk?
Suitability of the WN program as exercise treatment	De Virtual Reality biedt drie oefeningen in een natuurlijke omgeving aan: een ademhalingsoefening, een yogaoefening, en een strekoefening (vlinder oefening). Denkt u dat deze oefeningen symptomen van Bechterew kunnen verminderen?
	En waarom denkt u dat?

	Welke verbeteringen stel je voor om de ademhalingsoefening beter aan te laten sluiten als oefentherapie voor Bechterew?
	Welke verbeteringen stel je voor om de vlinder oefening beter aan te laten sluiten als oefentherapie voor Bechterew?
	Welke verbeteringen stel je voor om de yogaoefening beter aan te laten sluiten als oefentherapie voor Bechterew?
	Welke oefeningen zouden beter bij dit programma passen om Bechterew te behandelen?
	Denkt u dat de VR bril, beter in de thuissituatie of in de fysiotherapiepraktijk als oefentherapie kan worden aangeboden?
	Ziet u zichzelf de VR bril inzetten als oefentherapie?
	Waarom denkt u dat?

1.f Code tables

Patients

The number of interviews a quote was mentioned is categorized as N_{int} and the number of times a code was mentioned is categorized as N_{tot}.

Category	Main themes	Sub codes ($N_{int} \geq 2$)	N_{int}	N_{tot}
Intention to use VR of a home setting	Facilitating conditions: facilitators	Enough space	6	7
	Attitude	Positive	5	8
	Performance expectancy: facilitators	Personal preferences	5	8
	Effort expectancy: facilitators	Freedom	4	7
	Attitude	Earlier experience	4	7
	Social influences: facilitators	Can use VR without HP*	3	4
		Can use VR without HP*: instructions	3	3
	Performance expectancy: facilitators	Gamification	2	3
		Guidance VR and exercises	2	3
		Focus	2	2
		Value	2	2
	Effort expectancy: facilitators	Comfortable: silence	2	2
	Facilitating conditions: barriers	Space	6	8
	Social influences: barriers	Instructions	5	6
	Effort expectancy: barriers	Defect	4	5
	Effort expectancy: barriers	Heavy glasses	3	9
	Performance expectancy: barriers	Lack of motivation	3	7
		No added value exercises	3	5
	Facilitating conditions: barriers	Costs	3	5
	Performance expectancy: barriers	No feedback	3	4
	Facilitating conditons: barriers	Safety	3	3
	Performance expectancy: barriers	Technical skills	3	3
		Introduction to VR	3	3
	Performance expectancy: barriers	Addition to physical therapy	2	5
	Effort expectancy: barriers	Cable	2	4
	Attitude	No symptoms	2	3
	Effort expectancy: barriers	Less heavy glasses	2	3
		Variation in exercises	2	2
	Facilitating conditons: barriers	Help desk	2	2
Inention to use VR of a physiotherapy setting	Social influence: facilitators	Guidance exercises	7	14
		Guidance technology	4	6

	Facilitating conditions: facilitators	Separate room	4	4
		No barriers	3	3
	Performance expectancy: facilitators	Treat more patients	3	3
	Facilitating conditions: facilitators	Space	2	2
	Attitude	Positive	2	4
	Performance expectancy: barriers	No added value guidance physiotherapist	3	6
	Effort expectancy: barriers	Remove cable	2	4
	Facilitating conditions: barriers:	Noise	2	3
	Social influences: barriers	Guidance physiotherapist	2	2
	Performance expectancy: barriers	Not comfortable	2	2
WN program as exercise therapy	Butterfly task: facilitators	Fun	3	5
	WN program: facilitators	Presence	3	4
	Yoga exercise: facilitators	Stress relief	2	2
	WN program: barriers	Variation	4	5
	Yoga exercise: breathing bubble	Difficult	3	3
	WN program: barriers	Personal preferences	3	3
	Breathing tree: barriers	Visualization tree	3	3
	WN program: barriers	Focus on symptoms	2	6
	Yoga exercise: barriers	Too difficult	2	4
	Yoga exercise: barriers	Impatient	2	3
	WN program: barriers	Different levels	2	2
	Breathing tree: barriers	Too difficult	2	2
		Rushed feeling	2	2
	Butterfly task: barriers	Too easy	2	2
		Instructions	2	2
	Yoga exercise: barriers	No feedback	2	2

*Note. * healthcare professional*

Healthcare professionals

Category	**Main themes**	**Sub codes ($N_{int} \geq 2$)**	**N_{int}**	**N_{tot}**
Intention to use VR of a home setting	Attitude	Positive	7	10
	Facilitating conditions: facilitators	Enough space	6	11
	Performance expectancy: facilitators	Motivation	6	12
		Gamification	6	10
	Attitude	Positive: young target group	6	7
	Performance expectancy: facilitators	Personal preferences	5	8
		Guidance VR and exercises	5	8
	Effort expectancy: facilitators	Freedom	3	3
	Performance expectancy: facilitators	Value	3	3

	Facilitating conditions: barriers	Safety	7	18
	Performance expectancy: barriers	Technical skills	7	12
	Social influences: barriers	Instructions	6	11
	Facilitating conditions: barriers	Furniture	6	9
	Attitude	Negative: eldery	6	8
	Performance expectancy: barriers	Lack of motivation	5	9
		Easy to use	5	8
	Effort expectancy: barriers	Remove cable	5	5
	Performance expectancy: barriers	Addition to physical therapy	4	10
	Facilitating conditions: barriers	Costs	4	6
	Performance expectancy: barriers	Program in HMD	4	5
	Effort expectancy: barriers	Heavy glasses	4	4
	Performance expectancy: barriers	Independency	3	5
	Attitude	Negative	3	5
	Performance expectancy: barriers	Not comfortable	3	4
	Facilitating conditions: barriers	Improve safety	3	3
		No feedback	3	3
	Facilitating conditions: barriers	Pets	3	3
	Effort expectancy: barriers	Controllers	2	5
	Performance expectancy: barriers	Variation in exercises	2	3
	Facilitating conditions: barriers	Space	2	3
		Cable	2	2
	Facilitating conditions: barriers	Electrical energy	2	2
		Internet	2	2
	Performance expectancy: barriers	Responsibility	2	2
Intention to use VR of a physiotherapy setting	Social influence: facilitators	Guidance to use technology	7	11
	Social influence: facilitators	Guidance exercises	6	11
	Performance expectancy: facilitators	Motivation	6	8
	Facilitating conditions: facilitators	Space	5	5
		Safety	4	10
	Performance expectancy: facilitators	Introduction to VR	4	5
		Ease of use	4	4
	Attitude	Positive	4	4

	Facilitating conditions: facilitators	Separate room	4	4
	Performance expectancy: facilitators	Treat more patients	2	3
	Facilitating conditions: facilitators	Exercise room	2	2
	Performance expectancy: facilitators	Variation in treatment	2	2
	Facilitating conditions: barriers:	Use separate room	6	7
		Costs	7	11
	Performance expectancy: barriers	No added value guidance physiotherapist	4	6
	Attitude	Attitude physiotherapist	3	3
	Performance expectancy: barriers	Time	2	4
		Not comfortable	2	3
	Effort expectancy: barriers	Defect	2	2
	Facilitating conditions: barriers:	Noise	2	2
WN program as exercise therapy	WN program: facilitators	Mobility	6	8
		Presence	5	6
	Butterfly task: facilitators	Fun	4	4
	Yoga exercise: facilitators	Added value	4	4
	Butterfly task: facilitators	Added value	3	4
	Yoga exercise: breathing bubble: facilitators	Added value	3	4
	WN program: facilitators	Distraction	2	3
	WN program: barriers	Pain education	2	2
	Breathing tree: barriers	Shorter	6	7
		Too difficult	5	12
	Butterfly task: barriers	Different levels	5	7
	WN program: barriers	High disease activity	5	7
	Breathing tree: barriers	Visualization tree	5	6
	Yoga exercise: barriers	Too difficult	4	6
	Breathing tree: barriers	Lying down	3	6
	WN program: barriers	Different levels	3	5
		Development exercises	3	4
	Breathing tree: barriers	Rushed feeling	3	4
		Sitting down	3	4
	Butterfly task: barriers	Too easy	3	4
	Yoga exercise: barriers	Errors	2	3
	WN program: barriers	Sitting position	2	2

1.g Description of codes

Patients

WN program as exercise therapy

Main themes	Sub codes	Description	Quote
Butterfly task: facilitators	Fun	The exercise is fun which motivates the patient to use the WN program	'The butterflies exercise was the most fun' - 5
WN program: facilitators	Presence	The WN program facilitates a high feeling of presence	'It did really bring you into the virtual environment' - 3
Yoga exercise: facilitators	Stress relief	The yoga exercise causes stress relief	'I think yoga could help to relief stress' - 4
WN program: barriers	Variation	There are only three exercises, with more variation in exercises is preferred	'That there are more options available to you, including a wider range of content. I do believe that is important' - 1
Yoga exercise: breathing bubble	Difficult	The exercise is difficult to perform as it is difficult to focus on the yoga poses and the breathing exercise	'Yes, I found that complicated. I would like to focus more on the yoga poses instead of focusing on both' - 4
WN program: barriers	Personal preferences	The WN program is interesting for patients who prefer these exercises	'For me it does not have value to use VR because I already do yoga exercises by myself' - 7
Breathing tree: barriers	Visualization tree	The exercise would be functioning better when the breathing tree is moving	'No, well, if the tree works' - 6
WN program: barriers	Focus on symptoms	The possibility of focusing on a specific symptom could improve disease related symptoms	'For example, by indicating a pain score so that exercises are adjusted to that score' - 6
Yoga exercise: barriers	Too difficult	The poses are too difficult to perform for patients	'I found the last exercise very difficult. I can stand for a while but not that long. I also can't bend my legs that far and get my arms up that far either' - 5
Yoga exercise: barriers	Impatient	The patient feels impatient because he/she needs to wait to perform the next yoga pose when the instructor is done with explaining the pose	'Yes, I would like to speed it up a bit. Because at one point I thought, yes I get it, first left then right '- 4
WN program: barriers	Different levels	More patients could be able to use the WN program when there are different levels of the exercise	'It would be nice to adjust the level of the exercises to the level of symptoms' - 6
Breathing tree: barriers	Too difficult	The exercise is too difficult to perform for patients	'I cannot stand for that long' - 5
	Rushed feeling	The counting in the breathing exercise is too fast, causing a rushed feeling	'I was so focused on the counting; it gave

			me a rushed feeling' - 6
Butterfly task: barriers	Too easy	The exercise is too easy for patients	'I found it too easy' - 2
	Instructions	Instructions about how to use the controllers are unclear for the butterfly task	'I found the butterfly task hard because it took me a while to discover how to catch the butterflies' - 1
Yoga exercise: facilitators	Instructions	The instructions for the yoga poses are clear	'It was nice that the instructor demonstrated the poses' - 7
Yoga exercise: barriers	No feedback	You are not able to see your own body moving, which is making it difficult to perform the poses in the right way	'I would like to see how I am standing while performing the yoga exercises' - 7

Intention to use VR of a home setting

Main themes	Sub codes	Description	Quote
Performance expectancy: facilitators	Can use VR without HP	The patient can use VR without the guidance of a healthcare professional	'Yes, I could operate the glasses on my own but only after we have completed once as a team' - 4
	Can use VR without HP: instructions	The patient can use VR without the guidance of a healtcare professional after the physiotherapist gave instructions about how to use technology	'i could use the HMD, after we have practiced it once together' - 4
	Personal preferences	VR is a new possibility of performing exercises and is interesting for patients who prefer using VR	'It won't work unless you enjoy working with VR' - 7
Facilitating conditions: facilitators	Enough space	Patients have enough space to utilize the WN program	'I have enough space to perform the exercises' - 1
Attitude	Positive	The patient has a positive attitude towards using VR	'I would rather do it at home' - 3
Effort expectancy: facilitators	Freedom	The patient can use VR whenever he or she wants to	That you can, of course, take as long as you like and complete it whenever it's convenient for you' - 2
Attitude	Earlier experience	Earlier experience(s) using VR positively influence using it	'Yes, you can. If you have used the glasses before' - 5
Effort expectancy: facilitators	Comfortable	It is comfortable to use VR as the patient is in his/her environment	'No, and you are in a comfortable setting. If you run into something, you can quickly identify where you are' - 3
Performance expectancy: facilitators	Gamification	It is fun to use VR as exercise therapy	'It is challenging, performing exercises with VR' - 4

	Guidance VR and exercises	VR offers guidance to perform exercises	'You can follow the instructions as you can watch the instructor' - 8
	Focus	VR helps to focus on the exercises by not being distracted by the real world	'Even though I found it difficult to make free time, I was not distracted by the real world while performing the exercises' 4
	Help desk	A helpdesk that helps when the patient has questions regarding VR	'Something like a helpdesk, so you can easily contact someone when the technology is not working' - 4
	Motivation	VR could increase the motivation of the patient and therefore increase performing exercises	'The fact that I have HMD would even motivate me' - 1
	Value	There is potential for VR as exercise therapy	'It is new and contributes to my health' - 4
Facilitating conditions: barriers	Space	There is not enough space to utilize the WN program	'Yes, indeed. You need to have a space where you can perform the exercises. You can't do that when you live in a tiny apartment' - 6
Social influences: barriers	Instructions	It is important to hand out instructions as there is no guidance of a healthcare professional	'I would use it but I would like to receive instructions first' - 1
Effort expectancy: barriers	Defect	There is a possibility that VR breaks down	'Yes, but what's important is the system's reliability. So is works properly' - 3
Performance expectancy: barriers	No feedback	VR currently does not provide feedback about how the exercises are performed	'Thus, that would be a drawback if I had to list one. That you are unaware of how well you are performing the exercises' - 6
Effort expectancy: barriers	Heavy glasses	The HMD is too heavy to wear them	'Well, no, the HMD should be less heavy' - 6
Performance expectancy: barriers	Lack of motivation	Lack of motivation leads to not using VR	'Yes, exercising consistently is very important. If I a few symptoms, I might not be motivated to do exercises' - 1
	No added value exercises	The patient will not use VR when exercises don't provide a personal value	'I might as well turn on a video if I want to practice yoga. In such case, I don't believe VR is as valuable' - 7

Facilitating conditions: barriers	Costs	VR use comes at a steep expense	'The costs of the HMD for the patient are very high' - 8
Performance expectancy: barriers	Technical skills	The patient does not know how to use VR because the lack in technical skills	'Well, I don't think that everyone can work with the technology due technical skills' - 1
	Addition to physical therapy	VR could be an addition to physical therapy. It cannot be seen as a standalone treatment	'It would be a nice addition to physical therapy' - 4
Effort expectancy: barriers	Cable	The patient may fall over the cable connected to the HMD	'The cable is irritating me' - 7
	Independency	The confidence to use VR without guidance	'You need to have the confidence to use VR by yourself' - 5
Attitude	No symptoms	Having no symptoms decreases the motivation to perform exercises with VR	'If I don't have symptoms, I don't think it is necessary to do exercises' - 1
	Variation in exercises	Variation in exercises could increase the motivation to use VR	'It is not fun to do the same exercises for two weeks' - 7

