Implementation of a Virtual Reality Intervention in Outpatient Physiotherapy for Chronic Pain: Pilot Implementation Study Protocol

Alexander Elser, Christian Kopkow, Axel Georg Schäfer

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Abstract

Background: Chronic pain is a global health issue that causes physical, psychological, and social disabilities for patients, as well as high costs for societies. Virtual Reality (VR) is a new treatment that provides an opportunity to narrow the gap between clinical practice and recommended care, especially in the outpatient physiotherapy setting. However, there is currently no implementation strategy to integrate VR treatments into this setting.

Objective: This protocol outlines a pilot implementation study that aims to (1) identify barriers and facilitators for implementing a Virtual Reality (VR) intervention in outpatient physiotherapy care for people with chronic pain. And (2) to develop and pilot test an implementation strategy in five practices in Germany.

Methods: The study consists of four phases. The first phase involves adapting the treatment protocol of the VR intervention to the local context of outpatient physiotherapy practices in Germany. The second phase includes the collection of barriers and facilitators via semiscructured interviews from physiotherapists and the development of a theory-driven implementation strategy based on the Theoretical Domains Framework (TDF) and the Behavior Change Wheel (BCW). This strategy will be applied in the third phase, which will also include a six-month span of using VR interventions in practices, along with a process evaluation. The fourth phase will be a final evaluation of the entire process and implementation strategy at the end of the of the study.

Results: The recruitment process and phase 1, including the adaptation of the treatment protocol, have already been completed. We recruited five physiotherapy practices in Lower Saxony, Germany, where the VR intervention will be implemented. The collection of barriers and facilitators through semi-structured interviews is scheduled to begin in February 2024.

Conclusions: This pilot implementation study aims to develop a theory-driven implementation strategy for integrating a VR intervention into outpatient physiotherapy care for people with chronic pain. The identified barriers and facilitators, along with the implementation strategy, will serve as a starting point for future randomized controlled implementation studies in different settings to refine the implementation process and integrate VR interventions into the outpatient care of people with chronic pain. Clinical Trial: German Clinical Trials Register (ID: DRKS00030862)

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Abstract

Background: Chronic pain is a global health issue that causes physical, psychological, and social disabilities for patients, as well as high costs for societies. Virtual Reality (VR) is a new treatment that provides an opportunity to narrow the gap between clinical practice and recommended care in the use of patient education and behavioral interventions in the outpatient physiotherapy setting. However, there is currently no implementation strategy to integrate VR treatments into this setting.

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Results: The recruitment process and phase 1, including the adaptation of the treatment protocol, have already been completed. We recruited five physiotherapy practices in Lower Saxony, Germany, where the VR intervention will be implemented. The collection of barriers and facilitators through semi-structured interviews is scheduled to begin in February 2024.

Conclusions: This pilot implementation study aims to develop a theory-driven implementation strategy for integrating a VR intervention into outpatient physiotherapy care for people with chronic pain. The identified barriers and facilitators, along with the implementation strategy, will serve as a starting point for future randomized controlled implementation studies in different settings to refine the implementation process and integrate VR interventions into the outpatient care of people with chronic pain.

Trial Registration: German Clinical Trials Register (ID: DRKS00030862)

Keywords (3 bis 10): chronic pain; implementation; virtual reality; VR; physiotherapy;