Intention to use VR of a physiotherapy setting

Main themes	Sub codes	Description	Quote
Social influence: facilitators	Guidance exercises	A physiotherapist can provide feedback on how the patient can improve the performed exercises	'I anticipate that the physical therapist will be able to assist you with the exercises and provide guidance, correction, or both' - 8
	Guidance technology	A physiotherapist can provide feedback of how the patient can use VR	'Yes, if my physiotherapist properly informs and educate me' - 7
Facilitating conditions: facilitators	Separate room	There is a separate room available to execute VR in the physiotherapy practice	'Most physiotherapists have an extra room' - 1
	No barriers	There are no barriers in relation to using VR	'I don't see a barrier for in the physical therapy right now' - 8
Performance expectancy: facilitators	Treat more patients	Physiotherapists could treat more patients at the same time when using VR as exercise therapy	'The physiotherapists could treat more patients at the same time' - 8
Facilitating conditions: facilitators	Space	There is not enough space to utilize the WN program in the home environment	'I visited multiple physiotherapists, and all have enough space' - 1
Performance expectancy: barriers	No added value guidance physiotherapist	A physiotherapist is not necessary as VR provides guidance to perform exercises	'I don't see the value of visiting a physiotherapist when I already have guidance by VR' - 1

Attitude	Positive	The patient has a positive attitude towards using VR in the physiotherapy practice	'So I am positive to use it in the physiotherapy practice. Because I think it is, for now, easier to use it in there' - 7
Effort expectancy: barriers	Cable	The patient may fall over the cable connected to the HMD	'Yes, I think, removing the cable' - 3
Facilitating conditions: barriers:	Noise	Noise of other patients or colleagues can negatively influence the feeling of presence while using VR	'So yes, I can imagine that I can be uncomfortable to use VR in a noisy setting like a physiotherapy practice' - 3
Performance expectancy: barriers	Not comfortable	The patient does not feel comfortable using VR in the physiotherapy practice as people could stare	'I won't feel comfortable, as other people could be starting at me' - 4

Healthcare professionals

WN program as exercise therapy

Main themes	Sub codes	Description	Quote
WN program: facilitators	Mobility	The exercises could improve the mobility of the patient	'Exercises with VR could help the patient to make a movement instead of exercising without VR' - 10
	Presence	The WN program facilitates a high feeling of presence	You are in a virtual environment; it is stimulating to perform exercises' - 10
Butterfly task: facilitators	Fun	The exercise is fun which motivates the patient to use the WN program	I think that it is a fun exercise - 12
Yoga exercise: facilitators	Added value	The exercise could be effective in improving symptoms	'That sound is good though as you will be reminded of breathing. And doing it more often will make it easier' - 15
Butterfly task: facilitators	Added value	The exercise could be effective in improving symptoms	'The butterfly task would be a good exercise for axSpA patients' - 11
Yoga exercise: breathing bubble: facilitators	Added value	The exercise could be effective in improving symptoms	'That sound is good though as you will be reminded of breathing. And doing it more often will make it easier' - 15
WN program: facilitators	Distraction	The virtual environment creates a distraction mechanism	'It offers a nice distraction, reducing pain for patients' - 9

	Gamification	It is fun to use VR as exercise therapy	'It is more challenging because it is a game' - 14
	Pain education	Offering pain education in the WN program would improve patient's understanding how exercises contribute to their health	'The program needs to offer pain education, explaining why it is important to perform exercises even though the patient is experiencing pain' - 13
Breathing tree: barriers	Shorter	It would be better to make the duration of the poses shorter	'I think it is taking too long' - 9
	Too difficult	The exercise is too difficult to perform for patients	'The patient can lay his/her hand on the belly then you will receive information about your body. Then it will be easier to perform the exercise' - 10
Butterfly task: barriers	Different levels	More patients could be able to perform this exercise when there are different levels of the exercise	'I would like to provide this exercise in different levels' - 14
WN program: barriers	High disease activity	Patients with a high disease activity are not able to perform these exercises	'Patient with high disease activity experience symptoms while standing. The breathing exercise would be easier if the patient is able to sit' - 10
Yoga exercise: barriers	Instruction poses	The instructions of the yoga poses are taking too long	'Still, the instruction took a while to finish' - 14
Breathing tree: barriers	Visualization tree	The exercise would be functioning better when the breathing tree is moving	'It could be easier to execute the breathing exercise if the three is moving with your breath' - 14
Yoga exercise: barriers	Too difficult	The exercise is too difficult to perform for patients	''The yoga is a difficult exercise so I can imagine that it must be more difficult for axSpA patients' - 14
Breathing tree: barriers	Lying down	It is easier to perform this exercise while lying down, as the patient receives information about his/her body	'I would like to see if the patient is able to perform this exercise while lying down' - 13
WN program: barriers	Different levels	More patient could be able to use the WN program when there are different levels of the exercises	'For example, an easy, moderate, and difficult level for patients would be nice' - 14
	Development exercises	The WN program is more feasible as exercise therapy when the exercises are more developed	'The program works too slow and not properly' - 13
Breathing tree: barriers	Rushed feeling	The counting in the breathing exercise is too fast, causing a rushed feeling	'The counting is too fast; it gives me a rushed feeling' - 14

	Sitting down	Sitting down could also improve the exercise as the patient is able to receive information about his/her body	'The breathing exercise might contribute but I will choose a sitting position and shorten it' - 9
Butterfly task: barriers	Too easy	The exercise is too easy for patients, leading to no symptom's improvement	'It may be too easy for some patients' - 13
WN program: barriers	Sitting position	A sitting position in general could make it easier for patients who cannot stand for that long	'Maybe the possibility of performing the exercises while sitting instead of the need of standing for so long' - 9

Intention to use VR of a home setting

Main themes	Sub codes	Description	Quote
Attitude	Positive	The healthcare professional has a positive attitude about using VR	'Yes, I do have a positive attitude about it' - 11
Performance expectancy: facilitators	Motivation	The patient is more motivated to perform exercises with VR because the physiotherapist will guide the patient while performing exercises	'The therapist can motivate the patient to exercise and use VR' - 16
Performance expectancy: facilitators	Gamification	It is fun to use VR as exercise therapy	'It is more challenging because it is a game' - 14
Attitude	Positive: young target group	The patient group is relatively young. This young patient group knows how to use VR because of technical skills	'But I think the younger generation, who can also handle a smartphone. That they can benefit from it' - 15
Performance expectancy: facilitators	Personal preferences	VR is a new possibility of performing exercises and could be interesting for patients who prefers using VR	'There is not one program that works. This is person-dependent' - 13
	Guidance VR and exercises	VR offers a way of guidance when performing exercises	'The virtual environment creates a nice way of performing exercises' - 11
	Addition to physical therapy	VR could be an addition to physical therapy. It cannot be seen as a standalone treatment	'But really not only as therapy. You can't replace it with physical therapy' - 13
Effort expectancy: facilitators	Freedom	The patient can use VR whenever he or she want to	'Besides, you can use it whenever the patient would like to' - 13
Performance expectancy: facilitators	Value	VR has the potential as exercise therapy	'I think it is more valuable than giving patients instructions to do certain exercises at home' - 10
Facilitating conditions: facilitators	Enough space	The patient has enough space to utilize the WN program	'Well, I have enough space in my house' - 15

Facilitating conditions: barriers	Safety	It is not safe enough to use VR as there is a fall danger for the patient	You can't see what is near you because you are separated from your actual environment. This could be a safety risk' - 12
	Space	There is not enough space to utilize the WN program	'And you need to have enough space to execute these exercises, not everyone has that' - 14
Performance expectancy: barriers	Technical skills	The patient does not know how to use VR because of the lack in technical skills	'I really think that some people don't understand the technology' - 10
Social influences: barriers	Instructions	As there are no instructions of how to use VR from a healthcare professional, more instructions how to use VR are important	'There has to be more explanation about VR and the exercises' - 13
Facilitating conditions: barriers	Furniture	The furniture can be seen as an obstacle while performing exercises	'It can be difficult for patients who have a small house and have a lot of furniture' - 9
Attitude	Negative: eldery	Most elderly don't have the technical skills to use VR	'It may be too difficult for eldery and that it will only cause more frustration' - 16
Performance expectancy: barriers	Lack of motivation	Lack of motivation leads to not using the technology	'You still need to start which is for a lot of patients a big step' - 17
	Easy to use	More patients will use VR when it is easier to use	'Usability is important. Patients won't use it when it is not user friendly enough' - 11
Effort expectancy: barriers	Remove cable	The cable of the HMD should be removed	'Well, it is easier when there is no cable connected to the HMD' - 16
Facilitating conditions: barriers	Costs	VR use comes at a steep expense	'Well, the purchase of HMD' - 13
Performance expectancy: barriers	Program in HMD	It should be able to operate the WN program in the HMD	'You started the exercises; it should be possible to operate the program in the HMD- 11
Effort expectancy: barriers	Heavy glasses	The HMD is too heavy for patients to wear	'The HMD are a bit heavy, I can imagine that this could give neck pain' - 9
Performance expectancy: barriers	Independency	The patient should make the decision to use VR in the home environment	'Giving patient the option to use VR as something like: do you want to do exercises in a fun way?' - 10

	Not comfortable	The patient could not feel comfortable using VR	'I could be scary to use VR in the home environment' - 12
	No feedback	You are not able to see your own body moving, which is making it difficult to perform the poses in the right way	'You can't see your feet. Balance is really difficult' - 17
Facilitating conditions: barriers	Pets	The patient could fall over a pet while using VR	'You have to think about pets too' - 17
Effort expectancy: barriers	Controllers	It is not necessary to use the controllers for all exercises and it could create a risk of falling	'Consider taking the controllers out for the first workout. For the patient to use his or her hands in the event of a fall' - 9
Attitude	Negative	The healthcare professional has a negative attitude about using VR	'It is undeveloped, and I miss some explanation about the program' - 13
Performance expectancy: barriers	Variation in exercises	More variation in exercises could increase the adherence to exercises	'It would be nice to have more variation in the exercises as the patient will be bored to do the same exercises for two weeks' - 10
Effort expectancy: barriers	Cable	The patient may fall over the cable connected to the HMD	The patient needs to be careful to not fall over the cable' - 16
Facilitating conditions: barriers	Electrical energy	The patient needs electrical energy to use VR	'I have no clue how much power the HMD need but it is important to take in mind' - 17
	Internet	The patient needs internet to use VR	'And what about internet? I don't know if this needs it?' - 11
Performance expectancy: barriers	Responsibility	The physiotherapist could be responsible when the patient falls while using VR	'And I would like to know what happens when a patient falls while using VR. How about insurance?' - 9

Intention to use VR of a physiotherapy setting

Main themes	Sub codes	Description	Quote
Social influence: facilitators	Guidance technology	A physiotherapist can provide feedback of how the patient can use VR	'Yes, because a physiotherapist will be there to assist you in using VR. It only will be easier to use' - 12
Facilitating conditions: facilitators	Separate room	There is a separate room available to execute VR in the physiotherapy practice	'So I would really like to have a separate room for this kind of therapy, though' - 14
Social influence: facilitators	Guidance exercises	A physiotherapist can provide feedback of how the patient can improve the performed exercises	'The physical therapist can provide guidance to perform te exercises in the right way' – 9

Performance expectancy: facilitators	Motivation	The patient is more motivated to perform exercises with VR because the physiotherapist will guide the patient while performing exercises	'The therapist can motivate the patient to exercise and use VR' - 16
	Safety	There is a lower risk of falling as the physiotherapist is nearby the patient	'Well, you can obviously create a safe situation. Because you have more space, and you can pay more attention to the patient' - 13
Facilitating conditions: facilitators	Space	There is not enough space to utilize the WN program	'You do need a space where you can execute VR' - 10
Performance expectancy: facilitators	Introduction to VR	VR may be effectively introduced in the physiotherapy setting first, and then it could be used in the home setting	'I think that the first-time needs be in a physicaltherapy practice because you can give people proper instructions' - 10
Attitude	Positive	The healthcare professional has a positive attitude about using VR	'Yes, I do have a positive attitude about it' - 11
Performance expectancy: facilitators	Treat more patients	Physiotherapists could treat more patients at the same time when using VR	'You can maybe let a patient use VR and help another patient' - 10
Facilitating conditions: facilitators	Exercise room	VR can be executed in the exercise room of the physiotherapy practice	'If you have a space for VR, you can use it in the exercise room - 11
Performance expectancy: facilitators	Variation in treatment	VR is an addition to other exercise treatment possibilities	'It could be a fun addition to other exercises' - 14
Facilitating conditions: barriers:	Costs	VR use comes at a steep expense	'Well, the purchase of technology - 13
Performance expectancy: barriers	No added value guidance physiotherapist	A physiotherapist is not necessary as VR provides guidance to perform exercises	'In my opinion, there is no contribution of a physical therapists because VR guides the patient' - 17
Attitude	Attitude physiotherapist	VR could be used more when the physiotherapist has a positive attitude about the technology	'You need to be motivated to use VR otherwise the physiotherapist won't use it' - 13
Performance expectancy: barriers	Time	It costs time to prepare VR to use it as exercise therapy	'I takes to time to prepare VR and you only have 30 minutes per patient' - 10
	Not comfortable	Patients might not feel comfortable using VR while other patients could watch	'I can imagine that when there are other exercise groups, the patient might feel uncomfortable using VR in the same room' - 16

	Easy to use	VR could be used more when it is easier to use it	'You should be able to put it on and directly work with the exercises' - 14
Effort expectancy: barriers	Defect	The technology could break down	'Besides, it is important that the technology works properly' - 10
Facilitating conditions: barriers:	Noise	The noise in the exercise room could negatively influence the patient using VR	'You will be distracted by the real world when someone else gives you instructions' - 16

1.h Suggestions on improving the demand

Patients

Walk in Nature program

Three patients (38%) indicated a preference for exercises tailored to their personal liking rather than those in the Walk in Nature program. For instance, one patient suggested incorporating VR biking. These patients highlighted the importance of exercise variety to allow individual choice. Additionally, two patients (25%) expressed a desire for varied difficulty levels in all exercises, while another two patients (25%) suggested aligning exercise intensity with their symptoms.

'Maybe it is possible to work with different categories, so you can focus on a body part that is the stiffest. That it is possible to adjust the program to your symptoms' – (participant 6)

Breathing exercise

The breathing tree exercise is according to two patients (25%) too difficult to perform. One patient related it to not being able to stand for that long. The other patient said it was difficult to follow the rhythm of the breathing. Secondly, two patients (25%) expressed dissatisfaction with the verbal counting in the exercise. One patient focused on the counting instead of the breathing technique and one experienced a tendency to hyperventilate. Patients suggested improving the exercise by focusing more on visuals instead of the counting. By improving the visualization of the tree, as said by three patients (38%), because it currently does not grow or shrink at all.