Introduction

Chronic pain defined as persistent or recurrent pain lasting longer than three months [1] is a major global health problem. Chronic pain conditions (back pain, musculoskeletal disorders and neck pain) are three of the leading causes for years lost to disability in the last decades [2,3]. Prevalence rates in industrial nations like the USA (20.5 %) [4], Germany (28.3 %) [5], the UK (34 %) [6] and Chile (48.1 %) [7] are high, but also among low- and middle-income countries which prevalence rates ranging from 13% to 49.4% [8]. Chronic pain often results in physical disability, psychological distress, and reduced quality of life [3,9], and is associated with higher rates of divorce and suicide, and affects relationships and self-esteem [10,11]. For societies, chronic pain is an enormous financial burden on the healthcare system. The financial cost of chronic pain in the US is estimated to be between $560 billion and $635 billion in 2010, including medical costs and lost productivity [12]. In Germany chronic pain costs at least €53.9 billion annually [13]. Although evidence-based treatments and guidelines for the management of chronic pain are available [14–16], they are only partially used [17,18]. In Germany, for example, only 38% of physiotherapists in a survey reported that they work according to guidelines in chronic pain management [19]. Perceived barriers to the use of guidelines in clinical practice include lack of time, lack of research skills, limited access to guidelines, and inapplicability of guideline recommendations to individual patients [19,20].

Implementation studies offer an opportunity to improve this situation and overcome these barriers by developing and testing targeted implementation strategies for evidence-based interventions [21]. Currently, frameworks, models and theories for the development of implementation interventions and strategies are not yet used as standard in the implementation of VR interventions, although this is recommended. [22]. One model to guide the process of implementation is the Knowledge to Action (KTA) cycle [23]. The KTA cycle is a process model, which is increasingly used since its introduction in 2006 [24–27]. The KTA was developed from a concept analysis of 31 planned action theories to make sense of the complex implementation process. It provides a comprehensive view by integrating concepts of knowledge creation and application. At each stage of the action cycle, other frameworks or theories can be applied [23].

One such framework to determine barriers and facilitators is the Theoretical Domains Framework (TDF) [28,29]. The TDF was created to enhance healthcare researchers' access to psychological theory by providing a systematic and simplified approach to behavior change theories. Consisting of 14 theoretical domains derived from 33 theories and 128 constructs, this framework serves as a valuable tool for examining the barriers and facilitators that influence professional behavior change. Once the barriers and facilitators in a setting have been identified, they can be mapped to the domains. The Behavior Change Wheel (BCW) [30] can then be used to develop implementation interventions with specific functions and behavior change techniques to influence the targeted behavior. The BCW is a comprehensive framework that incorporates behavioral theory to effectively capture and address the mechanisms of action within interventions. Developed through expert consensus and a rigorous validation process, the wheel is organized into three levels. Its central element is the COM-B model, which includes aspects of **C**apability (both physical and psychological), **O**pportunity (both social and physical), and **M**otivation (both automatic and reflective). It is proposed that people need these three factors to increase the likelihood of performing the **B**ehavior in question [30].

A new evidence-based intervention for people with chronic pain is virtual reality (VR) [31]. It is used in physiotherapy in many specialties such as neurology and orthopedics to manage pain [32]. VR treatments include VR games, mindfulness-based interventions, practical exercises and visual illusions for people with chronic pain [33]. For example, one part of an intervention is a relaxation

exercise in which deep breathing is used to make a virtual tree blossom. Another is a virtual journey through the body to explain chronic pain to the patient. A meta-analysis showed large effects of VR interventions on pain (SMD 1.6; 95 % CI 0.83 – 2.36) and body functioning (SMD 1.4; 95 % CI 0.13 – 2.67) in people with chronic pain [33]. However, it is unknown how often VR treatments are used in the care of people with chronic pain. A recent review about the barriers and facilitators in the implementation of VR intervention for people with chronic pain shows various barriers. The main barriers were the inappropriate choice of VR devices and VR interventions in relation to the patients, and that patients did not have the required skills to use VR and no tutorials or instructions were available [34]. But also facilitators such as positive beliefs about consequences from a patient perspective [34]. However, little is known regarding barriers and facilitators from a health professional perspective. The next step in the implementation of VR interventions into health care is the development of an initial implementation strategy, supported by implementation frameworks focusing on behavior change of all stakeholders [35]. Therefore, the aim of this study is (1) to identify barriers and facilitators from the perspective of health care professionals and (2) to develop and test a strategy for the implementation of VR interventions in outpatient physiotherapy practices.
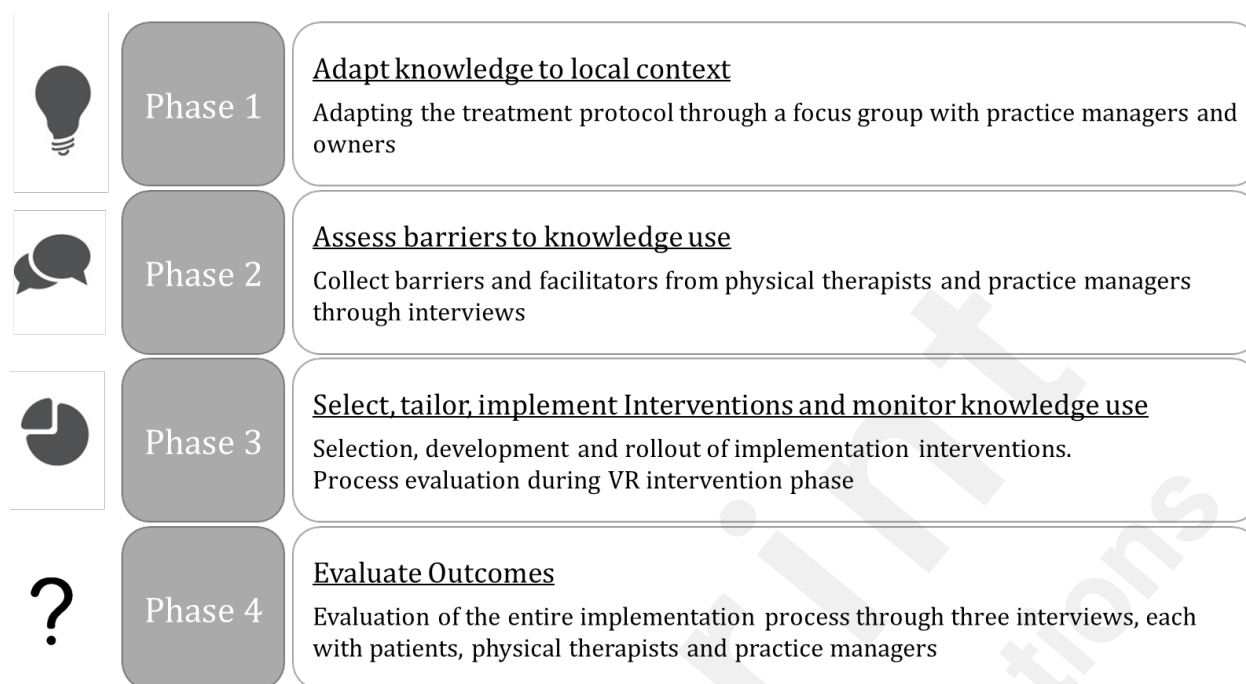
Methods

Overview

The four phases [Figure 1] of the pilot implementation study are derived from the KTA cycle [23] and the entire implementation process is accompanied by a formative evaluation [36], which makes it possible to collect data at several points throughout all phases and influence the implementation at the same time. The implementation takes place in five outpatient physiotherapy practices in Germany. In the first phase (Adapt knowledge to local context), the treatment protocol of the VR intervention is adapted to the context of outpatient physiotherapy practices. The second phase (Assess barriers to knowledge use) consists of collection of specific barriers and facilitators to the implementation of the VR intervention from a health care professional perspective. Participating therapists first receive training in the use of the VR devices and the VR intervention, and then semi-structured interviews are conducted with them. This will be the basis for the development of an implementation strategy with tailored implementation interventions in phase 3 (Select, tailor, implement interventions and Monitor knowledge use). After the implementation strategy has been carried out, the physiotherapists will use the VR intervention in the practice with an accompanying process evaluation. Finally, the entire process and implementation strategy will be evaluated and adapted in phase 4 (Evaluate outcomes).

The reporting of this protocol follows the CONSORT 2010 statement: extension to randomised pilot and feasibility trials [37]. The study was registered with the German Clinical Trials Register (ID: DRKS00030862).