'I think that the breathing exercise is not effective currently. I focused on the counting, instead of the breathing technique. It is a technical exercise, while it would be nice to focus more on surroundings and sounds in a breathing exercise' – (participant 6)

Butterfly exercise

While two patients (25%) considered the butterfly task too easy, another two (25%) encountered difficulty using the controllers to catch the butterflies. Instructions in the beginning of the exercise were too unclear. As a result, patients did not know how to use the controllers to catch butterflies.

Yoga exercise

Firstly, two patients (25%) said the yoga poses are too difficult to perform. One patient related it to the combination of the breathing exercise with the yoga poses, as it is difficult to combine both tasks. Another patient said the poses are too difficult because she was not able to stand for that long.

'The last exercise was way too difficult. I cannot stand for that long and it was challenging to raise my arms and bend my knees that much' – (participant 5)

However, two patients (25%) felt impatient during the yoga exercise. They suggested the option to skip explanations for the left-side poses to reduce wait times.

Thirdly, according to three patients (38%), the breathing exercise within the yoga exercise difficult to perform, as they needed to combine both tasks. Another patient said the breathing exercise is not in sync with the instruction of the yoga instructor, because the yoga instructor tells the patient to breathe in, while the breathing exercise tells the patient to breathe out.

Lastly, two patients (25%) said it was difficult to know how they performed the yoga poses as the patient was not able to see him- or herself. The patient is only able to see the hands, as the controllers function as hands in the virtual environment. One patient recommended incorporating a mirror in the exercise to allow self-assessment of pose performance.

Healthcare professionals

Walk in nature program

Firstly, 56% of healthcare professionals noted that the Walk in Nature program is too challenging for patients with high disease activity. Addressing this, 33% emphasized the necessity of incorporating different difficulty levels. Additionally, 22% recommended a seated position for all exercises for patients with high disease activity or those unable to stand for extended periods.

Secondly, 22% of healthcare professionals emphasized the importance of adding pain education in the Walk in Nature program, as there is currently no explanation in the program. Explaining the significance of performing exercises while experiencing pain is crucial.

Thirdly, 33% of healthcare professionals stated that the program needs further development to function effectively as exercise therapy, citing issues such as bugs in the program.

Breathing exercise

Firstly, the breathing exercise is currently too difficult, according to eight healthcare professionals (89%). Six healthcare professionals (67%) suggested making the exercise shorter, which makes it easier to complete the breathing exercise. They suggest decreasing the counting to 1, 2, 3. Instead of 1, 2, 3, 4, 5. For instance, it is easier to hold your breath for three seconds instead of five.

'The breathing exercise is extremely challenging. Breathing in for five seconds, holding your breath for five seconds, and then exhaling for five is a difficult exercise to start with. That is simply too difficult' (participant 13)

Secondly, three healthcare professionals (33%) experienced a rushed feeling, due to the rapid counting in the exercise. This made it more difficult to focus on the breathing technique. Thirdly, three healthcare professionals (33%) suggested the possibility of performing the exercise while lying down, to enhance relaxation and allow patients to focus on their breathing exercise.

‘To start with, it is preferable to lie down since your body will provide you with information. This makes it easier to perform the breathing exercise as you have more control over your body. For example, you can feel your belly moving up and down. That is why we also ask patients to lay their hands on the belly’ (participant 10)

An alternative, suggested by three healthcare professionals (33%), is to perform the exercise while sitting, promoting a more relaxed experience. Healthcare professionals prefer the lying position. Finally, five healthcare professionals (56%) expressed a desire for the tree to expand and contract with each breath.

Butterfly exercise

As said by three healthcare professionals (33%), the butterfly exercise is too easy due to a lack of challenge. They propose enhancing difficulty by introducing various levels, such as hanging butterflies lower or higher. Suggestions include providing a stopwatch to track completion time, as mentioned by one professional, and implementing a scoring system, as recommended by another.

Yoga exercise

Four healthcare professionals (44%) said the yoga exercise is too difficult, as patients cannot stand in a certain pose for that long. Another healthcare professional said patients are not able to reach, bend, or stretch that far. That is why three healthcare professionals (33%) suggested adding different levels to this exercise. Besides, two healthcare professionals (22%) mentioned the errors or bugs in the yoga exercise. The first bug is when the instructor demonstrates a pose where she puts one leg in the air instead of on the ground. The second one is that the instructor crosses her legs, instead of placing them beside each other. The final bug is that the instructor instructs the user to ‘go back’ twice instead of once.

1.i Suggestions on improving the intention to use

Patients of a home setting

Performance expectancy

Motivation

Another factor leading to decreased motivation is the lack of variation in exercises. Two patients (25%) said that it is not enjoyable to perform the same three exercises for a longer period.

‘Doing the same exercises for two weeks in a row is not enjoyable. Thus, it is crucial to vary in exercises’ – (participant 7)

Secondy, three of the patients (38%) said the fact that VR currently does not provide any feedback to the patient, is a barrier. It makes it more difficult to know if they performed the exercises in the right way.

‘I have done yoga exercises in a class before, and while it is important to observe the poses, it does not always mean you are doing the poses correctly. During yoga class, I received feedback about my

poses. So not receiving feedback from VR is one disadvantage if I must list one. Thus, it would be better to receive feedback from VR' – (participant 6)

Effort expectancy

Ease of use

Three patients (38%) preferred to use VR for the first time under the supervision of a physiotherapist before using it on their own. Instructions to use VR are important as five patients (63%) said they would like to receive instructions on how to use VR.

'Instructions about how it works and how to update the technology' – (participant 7)

As explained before, having an earlier experience with VR influences a positive attitude toward using the technology. This makes it even more understandable why patients would like to use VR with a healthcare professional before using it independently at home.

Comfortable

Secondly, two patients (25%) said that the HMD should be less heavy. This will make it more comfortable to wear them. Secondly, offering a way to make contact to receive help to use VR is seen as an improvement. For example, contacting a physiotherapist or providing a helpdesk, so the patient can call someone to receive help.

Social influences

In addition to physical therapy

Two patients said they would like to use VR complementary to physiotherapy. One patient explained he would like to talk about the progress of using VR as exercise therapy with a physiotherapist while using VR at home.

'It would be nice to talk about the progress of using VR at home. This is something I need, to ensure I perform the exercises, and everything is going well. That will motivate me to use VR' – (participant 4)

Another patient recommended using VR at home after initially practicing it for a while in a physiotherapy practice.

Healthcare professionals about the home environment

Performance expectancy

Personal preferences

Three healthcare professionals (33%) said the patient decides to use VR at home.

'Well, patients need care, and you can involve the patient in making a shared decision. For example, you can say that most of the patients do not perform the advised exercises, and doing exercises with VR could increase adherence. It is up to the patient to decide whether he or she wants to use VR. I

think it is important to engage the patient with this decision. By asking the patient if VR will work as exercise therapy' – (participant 11)

Motivation

Two healthcare professionals (22%) said providing more variation in exercises could increase the motivation to use VR. Additionally, two healthcare professionals (22%) said the physiotherapist should explain how VR contributes to the patient's health before the patient can use VR.

'Before the patient can use VR in the home environment, it is important that the patient knows how VR can contribute to his health. It is only possible to implement VR when the patient is convinced VR contributes to improving the patient's symptoms' – (participant 9)

For example, a healthcare professional said VR should contribute to the patient's health, and the patient sould not, for example gain neck symptoms. Moreover, it is important that the exercise program fits the patient.

'However, I won't suggest VR when the patient has neck pain. Because the program does not have exercise improving neck symptoms. Besides, patients could have other diseases, than it is even more difficult to suggest this program. To conclude with, it is important that the program fits the patient as the patient needs success to stay motivated. Otherwise, they will stop performing the exercises with VR' – (participant 9)

Effort expectancy

Ease of use

Four healthcare professionals (44%) said the technology should be easier to use and clarified this by improving the software so the patients quickly understand how to use the technology. Secondly, six healthcare professionals (67%) said providing instructions is an important improvement. This is related to feeling more comfortable using VR in the home environment, because two healthcare professionals (22%) said explaining how to use VR decreases the feeling of anxiety.

The instructions should include: how to start the technology, switch between exercises and to use the controllers properly. A healthcare professional said the technology should make an automatic connection with the internet and another recommended providing instructions, for example about which buttons on the controllers are necessary to complete an exercise, in the WN program, so the patient knows how to use the technology.

'How easy is it to use the technology? Because you need a computer to run the program and someone else needs to start the exercises. Otherwise, you need to leave the virtual environment to start the exercises by yourself. It is currently not easy to use VR in the home environment' – (participant 17)

Secondly, four healthcare professionals (44%) said HMD would be easier to use when the WN program is in the HMD instead of on the computer as it is currently not able to start an exercise without leaving the virtual environment.

'Providing a menu in the HMD where you can switch between exercises would made it much easier to use VR' – (participant 16)

Thirdly, two healthcare professionals (22%) said operating VR without controllers would make it easier to use.

'You could consider removing the controllers because do you really need them? They are a hinder with the first exercise. You can work with a pinch grip, by using your thumb and index finger, to guide through the program. This makes it possible to not use controllers' – (participant 11)

Fourthly, five healthcare professionals (56%) said removing the cable would make it easier to use VR.

Lastly, four healthcare professionals said it is more comfortable when the HMD is less heavy. It is important to make the HMD lighter as it is related to neck pain.

Social influences

In addition to physical therapy

Four healthcare professionals (44%) said using VR complementary to physiotherapy would be nice. Since patients can perform exercises at home and can get guidance from a physiotherapist in a physiotherapy practice.

'This is a nice base, but the physiotherapist can provide extra guidance, such as focusing on strength training. The exercises which the patient is not able to perform with VR' – (participant 11)

Secondly, three healthcare professionals (33%) specifically said the fact VR does not provide feedback means that it is important the physiotherapist provides this guidance with additional meetings at the physiotherapy practice. Patients could discuss their progress with a physiotherapist.

'A short question like: 'Where did you struggle with last week?'' – (participant 10)

Facilitating conditions

Safety

Three healthcare professionals specifically said it is important to ensure the patient can safely use VR.

Patients about the physiotherapy practice

Effort expectancy

Ease of use

Two patients (25%) specifically said removing the cable of the HMD is important.

Social influences

Guidance by the physiotherapist

As mentioned before, the guidance the physiotherapist can offer is an important facilitator. One patient said the physiotherapist could add other relevant exercises and another said the physiotherapist can correct her to improve exercises.

However, one patient mentioned that the physiotherapist should consider how to approach the patient while the patient is using VR.

'I expect from the physiotherapist that he guides the patient while performing exercises with VR. The physiotherapist could, for example, correct the patient. However, the physiotherapist should let the patient know that he will toch their shoulder, saying something like, 'I am going to touch you to correct your position' – participant 8

Facilitating conditions

Space

Four patients (50%) said they prefer a room where they can use VR, meaning that most patients prefer to use VR in a room where no other patients are performing exercises. Secondly, one patient said a physiotherapy practice does have a separate room where VR can be installed.

'I do not know; it depends on how many space the physiotherapy practice has. They need to have a separate room for VR but I do not know if the physiotherapy practice does have this extra room' – (participant 7)

Healthcare professionals about the physiotherapy practice

Performance expectancy

Efficiency

As said before, two healthcare professionals said VR could treat more patients in the physiotherapy practice. One healthcare professional said it would be nice to use VR for other treatment goals besides axSpA patients. The second healthcare professional said the physiotherapist might be able to leave the patient to treat other patients at the same time.

Facilitating conditions

Space

Six healthcare professionals (67%) said VR should be used in a room intended for it. Two related this to safety as the patient wearing HMD cannot walk into someone. One related it to not having enough space in the exercise room and another one to the exercise room being too loud. Still, one healthcare professional said the exercise room can be used when there is enough space to.

'You have created a nice space so I could perform the exercises. Physiotherapists could use VR in the exercise room, but they must create space for it. Like marker a border or something' – participant 11)

Appendix 2 Non-WMO declaration

2.a Study protocol

Versie 2 (nov 2021)

Format onderzoeksprotocol nWMO MST*

*Gebaseerd op onderzoeksprotocol ontwikkeld door Samenwerkende Topklinische Ziekenhuizen (STZ)

Toelichting:
Medisch-wetenschappelijk onderzoek dat niet onder de Wet Medisch Wetenschappelijk Onderzoek met Mensen (WMO) valt, maar waar wel proefpersonen bij betrokken zijn, moet ingediend worden bij het wetenschapsbureau MST. Het wetenschapsbureau toetst het onderzoek en adviseert de Raad van Bestuur over lokale uitvoerbaarheid. Pas nadat de Raad van Bestuur goedkeuring gegeven heeft, kan het onderzoek uitgevoerd worden.

De toetsing richt zich op de vraag of het onderzoek is opgezet en wordt uitgevoerd volgens geldende wet- en regelgeving en richtlijnen, of de belasting voor de deelnemer gerechtvaardigd is, of het onderzoek uitgevoerd kan worden binnen MST en of de wetenschappelijke kwaliteit voldoende is. Om tot een juiste beoordeling te komen, dient een niet WMO protocol bijgevoegd te worden. Hiervoor dient onderstaand format gebruikt worden. Nadere informatie over het indienen van niet WMO-plichtige studies staat op de website van MST.

Onderzoeksprotocol

1. Algemene informatie

1.1 **Volledige titel onderzoek**	Wat is de toepasbaarheid van Virtual Reality (VR) als oefentherapie bij patiënten met Bechterew?
1.2 **Verkorte titel onderzoek**	BYE BYE Bechterew
1.3 **Protocoldatum / Versie**	v.1 23/05/2023
1.4 **Opdrachtgever / verrichter**	Afdeling reumatologie Organisatie: MST Enschede
1.5 **Indiener**	Naam: M. Franke Organisatie: Universiteit Twente Afdeling: Student Master Health Sciences Contactgegevens: m.franke@student.utwente.nl
1.6 **Hoofdonderzoeker**	Naam: Dr. C. Bode Organisatie: Universiteit Twente Afdeling: Psychologie, Gezondheid en Technologie Contactgegevens: c.bode@utwente.nl
1.7 **MST (hoofd)onderzoeker**	Naam: Prof. dr. H.E. Vonkeman Organisatie: MST Enschede Afdeling: Reumatologie Contactgegevens: h.vonkeman@mst.nl] Naam: M. Franke Organisatie: Universiteit Twente Afdeling: Student Master Health Sciences Contactgegevens: m.franke@student.utwente.nl
1.8 **Het onderzoek wordt uitgevoerd in het kader van:** *Bijv. promotieonderzoek, wetenschappelijke stage geneeskunde, afstudeerproject verpleegkunde, etc.*	Wetenschappelijke stage Opleiding: Master Health Sciences Organisatie: Universiteit Twente

2. Akkoord protocol betrokkenen

		Datum en handtekening
2.1 **Hoofdonderzoeker**	M. Franke	
2.2 **MST onderzoeker(s)**	Prof. dr. H.E. Vonkeman	
2.3 **Vertegenwoordiger(s) betrokken RVE's**	Dr. K.W. Drossaers	

3. Achtergrond van het onderzoek

3.1 **Achtergrond en belang van het onderzoek** *Beschrijf de aanleiding en het belang (wetenschappelijke / maatschappelijke en/of klinische relevantie) van het onderzoek*	Axial spondylarthritis (AxSpa), ook wel de ziekte van Bechterew genoemd, ontstaat voornamelijk op jongvolwassen leeftijd. AxSpa is een vorm van ontstekingsreuma waarbij voornamelijk de gewrichten in de rug en de heupen zijn aangetast. Stijfheid in de rug, vermoeidheid, en chronische pijn zijn de meest voorkomende klachten. De prevalentie van AxSpa varieert tussen de 0,1 tot 0,4% (1). De behandeling van AxSpa bestaat uit fysieke oefeningen (fysiotherapie en oefentherapie) en medicatiegebruik (NSAID's, conventionele synthetische DMARD's, en biologische DMARD's) (2,3). Het verbeteren van de kwaliteit van leven is het hoofddoel van de behandeling van AxSpa, daarbij is het behouden van spinale flexibiliteit een belangrijk onderdeel. Daarnaast hangt deze aandoening ook samen met een vermindering van de pulmonale functie. Daarnaast is vermoeidheid ook een veelvoorkomende klacht (4). Meerdere studies concluderen dat vermoeidheid bij 70% van de patiënten voorkomt. Het is complex en ontstaat door meerdere factoren (5–7). Farmacologische therapie verbetert bijvoorbeeld de ziekteactiviteit, maar heeft weinig effect op vermoeidheidsklachten (8). Tot slot komt chronische pijn in de vorm van lage rugpijn veel voor. Dit ontstaat voornamelijk door ontstekingen of door nieuwe botvorming (9). De behandeling van AxSpa bestaat uit medicatiegebruik en fysieke oefeningen. Ook al heeft fysieke activiteit vergeleken met medicatie minder effect, het is een belangrijk onderdeel van de behandeling. Het verlaagd namelijk de kosten en heeft minder nadelige gevolgen dan medicatiegebruik (10). Data van longitudinaal onderzoek en RCT's tonen aan dat verhoogde fysieke activiteit de kans op verbeterde ziekteactiviteit vergroot. Een ander onderzoek toont bijvoorbeeld aan dat hogere fysieke activiteit is geassocieerd met verbeterde functionele capaciteit (BASFI), spinale mobiliteit (BASMI), en oefen capaciteit (6MWT). Terwijl verhoogd zittend gedrag is gerelateerd aan vermindering van oefencapaciteit (6MWT) en kwaliteit van leven (ASQoL) (11,12). Fysieke activiteit is dus erg belangrijk bij de behandeling van AxSpa. Daarvoor heeft de EULAR (European Alliance of Associations for Rheumatology) de volgende aanbevelingen opgesteld: flexibiliteit-, weerstand- (kracht), aerobe- (cardiorespiratoire) en neuro-oefeningen (13). Deze aanbeveling is vrij breed, daarom wordt er voor de patiënt een programma opgesteld. Het uitvoeren van oefeningen kan bijvoorbeeld met behulp van fysiotherapie of oefentherapie. Er bestaan verschillende programma's voor patiënten met AxSpa, zoals oefeningen onder supervisie (fysiotherapie en oefengroepen) en thuisoefeningen (14). Een systematische review en cross sectioneel onderzoek van oefentherapie bij spondylartritis toont aan dat het volgen van een oefenprogramma de ziekteactiviteit verbetert. Bovendien wordt er bij verschillende farmacologische behandelingen dezelfde hoeveelheid fysieke activiteit aanbevolen. Maar het meest effectieve programma, voor oefeningen bij AxSpa, blijft onduidelijk (12,15). Daarnaast houdt, volgens onderzoek, slechts 29% van de patiënten met ankylosing spondylitis zich aan de dagelijkse hoeveelheid lichaamsbeweging (16). Vermoeidheid wordt vaak als een barrière gezien, terwijl het doen van oefeningen de vermoeidheid juist kan verminderen (17). Tot slot heeft de EULAR aanbevolen op reguliere basis en levenslang oefeningen te gaan doen. Daarbij kan er volgens de EULAR gedacht worden aan thuisoefeningen of fysiotherapie. Daarvan is fysiotherapie effectiever dan thuisoefeningen, maar fysiotherapie is duurder en daardoor minder toepasbaar dan thuisoefeningen (13). Dit komt doordat fysiotherapie momenteel niet wordt vergoed vanuit de basisverzekering, hierdoor is het voor de patiënt voordeliger om thuis oefeningen te doen. Echter is de adherentie voor thuisoefeningen laag. Een artikel 'Adherence to long-term therapies: evidence for action' uit 2003 van de World Health Organisation (WHO) definieert adherentie als 'de mate waarin het gedrag van een person overeenstemt met overeengekomen aanbevelingen van een zorgverlener'. Daarbij

	is het voor patiënten met AS belangrijk om extrinsiek gemotiveerd te worden om oefeningen te blijven doen en zelfmanagement te verbeteren. Zo blijken oefengroepen de adherentie te bevorderen (18). Doordat de patiënt door een supervisor wordt gemotiveerd om oefeningen te doen en hierbij ook sociale ondersteuning heeft. Virtual Reality (VR) is 'een volledige onderdompeling in de door de computer gegenereerde wereld via een hoofdmonitor' en zou een andere mogelijkheid voor ondersteuning van fysieke activiteit kunnen zijn (19). Bijvoorbeeld voor het zelfstandig uitvoeren van oefeningen (thuisoefeningen) of onder supervisie van een fysiotherapeut. Daarnaast heeft VR de potentie om chronische lage rugpijn van AxSpa te behandelen, omdat het werkt als afleidingsmechanisme waardoor pijn verminderd wordt (19). Verder kan VR bijdragen aan het vergroten van de motivatie voor het doen van oefeningen. De leuke en aantrekkelijke manier van de behandeling betrekt de patiënt en de interactieve elementen en feedback kunnen de adherentie verhogen (20) De Universiteit Twente heeft een herstellende (restorative) virtuele omgeving (Walk in Nature) ontwikkelt om subjectieve vitaliteit te verbeteren onder internationale studenten. De omgeving bestaat uit fysieke en psychologische stimulaties bestaande uit vier oefeningen: 'walk in nature', 'breathing tree', 'butterfly task' en 'yoga'. Wanneer een participant de headset opzet wordt hij/zij meteen naar de Walk in nature oefening getransporteerd. Hier kan de participant rondlopen in een natuurlijke bosomgeving. Daarna kan de participant de breathing tree oefening uitvoeren. Dit is een ademhalingsoefening waarbij een boom na elke ademhaling steeds groener wordt. Aansluitend voert de participant de butterfly task uit. Hier grijpt de participant naar de vlinders zodat ze weg vliegen. De participant kan hierbij rondlopen en moet zich strekken om de vlinders te grijpen. Als laatste wordt de yogaoefening uitgevoerd. Hierbij volgt de participant instructies op van een virtuele yoga instructeur. Yoga is ontwikkeld om een gezonde balans te vinden in de fysieke, emotionele, mentale en spirituele dimensie en kan als therapie worden ingezet. Daarbij wordt er rekening gehouden met de medische conditie van de patiënt. Ademhalingsoefeningen en strekoefeningen helpen bijvoorbeeld bij het behouden van de spinale flexibiliteit en het verminderen van lage rugpijn (21). Een voorbeeld van een vorm van yogatherapie bij AxSpa is Tai Chi. Tai Chi (The Supreme Ultimate Boxing System) is van oorsprong een materiële kunstvorm uit China. Het bestaat uit rustgevende, langzame oefeningen die voor het lichaam een fysieke uitdaging zijn en voor de geest een meditatie. Tai Chi wordt ook wel 'meditatie in beweging' genoemd, omdat je in concentratie, oefeningen uitvoert (22). Onderzoek toont aan dat Tai Chi pijn vermindert en de mobiliteit van de rug verbetert. Daardoor kan het naast medicamenteuze behandeling als oefenprogramma ingezet worden ((23)) Een eerste onderzoek naar de toepasbaarheid (feasibility) van de Walk in Nature als oefentherapie bij patiënten met AxSpa, helpt om te bepalen of de interventie verder getest of ontwikkeld kan worden. Volgens de literatuur is onderzoek naar de toepasbaarheid gebaseerd op: 'een reeks bevindingen opleveren die helpen bepalen of een interventie moet worden aanbevolen voor een effectiviteitstest' (24). Het voornamelijk doel is om te testen of de interventie werkt in de echte wereld. Er zijn kerngebieden, zoals de toepasbaarheid (applicability): 'in welke mate wordt een nieuw idee, programma, proces of maatregel als geschikt, bevredigend of aantrekkelijk beoordeeld door degenen die het programma gebruiken?' Om de toepasbaarheid te meten wordt de Walk in Nature door patiënten met AxSpa, fysiotherapeuten en reumatologen met ervaring in de behandeling van AxSpA beoordeelt. Dit wordt in een gemixde methode (mixed methods) gedaan. De technologie wordt beoordeeld door de virtual reality veroorzaakte symptomen en effecten (VRSQ), aanwezigheid (IPQ) en gebruikerservaring (user experience) kwantitatief te meten. Daarbij worden bruikbaarheid (usability) aspecten kwalitatief

	onderzocht met interviews over de intentie om technologie te gebruiken en over de oefeningen in de Walk in Nature (25). Het onderzoek is in gemixde methode omdat het kwantitatieve deel, data geeft over de toepasbaarheid van het huidige Walk in Nature en het kwalitatieve deel, data geeft over welke mogelijke aanpassingen aan de interventie nodig zijn om het toepasbaar te maken in de echte wereld. Omdat de patiënt en zorgprofessional (fysiotherapeut en reumatoloog) vanuit eigen perspectief de technologie beoordelen, wordt er voor beiden verschillende onderzoeksvragen opgesteld: Voor de patiënt zijn de eerste en tweede onderzoeksvragen: 1. To what extent is the Walk in Nature environment applicable as exercise therapy in the home environment? 2. How could the suitability of the virtual nature environment as exercise therapy be improved as exercise therapy in the home environment? Voor de zorgprofessional zijn de eerste en tweede onderzoeksvragen: 1. To what extent is the Walk in Nature environment applicable as exercise therapy in the physiotherapy practice? 2. How could the suitability of the virtual nature environment as exercise therapy be improved as exercise therapy in the physiotherapy practice?

4. Doel van het onderzoek

4.1 **Wat zijn de primaire en secundaire doelen van het onderzoek?** *De primaire doelstelling is de belangrijkste onderzoeksvraag die wordt beantwoord met de resultaten van de studie en is bepalend voor studie design en sample size. Secundaire doelstellingen zijn aanvullende onderzoeksvragen.*	Het studydesign wordt opgesplitst voor twee groepen: patiënten en zorgprofessionals. Daarnaast hebben de groepen andere onderzoeksvragen, omdat de patiënt de toepasbaarheid van de interventie als oefening in de huiselijke omgeving beoordeelt en de zorgprofessional de toepasbaarheid van de interventie in de fysiotherapiepraktijk beoordeelt. Beide onderzoeksvragen onderzoeken de toepasbaarheid van de interventie als oefentherapie op de volgende gebieden: - Het product: de VR bril (Oculus rift s) - De oefeningen: walk in nature, breathing tree, butterfly task en yoga **Patiënten** Voor de patiënt zijn de eerste en tweede onderzoeksvragen: 1. To what extent is the Walk in Nature environment applicable as exercise therapy in the home environment? 2. How could the suitability of the virtual nature environment as exercise therapy be improved as exercise therapy in the home environment? Patiënten onderzoeken de eerste onderzoeksvraag kwantitatief met de uitkomsten: VAS-score ziekteactiviteit AxSpa, VRSQ, IPQ en UEQ-s. - Deze uitkomsten onderzoeken de VR bril en de oefeningen. De tweede onderzoeksvraag wordt onderzocht door dezelfde patiënten door interviewvragen over de intentie om de technologie (intention to use technology) te beantwoorden. - De uitkomst 'intentie om de technologie te gebruiken' onderzoekt de VR bril.

	Daarnaast wordt tijdens hetzelfde interview de bruikbaarheid (suitability) van de oefeningen als oefentherapie in de thuissituatie onderzocht. - Deze uitkomst onderzoekt de oefeningen. **Zorgprofessionals** Voor de zorgprofessional zijn de eerste en tweede onderzoeksvragen: 1. To what extent is the Walk in Nature environment applicable as exercise therapy in the physiotherapy practice? 2. How could the suitability of the virtual nature environment as exercise therapy be improved as exercise therapy in the physiotherapy practice? De fysiotherapeuten en reumatologen vallen onder de groep van de zorgprofessionals en gaan deze onderzoeksvragen beantwoorden. De zorgprofessionals beoordelen kwantitatief de uitkomsten: VRSQ, IPQ en UEQ-s. - Deze uitkomsten onderzoeken de VR bril en de oefeningen. De tweede onderzoeksvraag wordt onderzocht door dezelfde 9 zorgprofessionals door interviewvragen over de intentie om de technologie te gebruiken (intention to use technology) te beantwoorden. - De uitkomst 'intentie om de technologie te gebruiken' onderzoekt de VR bril. Daarnaast wordt tijdens hetzelfde interview de bruikbaarheid (suitability) van de oefeningen als oefentherapie in de fysiotherapiepraktijk onderzocht. - Deze uitkomst onderzoekt de oefeningen.