Figure 1 The four phases of the pilot implementation study for the development and evaluation of an implementation strategy. VR: Virtual Reality.

	Phase 1	**Adapt knowledge to local context** Adapting the treatment protocol through a focus group with practice managers and owners
	Phase 2	**Assess barriers to knowledge use** Collect barriers and facilitators from physical therapists and practice managers through interviews
	Phase 3	**Select, tailor, implement Interventions and monitor knowledge use** Selection, development and rollout of implementation interventions. Process evaluation during VR intervention phase
?	Phase 4	**Evaluate Outcomes** Evaluation of the entire implementation process through three interviews, each with patients, physical therapists and practice managers

VR intervention

The VR intervention (Reducept, NL) is a psychological VR intervention for the treatment of chronic pain. Reducept aims to teach patients that pain can be influenced and managed by changing the way they think about their pain. In the game, the user travels through the body in a spaceship [Figure 2]. Along the way, the user learns about the mechanisms of pain. Reducept is based on the "Explain Pain" guidelines [38], which state that understanding pain and influencing the cognitive, emotional and behavioral processes associated with it enables patients to reduce their pain experience. In addition to pain education, the user plays several serious games that stimulate the visual, auditory and proprioceptive systems to control chronic pain through distraction and relaxation. The VR intervention uses techniques from cognitive behavioral therapy (CBT), acceptance and commitment therapy (ACT), mindfulness, and hypnotherapy [39]. The game is divided into five modules that build on each other and last from five to ten minutes. A workbook with in-depth content on the VR modules accompanies the therapy. The planned therapy sequence consists of six therapy sessions of 10 to 20 minutes each.

Figure 2 Screenshot from the nerve level of Reducept.
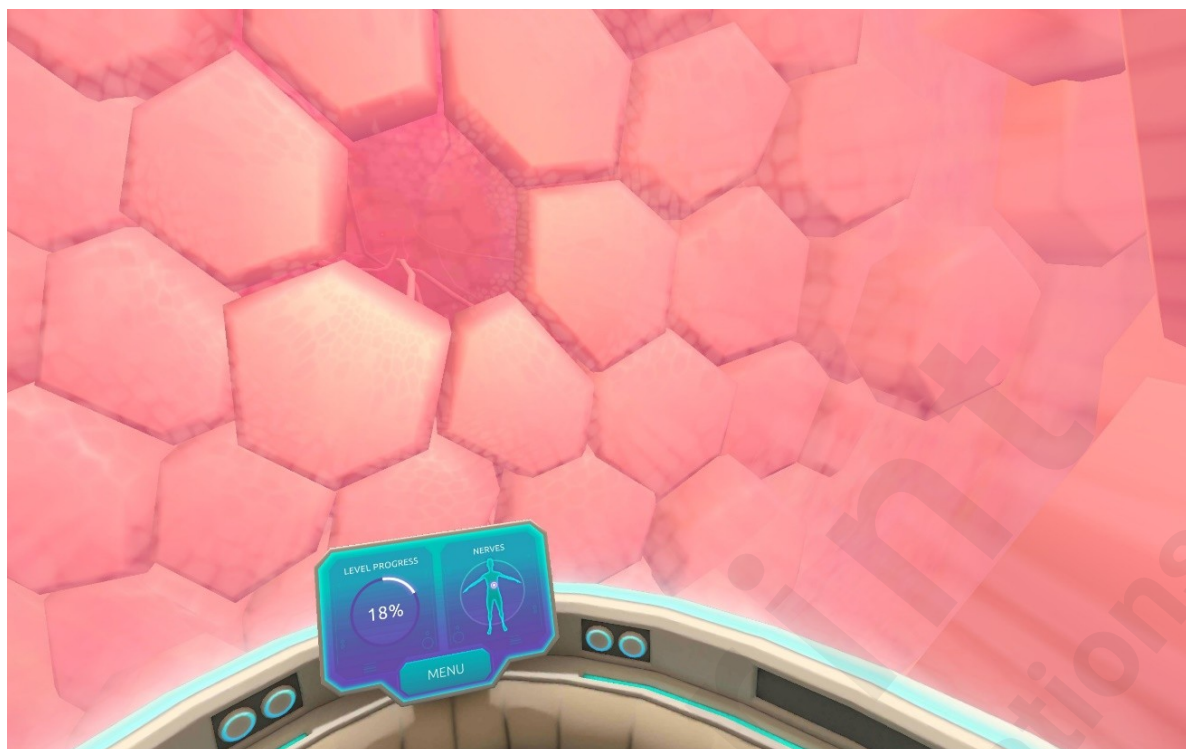
Data analysis