3. Onderzoeksopzet

5.1 **Algemene beschrijving van de onderzoeksopzet (design)** *Bijv.:* - *Experimenteel: RCT, cross-over trial, interventie-controle onderzoek* - *Observationeel: retrospectief dossier onderzoek* - *Kwalitatief onderzoek: semigestructureerde interviews, focusgroepgesprekken* *Geef ook aan of de studie een mono of multicenter studie is (in één of meer ziekenhuizen uitgevoerd).*	Gemixte methode (mixed methods) Monocenter studie: MST Enschede **Patiënt:** 'To what extent is the Walk in Nature environment applicable as exercise therapy in the home environment?' Kwantitatief descriptief met enquêtes: - Disease activity (VAS) (26) - Virtual reality symptoms and effects (VRSQ) (27) - Presence (IPQ) (28) - User experience of the product (UEQ-s) (29) 'How could the suitability of the virtual nature environment as exercise therapy be improved as exercise therapy in the home environment?' Kwalitatief exploratief inductief met interviews: - Intention to use (UTUAT model as framework) (25) - Suitability of the exercises as exercise therapy as AxSpa treatment in a home environment **Zorgprofessional**:

	'To what extent is the Walk in Nature environment applicable as exercise therapy in the physiotherapy practice?' Kwantitatief descriptief met enquêtes: - Virtual reality symptoms and effects (VRSQ) (27) - Presence (IPQ) (28) - User experience of the product (UEQ-s) (29) 'How could the suitability of the virtual nature environment as exercise therapy be improved as exercise therapy in the physiotherapy practice?' Kwalitatief exploratief inductief met interviews: - Intention to use (UTUAT model as framework) (25) - Suitability of the exercises as exercise therapy as AxSpa treatment in a physical therapy practice
5.2 **Duur van het onderzoek** *Prospectief (cohort) onderzoek: beschrijf de start- en einddatum. Retrospectief cohort onderzoek: beschrijf de periode waaruit data wordt verzameld en geef ook aan wanneer het onderzoek wordt uitgevoerd.*	Prospectief onderzoek: 13-02-2023 t/m 31-10-2023

1. Onderzoekspopulatie

6.1 **Onderzoekspopulatie** *Beschrijf de karakteristieken van de proefpersonen.*	De onderzoekspopulatie bestaat uit twee groepen: de patiënten met AxSpa en de zorgprofessionals (fysiotherapeuten en reumatologen). Naast dat de patiënt de toepasbaarheid beoordeelt, beoordelen fysiotherapeuten en reumatologen ook de toepasbaarheid. Daarbij bestaat de fysiotherapeut uit twee disciplines: drie fysiotherapeuten met ervaring in het behandelen van AxSpa en drie fysiotherapeuten met ervaring in het gebruik van VR. Deze twee disciplines zorgen ervoor dat de interventie vanuit twee kanten wordt beoordeeld: de technologie (ervaring in VR) en de oefeningen (ervaring in AxSpa). Daarnaast worden 3 reumatologen geïncludeerd. De reumatoloog is de hoofdbehandelaar van de patiënt en schrijft dus een programma aan de patiënt voor. De expertise van de reumatoloog wordt gebruikt om te beoordelen of de interventie past binnen een behandelplan. **1. Patiënten met AxSpa** 4 mannen 4 vrouwen Verschil in: - Leeftijd - Ziekteactiviteit - Ziekteduur De prevalentie van AxSpa is bij mannen en vrouwen is zo goed als gelijk. Door verschil in karakteristieken te werven, zoals

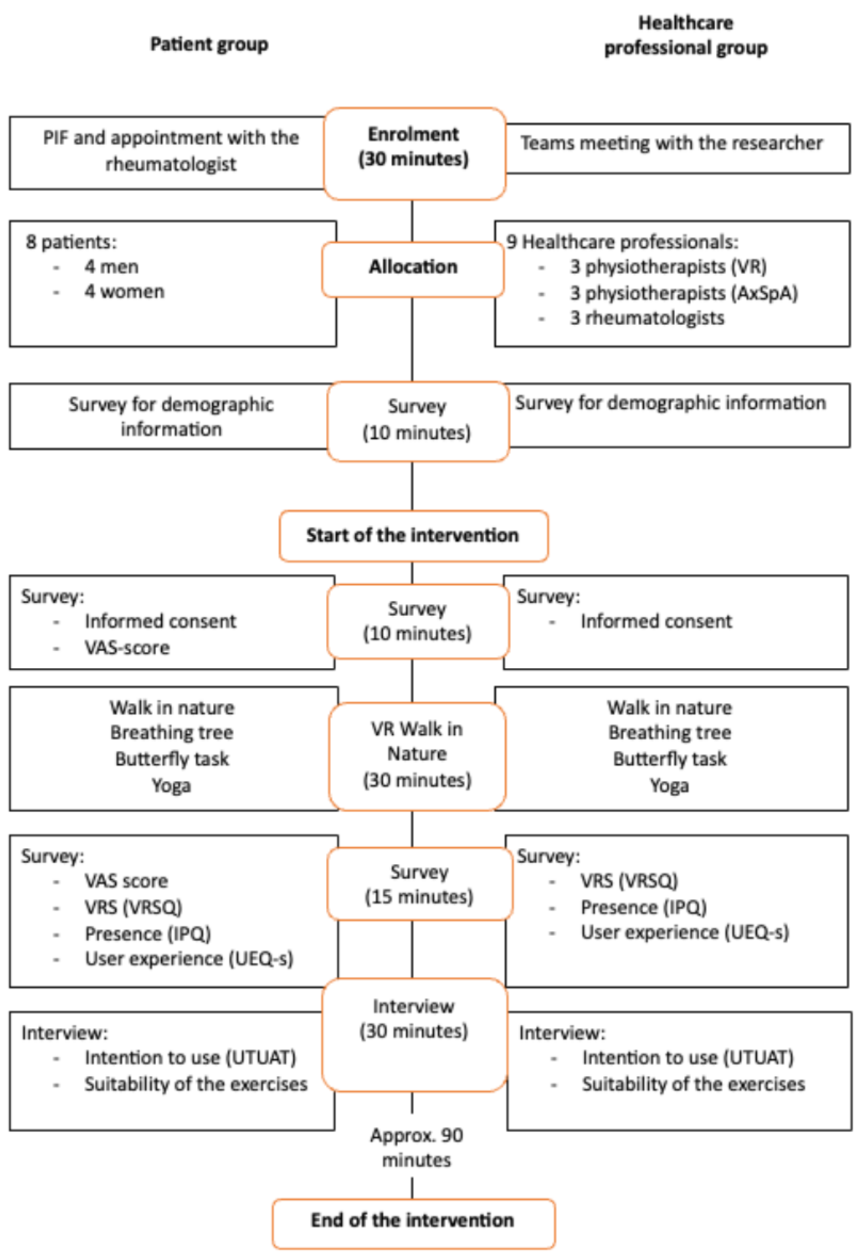
	patiënten in verschillende leeftijden, ziekteactiviteit en ziekteduur, wordt de externe validiteit vergroot. Aangezien deze variatie in patiënten een representatiever beeld geeft over de echte populatie. **2. Zorgprofessionals** 3 Fysiotherapeuten met ervaring in het behandelen van AxSpa. Verschil in: - Werkervaring - Hoeveelheid werkervaring De hoeveelheid werkervaring kan van invloed zijn op de manier van behandelen. Door verschil in de hoeveelheid werkervaring zou een fysiotherapeut andere technieken kunnen gebruiken. 3 Fysiotherapeuten met ervaring in het gebruik van VR. Verschil in: - Werkervaring - Hoeveelheid werkervaring Verder is het doel om fysiotherapeuten te werven die verschillende ervaringen hebben in het gebruik van VR. Bijvoorbeeld verschillende programma's en behandeldoeleinden van de VR bril. Omdat er veel onderzoek wordt gedaan naar het inzetten van VR als fysiotherapie en hierdoor de VR bril vooral in ontwikkeling is. 3 Reumatologen. Verschil in: - Hoeveelheid werkervaring De hoeveelheid werkervaring kan van invloed zijn op de manier van behandelen. Door verschil in de hoeveelheid werkervaring zou een reumatoloog andere technieken kunnen gebruiken. Affiniteit met technologie Voor beide groepen (patiënt en zorgprofessional) staat in de inclusiecriteria dat de participant enige affiniteit heeft met technologie. Want volgens M. Rogers (30) wordt een innovatie opgenomen door innovators, een groep mensen die geïnteresseerd zijn in nieuwe gadgets en deze ook als eerste aanschaffen. Participanten die geen affiniteit hebben, worden niet geëxcludeerd, om de hypothese ook te onderzoeken. Daarnaast is het belangrijk uit te sluiten dat de participant geen audiovisuele beperkingen heeft of een aandoening heeft die verergerd kan worden door het gebruik van de VR bil.
6.2 **Inclusie criteria** *Beschrijf de criteria waaraan de proefpersoon moet voldoen om deel te nemen aan de studie.*	**De patiënten:** - Hebben de diagnose axial spondyloartritis; - Spreken Nederlands; - Zijn uit verschillende leeftijdscategorieën, doel op: 4 met de leeftijd 18-65 en 4 met de leeftijd 65 en ouder; - Hebben verschillende ziekte intensiteit, gebaseerd op de BASDAI-score, doel op 4 patiënten met een score tussen 0-5, en 4 patiënten met een score tussen 5-10; - Met een kortere en langere ziekteduur (4 patiënten tussen 0-20 jaar en 4 patiënten van 20 en meer jaar) - Hebben affiniteit met technologie: de patiënt kan overweg met een smartphone en/of tablet **Zorgprofessionals** 3 fysiotherapeuten met ervaring in het behandelen van AxSpa: - Spreken Nederlands;

	- Zijn verschillend in de jaren werkervaring: junior (0-2 jaar), medior (2-5 jaar) en senior (5 of meer jaar); - Hebben affiniteit met technologie 3 fysiotherapeuten met ervaring in het gebruik van VR: - Spreken Nederlands; - Hebben verschil in werkervaring met de VR bril (programma's en doeleinden van de therapie); - Zijn verschillend in de jaren werkervaring: junior (0-2 jaar), medior (2-5 jaar) en senior (5 of meer jaar); - Hebben affiniteit met technologie 3 reumatologen: - Spreken Nederlands; - Zijn verschillend in de jaren werkervaring: junior (0-2 jaar), medior (2-5 jaar) en senior (5 of meer jaar); - Hebben affiniteit met technologie
6.2 **Exclusie criteria** *Beschrijf de criteria op basis waarvan proefpersonen niet mogen deelnemen aan de studie.*	**Patiënten**: - Ernstige audiovisuele beperkingen; - Een van de volgende hebben: duizeligheid, beperkte cognitie, psychiatrische voorgeschiedenis, evenwichtsstoornissen, en claustrofobie. - Beperkte digitale informatievaardigheden, zoals het omgaan met de VR bril **Zorgprofessionals** (geldt voor alle drie de disciplines: fysiotherapeuten en reumatologen): - Ernstige audiovisuele beperkingen; - Een van de volgende hebben: duizeligheid, beperkte cognitie, psychiatrische voorgeschiedenis, evenwichtsstoornissen, en claustrofobie. - Beperkte digitale informatievaardigheden, zoals het omgaan met de VR bril - Niet BIG geregistreerd
6.4 **Aantal proefpersonen / sample grootte** *Beoogd aantal proefpersonen met een toelichting. Bij een kwantitatief design bij voorkeur met een poweranalyse.*	17 proefpersonen: - **8 patiënten** - **9 zorgprofessionals**: 3 fysiotherapeuten met ervaring in het behandelen van AxSpa, 3 fysiotherapeuten met ervaring in het gebruik van VR en 3 reumatologen.

2. Procedure

7.1 **Studie procedure** *Beschrijf de procedure. Denk hierbij aan werving van proefpersonen (hoe, waar en door wie*	Voor een overzicht van het study design, zie afbeelding 1: research process. De procedure wordt hieronder per fase uitgelegd. De interventie (survey, VR Walk in Nature, survey en interview) duurt ongeveer 1,5 uur (90 minuten). Het onderzoek wordt op een middag of ochtend ingepland, hiervoor heeft de patiënt of zorgprofessional een afspraak gemaakt met de onderzoeker. Het onderzoek vindt plaats op de Universiteit Twente en niet op het MST, omdat de VR bril gebonden is aan de ruimte waar het momenteel is geïnstalleerd. Het programma 'Walk in Nature' voor de VR bril is ontwikkeld door studenten van de Universiteit Twente en in bruikleen voor het MST. Het is helaas (nog niet) mogelijk om de VR bril te verplaatsen. - **Patiënten**	

benaderd, geïnformeerd en geworven) en hoe informed consent verkregen wordt. *Tevens beschrijving van de procedures die proefpersonen zullen ondergaan in de loop van het onderzoek. Geef hierbij aan welke procedures regulier zijn (gebruikelijke zorg) en welke extra zijn voor deze studie.*	**Enrolment**: Patiënten van de afdeling reumatologie van het MST Enschede kunnen geïncludeerd worden als ze voldoen aan de inclusie en exclusiecriteria. De behandelend reumatoloog zal de patiënt vragen voor het onderzoek en de hoofdonderzoeker kan aanvullende informatie geven. De patiënt krijgt de PIF (Patiënt Informatie Formulier) mee en wordt na een week gebeld, zodat de patiënt een bedenktijd heeft om een keuze te maken of hij/zij mee wil doen aan het onderzoek. **Informed consent:** als de patiënt meedoet met het onderzoek wordt op locatie (Universiteit Twente) het toestemmingsformulier ondertekent voor het gebruik van de VR bril. **Allocation**: De patiënt wordt na een week gebeld om te vragen of hij/zij mee wil doen aan het onderzoek. **Start of the intervention:** **Survey:** voor de interventie (eenmalig gebruik van de VR bril) komt de patiënt naar de Universiteit Twente. De patiënt vult als eerst de informed consent in, daarna de VAS-score over de huidige ziekteactiviteit van AxSpa. Tijdens het gebruik van de VR bril is er altijd iemand in de buurt om de patiënt te begeleiden. **VR Walk in Nature:** de patiënt gebruikt alle oefeningen van het Walk in Nature programma. Daarbij komt de patiënt eerst in een bosomgeving terecht om te wennen aan de omgeving (walk in nature), daarna voert de patiënt de breathing tree uit, dan de butterfly task en tot slot de yoga. **Survey:** de patiënt kan voor het invullen van deze vragenlijst een rustig plekje opzoeken in een andere ruimte dan waar de VR bril wordt gebruikt. Hierdoor kan de patiënt ongestoord de vragenlijst invullen. De VAS-score wordt weer gevraagd om de ziekteactiviteit na gebruik van de VR bril in kaart te brengen. Aansluitend worden de virtual reality induced symptoms and effects (VRS), presence en user experience uitgevraagd met een vragenlijst. **Interview:** het interview schema is opgesteld door een framework te gebruiken afgeleid van het UTUAT-model. Per onderwerp (effort expectancy, social influence, attitude, facilitating conditions and performance expectancy) worden vragen gesteld gerelateerd aan de groep: patiënt of zorgprofessional. Hierbij worden de barrières en facilitators van de VR bril in kaart gebracht. Hiervoor is het belangrijk dat de patiënt kan inbeelden dat hij/zij de VR bril in de thuissituatie ziet gebruiken als oefentherapie voor AxSpa. Het interview wordt, na het invullen van de vragenlijst met de onderzoeker, afgelegd. Tijdens het interview wordt er een audio-opname gemaakt, zodat de data na de datacollectie geanalyseerd kan worden. - **Zorgprofessionals** Enrolment: Door gebruik te maken van het sociale netwerk wordt er gezocht naar fysiotherapeuten. Via de tweede begeleider van het onderzoek kan er contact worden opgenomen met fysiotherapeuten die ervaring hebben in het gebruik van VR. Daarnaast wordt er gebeld naar fysiotherapiepraktijken in de regio om participanten te werven. **Informed consent:** als de zorgprofessional meedoet met het onderzoek wordt op locatie (Universiteit Twente) het toestemmingsformulier ondertekent voor het gebruik van de VR bril. **Start of the intervention** **Survey**: voor de interventie (eenmalig gebruik van de VR bril) komt de zorgprofessional naar de Universiteit Twente. Hier vult de zorgprofessional de informed consent in. Tijdens het gebruik van de VR bril is er altijd iemand in de buurt om de zorgprofessional te begeleiden. **VR Walk in Nature:** net zoals de patiënt, voert de zorgprofessional in dezelfde volgorde de oefeningen uit. **Survey**: ook de zorgprofessional vult de vragenlijst in. In vergelijking met de patiënt, hoeft de zorgprofessional geen VAS-score voor en na gebruik van de VR bril te geven. **Interview**: hiervoor is het belangrijk dat de zorgprofessional kan inbeelden dat hij/zij de VR bril in de fysiotherapiepraktijk ziet gebruiken als oefentherapie voor AxSpa. Het interview wordt, na het invullen van de vragenlijst met de onderzoeker, afgelegd.	



Afbeelding 1: research process

3. Uitkomstmaten en meetmethoden*

8.1 **Primaire uitkomstmaat** *De primaire uitkomstmaat is de belangrijkste uitkomst die*	**Patiënten** Survey **voor** gebruik van VR Walk in Nature: - VAS score voor ziekteactiviteit

verzameld wordt. Deze wordt gebruikt om de hoofdvraag te beantwoorden. *Geef aan wat de primaire uitkomstmaat is (er kunnen meerdere zijn), hoe deze gemeten wordt en wanneer. Bijvoorbeeld: kwaliteit van leven, gemeten met SF-36 op baseline en na 3 maanden.*	Survey **na** gebruik van VR Walk in Nature, met een vragenlijst die via de laptop digitaal ingevuld kan worden: - VAS score voor ziekteactiviteit - Virtual reality induced symptoms and effects (VRSQ questionnaire) - Presence (IPQ questionnaire) - User experience (UEQ-s questionnaire) **Zorgprofessionals**: Survey **na** gebruik van VR Walk in Nature, met een vragenlijst die via de laptop digitaal ingevuld kan worden: - Virtual reality induced symptoms and effects (VRSQ questionnaire) - Presence (IPQ questionnaire) - User experience (UEQ-s questionnaire)
8.2 **Secundaire uitkomstmaat** *Geef aan wat de secundaire uitkomstmaten zijn (voor het het beantwoorden van de secundaire onderzoeksvragen), hoe ze gemeten worden en wanneer (indien van toepassing).*	**Patiënten** Een interview **na** gebruik van VR Walk in Nature: - Intention to use technology. Het is belangrijk dat de patiënt kan inbeelden dat hij/zij de interventie in de thuissituatie gebruikt als oefentherapie voor AxSpa. - Suitability of the exercises: de bruikbaarheid van de Walk in Nature wordt als oefentherapie in de thuissituatie beoordeeld. **Zorgprofessionals** Een interview **na** gebruik van VR Walk in Nature: - Intention to use technology. Het is belangrijk dat de zorgprofessional kan inbeelden dat hij/zij de interventie in de fysiotherapiepraktijk gebruikt als oefentherapie bij patiënten met AxSpa. - Suitability of the exercises: de bruikbaarheid van de Walk in Nature wordt als oefentherapie in de fysiotherapie praktijk beoordeeld.
8.3 **Overige variabelen** *Overige te verzamelen variabelen. Geef aan hoe ze verzameld worden (bijv. via vragenlijst, EPD). Bijvoorbeeld baseline metingen als geslacht, leeftijd, gewicht, etc.*	**Patiënt** Demografische gegevens: - Geslacht: man, vrouw, niet-binair/derde geslacht, ik zeg dat liever niet - Leeftijd: geboortedatum - Hoogst behaalde diploma: basisonderwijs, VMBO, HAVO, VWO, Bachelor (HBO/WO), Master (HBO/WO), Doctor (PhD) - Affiniteit met technologie: ja, onzeker, nee Medische gegevens: - Ziekteduur klachten: jaren last van klachten passend bij AxSpa - Ziekteduur: jaar van diagnose - Medicatiegebruik voor AxSpa: nee, paracetamol, NSAID's, conventionele synthetische DMARDs: bijvoorbeeld methotrexaat of Biologic DMARDs: bijvoorbeeld Anti-TNF therapie zoals etanercept - Aanwezigheid van geen, een, twee of meerdere lichamelijke aandoeningen, naast AxSpa

	- Ziekteactiviteit: a.d.h.v. de BASDAI-score **Zorgprofessional** - Geslacht: man, vrouw, niet-binair/derde geslacht, ik zeg dat liever niet - Leeftijd: geboortedatum - Hoogst behaalde diploma: Bachelor (HBO/WO), Master (HBO/WO), Doctor (PhD) - Functie: fysiotherapeut, reumatoloog - Jaren werkervaring: 0 t/m 2 jaar, 2 t/m 5 jaar en 5 jaar of meer - Ervaring in het gebruik van VR: ja of nee - Affiniteit met technologie: ja, onzeker, nee

4. Analyses

9.1 **Statistische analyse** *Beschrijf voor elk van de uitkomstmaten:* - *Hoe de uitkomstmaat samengevat zal worden (gemiddelde, mediaan, percentage,..)* - *Welke vergelijking van interesse is (verschillen tussen groepen, relaties binnen een groep, trend over de tijd,..)* - *Welke statistische toets of analyse gebruikt zal worden* *In geval van kwalitatief onderzoek, beschrijf op welke manier de data wordt verwerkt, gecodeerd en geanalyseerd.*	Analyse van de eerste onderzoeksvraag: • Met RStudio wordt de data geanalyseerd; • Descriptieve statistieken: distributie, central tendency en variabiliteit Analyse van de tweede onderzoeksvraag: • Atlas om data te coderen • RStudio voor analyse • Inductief coderen • descriptive statistics Vergelijking van interesses: **Patiënten** Eerste onderzoeksvraag, patienten: - Geslacht, leeftijd, hoogst behaalde diploma, affiniteit met technologie, ziekteduur klachten, ziekteduur, medicatiegebruik, comorbiditeiten, ziekteactiviteit → VRSQ, IPQ en UEQ-s Tweede onderzoeksvraag, patienten: - Geslacht, leeftijd, hoogst behaalde diploma, affiniteit met technologie, ziekteduur klachten, ziekteduur, medicatiegebruik, comorbiditeiten, ziekteactiviteit → Effort expectancy, social influence, attitude, facilitating conditions and performance expectancy - Geslacht, leeftijd, hoogst behaalde diploma, affiniteit met technologie, ziekteduur klachten, ziekteduur, medicatiegebruik, comorbiditeiten, ziekteactiviteit → Suitability of the exercises **Zorgprofessionals** Eerste onderzoeksvraag, fysiotherapeuten met ervaring in het behandelen van AxSpa & fysiotherapeuten met ervaring in het gebruik van VR: - Geslacht, leeftijd, hoogst behaalde diploma, affiniteit met technologie, ervaring in VR, werkervaring → VRSQ, IPQ en UEQ-s Reumatologen:

	- Geslacht, leeftijd, hoogst behaalde diploma, affiniteit met technologie, ervaring in VR, werkervaring → VRSQ, IPQ en UEQ-s Tweede onderzoeksvraag, fysiotherapeuten met ervaring in het behandelen van AxSpa & fysiotherapeuten met ervaring in het gebruik van VR: - Geslacht, leeftijd, hoogst behaalde diploma, affiniteit met technologie, ervaring in VR, werkervaring → Effort expectancy, social influence, attitude, facilitating conditions and performance expectancy - Geslacht, leeftijd, hoogst behaalde diploma, affiniteit met technologie, ervaring in VR, werkervaring → Suitability of the exercises Reumatologen: - Geslacht, leeftijd, hoogst behaalde diploma, affiniteit met technologie, ervaring in VR, werkervaring → Effort expectancy, social influence, attitude, facilitating conditions and performance expectancy Geslacht, leeftijd, hoogst behaalde diploma, affiniteit met technologie, ervaring in VR, werkervaring → Suitability of the exercises

5. Ethische aspecten

10.1 **Motivatie niet WMO-plichtig onderzoek** *Beschrijf waarom het onderzoek <u>niet</u> valt onder de Wet medisch-wetenschappelijk onderzoek met mensen (WMO).*	Deelname bestaat uit eenmalig 3 oefeningen uitvoeren met de VR bril. Daarnaast wordt er aan de patiënt gevraagd een vragenlijst in te vullen. Aansluitend kan de patiënt deelnemen aan een interview naar de toepasbaarheid van VR bij Bechterew.
10.2 **Geef aan wat de belasting voor de proefpersoon is.** *Beschrijf in hoeverre de proefpersonen worden onderworpen aan handelingen zoals vragenlijsten, interviews, lichamelijk onderzoek, etc. Beschrijf hoeveel tijd de proefpersoon kwijt is door deelname aan het onderzoek (bijv. tijd die het kost om vragenlijst in te vullen, tijd waarmee reguliere polibezoek wordt uitgebreid).*	- Het gebruik van VR; - Daarvoor wordt de patiënt verzocht éénmalig naar de Universiteit Twente te reizen (reiskosten worden vergoed); - Het uitvoeren van oefeningen: een ademhalingsoefening, yogaoefening en strekoefening van 30 minuten met VR; - De patiënt vult een vragenlijst vooraf en achteraf in, waarvan de vragenlijst vooraf 10 minuten zal duren en de vragenlijst achteraf ongeveer 20 minuten (totaal 30 minuten); - Er wordt een interview met de patiënt gedaan (30 minuten) Totale tijdsbelasting circa 1.5 uur (excl. reistijd)
10.3 **Geef aan wat het risico voor de proefpersoon is.** *Hier wordt niet alleen het risico op lichamelijk letsel bedoeld, maar ook het risico op een datalek.*	Er wordt geen direct positief of negatief effect verwacht op de klachten van patiënt. Bij het gebruik van VR kan de patiënt last krijgen van symptomen zoals duizeligheid of misselijkheid (virtual reality induced symptoms and effects / cybersickness). Het onderzoek kan ten alle tijden direct worden gestopt.

6. Databeheer en privacy

11.1 **Wordt in het kader van dit onderzoek aan patiënten/betrokkenen toestemming gevraagd voor het gebruik van hun (medische) gegevens?** **Indien géén toestemming wordt gevraagd: licht toe waarom geen toestemming wordt gevraagd.**	Ja, schriftelijke toestemming door middel van het toestemmingsformulier
11.2 **Is er in het verleden aan patiënten/betrokkenen toestemming gevraagd voor het gebruik van (medische) gegevens voor wetenschappelijk onderzoek?**	Nee
11.3 **Is er sprake (geweest) van een behandelrelatie tussen de onderzoeker(s) of de afdeling van de onderzoeker(s) en de patiënten van wie de status wordt ingezien?**	De behandelaar (reumatoloog) van de patiënt benaderd de patiënt voor het onderzoek. Er is dus een behandelrelatie tussen patiënt en onderzoeker.
11.4 **Wordt er van het gebruik van (medische) gegevens voor wetenschappelijke doeleinden aantekening gemaakt in de status van de desbetreffende patiënt(en)?** *Voor de verstrekking van (medische) gegevens in het kader van wetenschappelijk onderzoek, zonder uitdrukkelijke toestemming van de patiënt, vereist de wet dat de behandelaar die de gegevens verstrekt daarvan aantekening maakt in het patiëntendossier.*	Ja, er wordt een aantekening gemaakt in het EPD
11.5 **Door wie worden de benodigde gegevens uit de patiëntendossiers gehaald?** **a. Zijn de personen die de benodigde gegevens uit de patiëntendossiers halen hiertoe gerechtigd uit hoofde van een behandelrelatie met de desbetreffende patiënt (of**	Prof. dr. H.E. Vonkeman, MST Enschede, Reumatologie Ja, prof. dr. H.E. Vonkeman is gerechtigd uit hoofde van een behandelrelatie met de patiënt.

is hiervoor toestemming aan de patiënt gevraagd)? b. **Indien het antwoord op vraag 11.5 a 'nee' is: Staan de personen die de gegevens uit de patiëntendossiers halen onder directe supervisie van een behandelaar die uit hoofde van de behandelovereenkomst wel gerechtigd is tot inzage in de dossiers?** *Als de onderzoeker(s) zelf geen behandelrelatie heeft/hebben (gehad) met de desbetreffende patiënten en daarom niet gerechtigd zijn tot inzage van het dossier, dient de behandelaar die wél gerechtigd is tot inzage de gegevens uit het dossier aan de onderzoeker(s) ter beschikking te stellen, dan wel dient de persoon die de gegevens uit de dossiers haalt onder directe supervisie van de behandelaar te staan.*	
11.6 **Worden er tot de persoon herleidbare gegevens ter beschikking gesteld aan de onderzoeker(s)?** *Indien er geen behandelrelatie tussen de onderzoeker(s) en de desbetreffende patiënten bestaat, is het niet toegestaan tot de persoon herleidbare gegevens ter beschikking te stellen aan de onderzoekers, tenzij de desbetreffende patiënt daarvoor uitdrukkelijke toestemming heeft gegeven. Indien dat niet het geval is moeten gegevens door de behandelaar in zodanige vorm worden verstrekt dat herleiding tot individuele natuurlijke personen redelijkerwijs wordt voorkomen. Daarvoor kan codering met een onderzoeksnummer worden gebruikt.*	Ja, de meeste gegevens worden door de onderzoekers verkregen door middel van een interview. Voor verdere analyse worden de gegevens gecodeerd en geanonimiseerd.
11.7	Codering vindt plaats bij inclusie door de medewerkers van het onderzoeksbureau Reumatologie.