Qualitative content analysis according to Kuckartz [40] will be used throughout the study to analyze qualitative data. Qualitative content analysis is a systematic and structured way of analyzing qualitative data. First, main categories are identified deductively or inductively, then text segments are systematically assigned to these categories. From these text segments, subcategories are inductively derived. This method helps to identify themes, patterns, and correlations in the data, thus providing deeper insights into the phenomenon under study. In addition, Kuckartz content analysis provides a transparent approach that increases the validity and reliability of research findings. MAXQDA (MAXQDA Plus 2022, Release 22.0.1) will be used for the qualitative analysis.

The data related to the patients' health outcomes are evaluated for normal distribution and sphericity, and then analyzed using repeated measures ANOVA with SPSS (28.0.1.0, IBM Corp.).

Phase 1

The first phase of the implementation process consists of adapting the treatment protocol of the VR intervention to the context of outpatient physiotherapy practices in Germany.

Five outpatient physiotherapy practices in Lower Saxony (Germany) will participate in the study and implement the VR intervention. At least five physiotherapists must work in the practices to be eligible to participate in the study. Practice managers or owners and two researchers will participate in guided focus groups to adapt the original treatment protocol of the VR intervention. Focus groups are a good method to investigate what participants think and why they think it [41]. In addition, the group setting can stimulate new ideas that may be hidden in individual discussions [42]. Another goal is to establish collaboration and networking among participants. The focus group guideline will be developed using the implementation outcomes of acceptability, appropriateness, adoption and

feasibility [43]. The guideline will be pre-tested and adapted, if necessary.

The focus group will take place at the University of Applied Science and Art in Hildesheim/Holzminden/Göttingen (Germany) and will last approximately 2 hours. One researcher will moderate the focus group, while a second researcher will take care of technical aspects, keep time and take notes on important aspects or special incidents.

At the beginning of the focus group, the moderator gives an introduction explaining the process and goals of the overall study and the focus group, followed by a presentation of the original VR treatment protocol. During the focus group, a table is displayed with the content and duration of the six VR treatment sessions originally planned in the treatment protocol. The main part of the focus group addresses the four outcomes of acceptability, appropriateness, adoption and feasibility in relation to the treatment protocol. By discussing these aspects, it will be possible to adapt the treatment protocol to the context of outpatient physiotherapy practices. The final section is an open-ended question and answer session where participants can speak and discuss freely about the treatment protocol and possible adaptations. At the end of the focus group, participants will complete an online demographic survey. The audio of the focus group is recorded with an audio recorder for the entire duration.

In this phase, the qualitative content analysis according to Kuckartz [40] will focus on possible adjustments to the original treatment protocol in relation to the setting. After the analysis, the VR treatment protocol will be adapted in consultation with the practice owners to develop a treatment protocol for implementation.