Indien codering plaatsvindt: wanneer vindt codering plaats, door wie en op welke wijze (hoe is deze codering opgebouwd)?	Voorbeeld van codering: Patiënt: VRP001 en oplopende nummers Fysiotherapeut: VRF001, etc. Reumatoloog: VRR001, etc.
11.8 **Indien van toepassing: waar en in welk systeem worden gecodeerde gegevens opgeslagen en wie hebben er toegang tot de gecodeerde gegevens (noem naam en functie van personen)?**	Gebruik van software: Rstudio De onderzoekers van dit onderzoek zijn gekoppeld aan dit onderzoek
11.9 **a. Indien van toepassing: waar wordt de sleutel, waarmee gecodeerde gegevens zijn te herleiden tot de patiënt, bewaard?** **b. Door wie wordt de sleutel van de gecodeerde data beheerd / wie heeft toegang tot de sleutel en tot de brondocumenten en eventuele andere tot de persoon herleidbare gegevens (noem naam en functie van personen)?** *De onderzoekssleutel en andere tot de persoon herleidbare gegevens mogen MST nooit verlaten.*	Sleutel wordt beheerd door de research medewerkers van het onderzoeksbureau Reumatologie. Deze sleutel wordt opgeslagen op een beveiligde afdelingsschijf die alleen toegankelijk is voor medewerkers van de polikliniek Reumatologie. De sleutel van de gecodeerde data wordt door de research manager beheert: Mirjam Hegeman.
11.10 **Welke technische en organisatorische maatregelen zijn er getroffen ter voorkoming van verlies, diefstal of ongeautoriseerd gebruik van de onderzoeksdata?** *De onderzoeksdata behoren te worden opgeslagen op een netwerkschijf met back-up voorziening en mogen alleen toegankelijk zijn voor betrokken onderzoekers. Dit kan op de T- of P-schijf, mits de toegang is af te schermen voor de betrokken onderzoekers.*	Onderzoeksdata wordt opgeslagen op de beveiligde afdelingsschijf met back-up voorziening. Alleen medewerkers van de polikliniek Reumatologie hebben toegang tot deze schijf.
11.11 **a. Vindt er uitwisseling (zowel uitgifte als opvragen extern) van (onderzoeks)gegevens plaats met (een) andere**	Nee

instelling(en) binnen Nederland en/of de EU? *Zo ja, dan dienen de gegevens bij voorkeur volledig anoniem (d.w.z. ook niet voorzien van een code) te worden overgedragen aan de andere instelling (noem naam instelling). Indien dat in het licht van de onderzoeksopzet niet mogelijk of wenselijk is, dienen de gegevens gecodeerd te worden overgedragen aan de andere instelling. Codering moet plaatsvinden vóórdat de onderzoeksgegevens worden verstuurd naar de andere instelling. Beschrijf indien van toepassing hoe en wanneer codering plaatsvindt.* *Gebruik liever geen usb stick. Als het niet anders kan, bescherm dan de usb stick met encryptiesoftware .* **b. Zo ja, geef de namen van de instellingen aan.** **c. Zo ja, is er een verwerkersovereenkomst of data transfer agreement afgesloten met degene met wie de data gedeeld worden?**	
11.12 **a. Vindt er uitwisseling van (onderzoeks)gegevens plaats met (een) andere instelling(en) buiten de EU?** *Zie toelichting onder 11.11.* **b. Zo ja, geef de namen van de instellingen aan.** **c. Zo ja, wordt aan de desbetreffende patiënten toestemming gevraagd voor het uitwisselen van persoonsgegevens met een land buiten de EU?** *De uitwisseling van persoonsgegevens met een instantie/instelling in een*	Nee

land buiten de EU is aan strengere regels onderworpen met als doel dat een zelfde bescherming als binnen Europa wordt gewaarborgd. In beginsel is daarvoor toestemming van de desbetreffende patiënten vereist. Ook als gegevens gecodeerd zijn, zijn deze indirect identificerend en is het strengere regime uit de AVG op de uitwisseling van deze gegevens van toepassing. **d. Zo ja, is er een verwerkersovereenkomst of data transfer agreement afgesloten met degene met wie de data gedeeld worden?**	
11.13 **Hoe lang worden de (onderzoeks)gegevens bewaard?** *De standaardbewaartermijn voor onderzoeksgegevens is 5 jaar (of zolang als nodig)*	Maximaal 5 jaar op het MST.

7. Publicatiebeleid

12.1 **Hoe worden de resultaten van het onderzoek gepubliceerd (artikel, verslag opleiding, etc.)?**	Het eindproduct van het onderzoek is een scriptieverslag voor de Master Health Sciences aan de Universiteit Twente. Aansluitend wordt er een verdediging voor het onderzoek gehouden.

8. Financieel

13.1 **Is er een (financiële) vergoeding beschikbaar voor dit onderzoek?** *Als er sprake is van een vergoeding graag aangegeven: waaruit bestaat de vergoeding in totaal / per patiënt? Het gaat hierbij om zowel financiële ondersteuning / vergoeding als het krijgen van bepaalde materialen.*	Alleen reiskosten worden vergoed voor de participanten. Daarvoor wordt een reiskostenformulier ingevuld. In de bijlagen treft u hiervoor het formulier. De VR bril wordt kosteloos in bruikleen beschikbaar gesteld door de UT (Universiteit Twente). Het onderzoek is in samenwerking met de UT, daardoor kan de VR door de onderzoeker gebruikt worden.

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2.b Patient Information Form (PIF)

INFORMATIE OVER DEELNAME AAN EEN WETENSCHAPPELIJK ONDERZOEK

Titel: Wat is de toepasbaarheid van Virtual Reality (VR) als oefentherapie in de thuissituatie bij patiënten met Bechterew?
Onderzoekers: Myrthe Franke, dr. C. Bode, prof. dr. H.E. Vonkeman
Centrum: Medisch Spectrum Twente

Inleiding
Geachte heer/mevrouw,

U wordt gevraagd om deel te nemen aan een wetenschappelijk onderzoek (zie titel). In dit onderzoek wordt onderzocht of het doen van fysieke oefeningen met een VR bril toepasbaar is als oefentherapie voor Bechterew.
U beslist zelf of u mee wilt doen. Voordat u een beslissing neemt, is het belangrijk dat u over de benodigde informatie beschikt om te kunnen beslissen of u wilt deelnemen. Een arts of één van de onderzoekers zal het onderzoek met u bespreken en al uw vragen beantwoorden. U mag ook met familie en vrienden over uw beslissing praten. Neem alstublieft voldoende tijd om te beslissen. Dit onderzoek zal uw aandoening weinig/niet verbeteren, maar andere patiënten kunnen mogelijk in de toekomst voordeel hebben uit de informatie die in dit onderzoek wordt verzameld. Hebt u na het lezen van deze informatie nog vragen? Dan kunt u terecht bij de onderzoekers. Op bladzijde 3 vindt u de contactgegevens

1. **Doel van het onderzoek**

Het doel van dit onderzoek is om te onderzoeken of het doen van drie oefeningen (ademhalingsoefening, yogaoefening, en strekoefening) met een VR bril in een natuuromgeving toepasbaar is als oefentherapie voor Bechterew. Virtual Reality (VR) bestaat uit een digitale wereld waar u in terecht komt door middel van het opzetten van een VR-bril (zie figuur 1 en 2). VR lijkt mogelijk effectief te zijn voor het uitvoeren van fysieke oefeningen, maar de toepasbaarheid van een VR-bril bij patiënten met Bechterew is nog niet onderzocht. Daarvoor worden de meningen van patiënten, fysiotherapeuten, en reumatologen gevraagd. Daarna kan er worden bepaald of het verder onderzoeken van de effectiviteit van VR nuttig is voor patiënten met Bechterew.

Figuur 1: Virtual Reality omgeving

Figuur 2: De VR-bril

2. Hoe wordt het onderzoek uitgevoerd?

Als u deelneemt aan dit wetenschappelijk onderzoek wordt er van u gevraagd om eenmalig de VR-bril te gebruiken om oefeningen te doen op de Universiteit Twente. Dit zal zo'n 30 minuten duren. Van tevoren wordt u uitgelegd hoe de VR-bril werkt en zal u tijdens het doen van oefeningen begeleid worden. Daarna wordt een vragenlijst afgenomen en vindt er een interview plaats met een onderzoeker, om de toepasbaarheid van VR-bril in de thuissituatie te onderzoeken. Dit zal ongeveer een uur duren. Totaal bent u ongeveer 1,5 uur bezig met het onderzoek.

3. Wat wordt er van u verwacht?

Wanneer u meedoet aan dit onderzoek wordt u benaderd voor het inplannen van het onderzoek. Voor het onderzoek wordt u gevraagd naar de Universiteit Twente te komen om de VR-bril eenmalig te gebruiken. U ontvangt uitleg over de VR-bril en er wordt gevraagd alle drie de oefeningen (ademhalingsoefening, yogaoefening, en strekoefening) uit te voeren. Daarna wordt er aan u gevraagd een vragenlijst in te vullen om het ontwerp van de VR-bril te beoordelen. Aansluitend wordt er een interview gehouden om de toepasbaarheid van de VR-bril te beoordelen. Het is belangrijk dat u zich hiervoor kunt verplaatsen in hoe toepasbaar de VR-bril zou kunnen zijn.

4. **Wat gebeurt er als u niet wenst deel te nemen aan dit onderzoek?**

U beslist zelf of u meedoet aan het onderzoek. Deelname is geheel vrijwillig. Als u besluit niet mee te doen, hoeft u verder niets te doen. U hoeft ook niet te zeggen waarom u niet wilt meedoen.
Als u wel meedoet, kunt u zich altijd bedenken en toch stoppen, ook tijdens het onderzoek. U hoeft geen reden te geven waarom u wilt stoppen.

5. **Wat gebeurt er met uw gegevens?**

Voor dit onderzoek worden uw persoonsgegevens gebruikt en bewaard. Het gaat om gegevens zoals uw naam, geboortedatum en om gegevens over uw gezondheid. Daarnaast vindt er tijdens het interview een audio-opname plaats. Het verzamelen, gebruiken en bewaren van uw gegevens is nodig om de vragen die in dit onderzoek worden gesteld te kunnen beantwoorden en de resultaten te kunnen publiceren. Wij vragen voor het gebruik van uw gegevens uw toestemming.

Vertrouwelijkheid van uw gegevens

Om uw privacy en identiteit te beschermen krijgen uw gegevens een anonieme code. Uw naam en andere gegevens die u direct kunnen identificeren worden daarbij weggelaten. Nergens wordt uw naam gekoppeld aan uw onderzoeksgegevens. Alleen de hoofdonderzoeker heeft toegang tot deze codelijst. Alleen met de sleutel van de code zijn gegevens tot u te herleiden. De sleutel van de code blijft veilig opgeborgen in de lokale onderzoeksinstelling. De gegevens in rapporten en publicaties over het onderzoek zijn eveneens niet naar u te herleiden.

Toegang tot uw gegevens voor controle

Sommige personen kunnen in het ziekenhuis toegang krijgen tot al uw gegevens. Ook tot de gegevens zonder code. Dit is nodig om te kunnen controleren of het onderzoek goed en betrouwbaar is uitgevoerd. Personen die ter controle inzage krijgen in uw gegevens zijn prof. dr. H.E. Vonkeman, bevoegde medewerkers van dit onderzoek, en zo nodig de Inspectie voor de Gezondheidszorg en controleurs van de Raad van Bestuur van de instelling waar het onderzoek wordt uitgevoerd, nationale en internationale toezichthoudende autoriteiten, bijvoorbeeld de Inspectie Gezondheidszorg en Jeugd. Zij houden uw gegevens geheim. Wij vragen u voor deze inzage toestemming te geven.

Bewaartermijn gegevens

Volgens wettelijke bepalingen zullen uw gegevens 5 jaar worden bewaard in het ziekenhuis. Hierna worden de gegevens vernietigd.

Intrekken toestemming

U kunt uw toestemming voor gebruik van uw persoonsgegevens altijd weer intrekken. De onderzoeksgegevens die zijn verzameld tot het moment dat u uw toestemming intrekt worden nog wel gebruikt in het onderzoek.

Meer informatie over uw rechten bij verwerking van gegevens

Voor algemene informatie over uw rechten bij verwerking van uw persoonsgegevens kunt u de website van de Autoriteit Persoonsgegevens raadplegen.

Bij vragen of klachten over de verwerking van uw persoonsgegevens raden we u aan eerst contact op te nemen met het ziekenhuis. U kunt ook contact opnemen met de Functionaris voor de Gegevensbescherming van de instelling [zie bijlage A].

6. Kosten

Er worden alleen de kosten voor de ziekenhuisbehandeling bij u of uw zorgverzekeraar in rekening gebracht. U maakt geen extra kosten voor het onderzoek.

- Indien u reiskosten moet maken om naar de Universiteit Twente te komen, worden deze vergoed.

7. Door wie is dit onderzoek goedgekeurd?

De Raad van Bestuur van Medisch Spectrum Twente heeft goedkeuring gegeven om dit onderzoek uit te voeren.

8. Wilt u verder nog iets weten?

Wanneer u na het lezen van deze informatie of tijdens deelname aan dit onderzoek vragen heeft kunt u contact opnemen met:

Prof. dr. H.E. Vonkeman, reumatoloog-onderzoeker
Telefoonnummer: 053-4872450

Indien u na zorgvuldige overweging besluit deel te nemen aan dit wetenschappelijk onderzoek, dan vragen we u om het toestemmingsformulier te ondertekenen en van een datum te voorzien.

Met vriendelijke groet,
Prof.dr. H.E. Vonkeman, reumatoloog-onderzoeker

Bijlage A: Contactgegevens
Bijlage B: Toestemmingsformulier

Bijlage A: Contactgegevens voor Medisch Spectrum Twente

Prof.dr. H.E. Vonkeman, reumatoloog-onderzoeker
Koningsplein 1
7512 KZ Enschede
Te bereiken: maandag t/m vrijdag (8.00-17.00 uur) via telefoonnummer: 053-487 24 50

Mw. M. Franke, student Master Gezondheidswetenschappen
Koningsplein 1
7512 KZ Enschede
Te bereiken: maandag t/m vrijdag (8.00-17.00 uur) via telefoonnummer: 053-487 24 50

Klachten: Patiënten servicecentrum
Te bereiken: maandag t/m vrijdag (8.30-17.00 uur) via telefoonnummer: 053-487 20 45

Functionaris voor de Gegevensbescherming van de instelling:
Mw. P. van Paridon
Te bereiken maandag t/m vrijdag (09:00-17.30 uur) via telefoonnummer: 06 31 75 13 87 (1424)

Bijlage B: Toestemmingsformulier

Toepasbaarheid van Virtual Reality als oefentherapie bij patiënten met Bechterew.

Versie 1.0, datum: 4 april 2023

- ✓ Ik heb de informatiebrief voor deelname aan het onderzoek gelezen. Ik kon aanvullende vragen stellen. Mijn vragen zijn genoeg beantwoord. Ik had genoeg tijd om te beslissen of ik meedoe.
- ✓ Ik weet dat meedoen helemaal vrijwillig is. Ik weet dat ik op ieder moment kan beslissen om toch niet mee te doen. Daarvoor hoef ik geen reden te geven.
- ✓ Ik geef toestemming dat er een audio-opname plaatsvindt tijdens het interview
- ✓ Ik weet dat sommige mensen mijn gegevens kunnen zien. Die mensen staan vermeld in de informatiebrief.
- ✓ Ik geef toestemming om mijn gegevens te gebruiken, voor de doelen die in de informatiebrief staan.
- ✓ Ik geef toestemming om mijn onderzoeksgegevens 5 jaar na afloop van dit onderzoek te bewaren.
- ✓ Ik wil meedoen aan dit onderzoek.

Naam deelnemer:
Handtekening: Datum : __ / __ / __

Ik verklaar hierbij dat ik deze deelnemer volledig heb geïnformeerd over het genoemde onderzoek. Als er tijdens het onderzoek informatie bekend wordt die de toestemming van de deelnemer zou kunnen beïnvloeden, dan breng ik hem/haar daarvan tijdig op de hoogte.

Naam onderzoeker (of diens vertegenwoordiger):
Handtekening: Datum: __ / __ / __

Aanvullende informatie is gegeven door (indien van toepassing):
Naam:
Functie:
Handtekening: Datum: __ / __ / __ -

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* Doorhalen wat niet van toepassing is.

2.c Email sent to participants about participation before the study

Beste mw./dhr.,

U heeft zojuist een afspraak gemaakt voor het onderzoek: Virtual reality en Bechterew
Hierbij stuur ik u verdere informatie over uw afspraak op: **...**

Het onderzoek vindt plaats op de Universiteit Twente (UT) in het gebouw Cubicus. U kunt hier gratis parkeren.
Het adres is: Cubicus, De Zul 10, 7522 NJ Enschede.

U wordt om … uur verwacht bij de receptie van de Cubicus. De receptie is te vinden bij de hoofdingang.
Ik wacht daar op u, om u daarna te begeleiden naar de ruimte waar het onderzoek zal plaatsvinden. Het onderzoek zal zo'n 1,5 uur duren. U kunt het informatie formulier over het onderzoek nogmaals doorlezen, als u wil (zie bijlagen). De informed consent, die op de laatste pagina van het formulier staat, wordt tijdens uw afspraak, voor de start van het onderzoek ondertekent. Mocht u reiskosten maken om naar de Universiteit te komen, kunt u deze declareren. Bij uw afspraak krijgt u hiervoor een declaratieformulier mee.

Mocht u het gebouw niet kunnen vinden, kunt u mij bellen op 06 23 11 55 68

Als u andere vragen heeft, kunt u mij gerust mailen.

Met vriendelijke groet,
Myrthe Franke
Student Master Gezondheidswetenschappen
Universiteit Twente - MST Enschede

2.d Declaration form travel expenses

Declaratie formulier reiskosten

VR en Bechterew studie reumatologie

Naam	:	……………………………………………
Adres	:	……………………………………………
Postcode / woonplaats	:	……………………………………………
Bankrekeningnummer	:	……………………………………………
Ten name van	:	……………………………………………

Reiskosten:

Openbaar vervoer	:	€………………………………………… *Graag uw vervoersbewijs bijvoegen*
Auto	:	……..km à € 0.19 = € …………

Het ingevulde formulier kunt u door middel van de bijgevoegde antwoord enveloppe terug sturen naar het secretariaat reumatologie.

Bij vragen kunt u contact opnemen met het secretariaat, telefoonnummer: 053-487 24 50

Dit gedeelte hoeft u niet in te vullen.

Akkoord Principal Investigator	:	………………………………………..
Datum	:	………………………………………..

Appendix 2. Request for ethical review

UNIVERSITY OF TWENTE.

FACULTY BMS

230719 REQUEST FOR ETHICAL REVIEW

Request nr: 230719

Researcher: Franke, M.

Supervisor: Bode, C.

Reviewer: Klooster, P.M. ten

Status: Approved by commission

Version: 2

1. START

A. TITLE AND CONTEXT OF THE RESEARCH PROJECT

1. What is the title of the research project? (max. 100 characters)

    What is the feasibility of Virtual Reality as exercise therapy for patients with Bechterew?

2. In which context will you conduct this research?

    Master's Thesis

3. Date of the application

    23-06-2023

5. Is this research project closely connected to a research project previously assessed by the BMS Ethics Committee?

    Yes

please provide the ethic request number(s) for the research project(s):

    89140, 93538, 221174

B. CONTACT INFORMATION

6. Contact information for the lead researcher

    6a. Initials:

    M.

    6b. Surname:

    Franke

    6c. Education/Department (if applicable):

    M-HS

    6d. Staff or Student number:

    2736071

6e. Email address:

m.franke@student.utwente.nl

6f. Telephone number (during the research project):

+31623115568

6g. If additional researchers (students and/or staff) will be involved in carrying out this research, please name them:

Name: Dr. C. Bode, c.bode@utwente.nl & Name: Prof. dr. H.E. Vonkeman, h.vonkeman@mst.nl

6h. Have you completed a PhD degree?

No

7. Contact information for the BMS Supervisor

7a. Initials:

C.

7b. Surname:

Bode

7c. Department:

BMS-PGT

7d. Email address:

c.bode@utwente.nl

7e. Telephone number (during the research project):

+31534896044

8. Is one of the ethics committee reviewers involved in your research? Note: not everyone is a reviewer.

No

C. RESEARCH PROJECT DESCRIPTION

9a. Please provide a brief description (150 words max.) of the background and aim(s) of your research project in non-expert language.

Axial spondylarthritis (axSpA), also popularly referred to as Bechterew's disease, is a chronic inflammatory disease that predominantly affects the sacroiliac joints (SIJ) and the spine (axial). The most common symptoms are chronic pain, fatigue, and stiffness in the spine. Besides medication, exercise therapy is important to reduce symptoms of Bechterew disease, but physiotherapy is not included in the basic insurance. VR shows potential as exercise therapy since the gaming elements of VR could address adherence to exercise. A feasibility study helps to define if it is appropriate to keep an intervention for further testing. It is important to perform such a study, because of resource constraints, not all interventions can be tested for efficacy and effectiveness. This research aims to investigate the feasibility of the Walk in Nature (VR) as exercise therapy for patients with Bechterew. Therefore, the applicability of the Walk in Nature environment is investigated by patients, physiotherapists, and rheumatologists. This thesis employs the 'Walk in Nature' Virtual Reality environment to investigate 1) 'To what extent is the virtual nature environment applicable as exercise treatment for AxSpa in the home environment?' 2) 'How could the suitability of the virtual nature environment as exercise therapy be improved for patients with axial spondylarthritis in the home environment?', by patients. And 1) 'To what extent is the virtual nature environment applicable as exercise treatment for AxSpa in the physiotherapy practice?' 2) 'How could the suitability of the virtual nature environment as exercise treatment be improved for patients with axial spondylarthritis in the physiotherapy practice?', by physiotherapists and rheumatologists.

9b. Approximate starting date/end date of data collection:

Starting date: 2023-07-08

End date: 2023-08-30

9c. If applicable: indicate which external organization(s) has/have commissioned and/or provided funding for your research.

Commissioning organization(s):

Not applicable

Funding organization(s):

Not applicable

2. TYPE OF STUDY

Please select the type of study you plan to conduct:

I will be collecting new data from individuals acting as respondents, interviewees, participants or informants.

4. RESEARCH INVOLVING THE COLLECTION OF NEW DATA

A: RESEARCH POPULATION

20. Please provide a brief description of the intended research population(s):

The research population exists of two groups: patients and healthcare professionals. Each group has different research questions. Since both groups evaluate the feasibility from their own perspective. - Patients with Bechterew disease (axial spondyloarthritis): the prevalence between men and women is equally divided. That's why there are four men and four women included. Besides, the difference in medical history about axSpA is preferred. Since this higher variability fits as external validity. Patients are included by a difference in: age, disease activity (severity of symptoms), disease duration - The physiotherapists are divided into two disciplines: three physiotherapists with experience in treating axSpA and three physiotherapists with experience in using VR as physiotherapy. Both disciplines evaluate the intervention from their own perspective: the technology (experience in VR) and the exercises (experience in treating axSpA). Physiotherapists with experience in treating axSpA are included by: a difference in work experience since a difference in expertise means that physiotherapists use different approaches/techniques. The same inclusion criteria matter for physiotherapists with experience in using VR because VR is still in the development stage. This means that almost every physiotherapist has a different experience with VR. This influences their perspective on the feasibility of the Walk in Nature environment. - Rheumatologists: are lead practitioners. They prescribe exercise therapy and their judgment is necessary to evaluate if the intervention fits as a treatment.

21. How many individuals will be involved in your research?

- 8 patients - 6 physiotherapists: 3 physiotherapists with experience in using VR and 3 physiotherapists with experience treating axSpA - 3 rheumatologists in total: 17 participants

22. Which characteristics must participants/sources possess in order to be included in your research?

Patients: - Diagnosed with axial spondyloarthritis - Patients from MST hospital - Dutch language - different age categories: aiming for 4 patients between the age of 18-65, and 4 patients 65+ - different disease activity: aiming for 4 patients with a BASDAI score of 0-5, and 4 patients with a BASDAI score between 5-10 - aiming for different disease durations Healthcare professionals: Physiotherapists Physiotherapists with experience in treating patients with axial spondyloarthritis - Dutch language - Aiming for a difference in work experience: junior (0-2 years), medior (2-5 years) or senior (5 or more years) 3 physiotherapists with experience in using VR as treatment - Dutch language - Aiming for a difference in work experience: junior (0-2 years), medior (2-5 years) or senior (5 or more years) Rheumatologists - Dutch language - working at MST hospital Exclusion criteria for all participants: - Low digital information literacy - Have any of the following conditions: dizziness, impaired cognition, psychiatric history, balance disorders, and claustrophobia.

23. Does this research specifically target minors (<16 years), people with cognitive impairments, people under institutional care (e.g. hospitals, nursing homes, prisons), specific ethnic groups, people in another country or any other special group that may be more vulnerable than the general population?

No

24. Are you planning to recruit participants for your research through the BMS test subject pool, SONA

No

B. METHODS OF DATA COLLECTION

25. What is the best description of your research?

- (Online) survey research
- Interview research

26. Please prove a brief yet sufficiently detailed overview of activities, as you would in the Procedure section of your thesis or paper. Among other things, please provide information about the information given to your research population, the manipulations (if applicable), the measures you use (at construct level), etc. in a way that is understandable for a relative lay person.

This research is performed in mixed methods. Both research questions aim to investigate the product (VR glasses: Oculus rift s) and the program (exercises of the Walk in Nature program: walk in nature, breathing tree, butterfly task and yoga) The first research question provides quantitive data using a questionnaire to investigate the VAS-score symptoms severity, VRSQ, IPQ and UEQ-s. The VAS-score is only for patients, not for healthcare professionals. Additionally, the second research question provides qualitative data using a interview to investigate the intention to use technology (UTUAT model as framework) and the suitability of the exercises as exercise therapy. The procedure for each participant is as follows: the participant is included in the study and fills in a questionnaire for demographic information (includes information about one's age, gender, nationality, level of education, and experience with VR), then the participant is scheduled for an appointment to use the VR at the University. During the appointment, the participant is using all three exercises of VR, individuals will participate in the Virtual Reality intervention in the ManouVR room at the Cubicus building at the University of Twente. First, they will be introduced to the VR display and instructed about its use and motion sickness. Participants will be invited to put on the VR headset, and the controllers will be given to them. The Virtual Reality nature will be played to let participants get used to the environment until they say they are ready to participate in the exercises. Then, they will complete three exercises from the "Walk in Nature" project one by one. The researcher does not intervene or interact with participants while they are completing the exercises. After they complete the final exercise, they will take off the headset. They will be asked to fill in the validated questionnaire (including VAS-score for patients, virtual reality symptoms, feeling of presence, and user experience) to measure the applicability of the technology. When they completed this questionnaire, an interview is conducted about the suitability of the intervention as exercise therapy. The interview questions if the exercises of the Walk in Nature program are valuable as exercise therapy, additionally questions are formulated about the concepts of the UTUAT-model:

performance expectancy, effort expectancy, social influence, facilitating conditions and attitude towards using technology. The difference between the measurements between the patient and healthcare professional (physiotherapist and rheumatologist) is that the patients evaluate the intervention in a home environment and the healthcare professional in a physiotherapy practice. Besides, the demographic questionnaire includes medical history for the patients and work experience for the healthcare professional.

How much time will each participant spend (mention the number of sessions/meetings in which they will participate and the time per session/meeting)?

5 minutes for filling in the demographic questionnaire, 10 for minutes explaining VR, 30 minutes for using VR, 15 minutes for fillling in the questionnaire, and 30 minutes for the interview. In total 1,5 hour

C: BURDEN AND RISKS OF PARTICIPATION

27. Please provide a brief description of these burdens and/or risks and how you plan to minimize them:

Some participants may be prone to experiencing motion sickness while interacting with the Virtual Reality environment. If motion sickness occurs, the participant will be asked to remove the headset, and the intervention will be stopped immediately.

28. Can the participants benefit from the research and/or their participation in any way?

No

29. Will the study expose the researcher to any risks (e.g. when collecting data in potentially dangerous environments or through dangerous activities, when dealing with sensitive or distressing topics, or when working in a setting that may pose 'lone worker' risks)?

No

D. INFORMED CONSENT

30. Will you inform potential research participants (and/or their legal repsentative(s), in case of non-competent participants) about the aims, activities, burdens and risks of the research before they decide whether to take part in the research?

Yes

Briefly clarify how:

Patients will be informed about the aim, duration, activities, and risk of the study, the intervention program and its purpose (investigating the feasibility of the walk in nature program) in the PIF (patient information form), provided by the rheumatologist of the patient, where the informed consent will be signed. Other participants (physiotherapists and rheumatologists) will be contacted by the researcher and informed about the same subjects as the patients, but during a video call by the researcher. They will sign the informed consent before participating the VR at the University. In addition, on the day of their participation in the Virtual Reality intervention, they will be reminded about the activities they will do and informed about the chance of experiencing motion sickness.

32. How will you obtain the voluntary, informed consent of the research participants (or their legal repsentatives in case of non-competent participants)?

Signed

33. Will you clearly inform research participants that they can withdraw from the research at any time without explanation/justification?

Yes

34. Are the research participants somehow dependent on or in a subordinate position to the researcher(s) (e.g. students or relatives)?

No

35. Will participants receive any rewards, incentives or payments for participating in the research?

- Reimbursement of travel expenses (indicate the maximum payment to the participant):
  0,19 cents per kilometer. Reimbursed form the hospital (MST)

36. In the interest of transparency, it is a good practice to inform participants about what will happen after their participation is completed. How will you inform participants about what will happen after their participation is concluded?

- Participants who indicate they are interested will receive a summary of the research results.

E. CONFIDENTIALITY AND ANONYMITY

37. Does the data collected contain personal identifiable information that can be traced back to specific individuals/organizations?

Yes

38. Will all research data be anonymized before they are stored and analysed?

Pseudonymazation

39. Will you make use of audio or video recording?

No

5. DATA MANAGEMENT

- I have read the UT Data policy.
- I am aware of my responsibilities for the proper handling of data, regarding working with personal data, storage of data, sharing and presentation/publication of data.

6. OTHER POTENTIAL ETHICAL ISSUES/CONFLICTS OF INTEREST

40. Do you anticipate any other ethical issues/conflicts of interest in your research project that have not been previously noted in this application? Please state any issues and explain how you propose to deal with them. Additionally, if known indicate the purpose your results have (i.e. the results are used for e.g. policy, management, strategic or societal purposes).

I do not anticipate any other ethical issues/conflicts of interest.

7. ATTACHMENTS

PIF_VR_Bechterew_2.pdf, RvB2065-23 K23-25.pdf

8. COMMENTS

-

9. CONCLUSION

Status: Approved by commission

The BMS ethical committee / Domain Humanities & Social Sciences has assessed the ethical aspects of your research project. On the basis of the information you provided, the committee does not have any ethical concerns regarding this research project. It is your responsibility to ensure that the research is carried out in line with the information provided in the application you submitted for ethical review. If you make changes to the proposal that affect the approach to research on humans, you must resubmit the changed project or grant agreement to the ethical committee with these changes highlighted.

Moreover, novel ethical issues may emerge while carrying out your research. It is important that you re-consider and discuss the ethical aspects and implications of your research regularly, and that you proceed as a responsible scientist.

Finally, your research is subject to regulations such as the EU General Data Protection Regulation (GDPR), the Code of Conduct for the use of personal data in Scientific Research by VSNU (the Association of Universities in the Netherlands), further codes of conduct that are applicable in your field, and the obligation to report a security incident (data breach or otherwise) at the UT.