Phase 2

The second phase is derived from the "Assess barriers to knowledge use" step of the KTA cycle [23]. Two physiotherapists from each practice will participate in the study. They must have completed their physiotherapy training and be employed in the practice. Participants will receive training in the use of the VR intervention, including the use of VR devices (PICO 4), as the first part of the implementation strategy. In addition, participants will receive information on how the VR intervention should be applied to people with chronic pain. This information will also be made available on demand on an online platform. After the VR training, the acceptance, appropriateness, and feasibility of the VR intervention from the therapists' perspective will be assessed via an online survey using the German versions of the Acceptability of Intervention Measure (AIM), Intervention Appropriateness Measure (IAM), and the Feasibility of Intervention Measure (FIM) questionnaires [44,45]. Then they receive the VR devices to test the intervention at home. Approximately two weeks later, an optional online meeting will be offered to therapists to answer any remaining questions about the VR intervention or the use of the VR devices. The barriers identified in the focus group and in the online survey after the VR training will be used to define the behaviors that need to be changed or implemented when the VR intervention is used in practices. From these behaviors, the study team will select one or two core behaviors to change that appear promising to support implementation of the VR intervention. The selection of the target behaviors will be based on the potential impact on the implementation of the VR intervention, the potential multiplier effect in practices, and the feasibility of measuring behavior change. These target behaviors are specified by the question: Who needs to do what differently, when, where, how, and with whom [46]?

Approximately one week after the online meeting, semistructured interviews will be conducted with the participating physiotherapists to identify and specify barriers and facilitators to the implementation of the VR intervention. An interview guideline will be developed to understand the factors that may influence the implementation of VR interventions in practices. It will be based on the previously defined target behaviors and the domains of the Theoretical Domains Framework

(TDF)[28,29]. Before being used, the interview guide is pilot-tested with two physiotherapists to test its comprehensibility.

The interviews are expected to last approximately 45 to 60 minutes and will be conducted online via Zoom (Zoom Video Communications, Inc.). Participants will receive written informed consent prior to participation in the study. Interviews will be audio-recorded and transcribed verbatim. Data collection and storage will be pseudonymized. The data of the focus group and the semi structured interviews will be analyzed at the end of this phase using qualitative content analysis according to Kuckartz [40]. The TDF domains will be used as deductive codes to which the data will be assigned, to gather barriers and facilitators from the focus group and the semi structured interviews.

Phase 3

Based on the qualitative and quantitative assessed barriers and facilitators in phase 1 and 2 and the barriers and facilitators found in a scoping review [47], an implementation strategy, consisting of various implementation interventions, will be developed. The identified domains of the TDF are mapped to the COM-B model of the BCW [48]. This helps to determine what underlying factors need to be changed in order for the therapist's behavior to change. Based on these factors, the functions of the implementation interventions and the recommended behavior change techniques can be specified and preliminary implementation interventions (e.g. training, modeling, environmental restructuring) can be developed [48]. Affordability, practicality, effectiveness and cost-effectiveness, acceptability, side effects or safety, and equity will be used to select the most appropriate and effective implementation interventions for the implementation strategy [48]. In our study, we will not include policy categories such as regulation, fiscal and legislation, as recommended by the BCW framework. This exclusion is due to the limited timeframe and scope of our project, which does not extend to policy-level changes.

The developed implementation strategy will be discussed with the stakeholders from the participating practices, to specify the execution of the implementation interventions. The strategy will then be executed in all five practices and process evaluated via an online questionnaire. The strategy will be reported according to the standards of Proctor et al [49].

Patients are eligible if they are older than 18 years, self-report that they have a chronic pain condition and are able to understand and speak the German language fluently. Patients will be excluded if they have a current or previous diagnosis of epilepsy, dementia, migraine or other neurological conditions that may prevent the use of VR or lead to adverse effects, hypersensitivity to flashing lights or severe hearing impairment. Pain intensity, disability due to pain, fear of movement, pain catastrophizing, quality of life and pain-related self-efficacy will be assessed using the German versions of the Numeric Pain Rating Scale [50,51], Pain Disability Index [52], Tampa Scale for Kinesiophobia [53], Pain Catastrophizing Scale [54], EQ-5D-5L (quality of life) [55] and a questionnaire assessing pain-related self-efficacy[56] before and after the VR intervention.

Physical therapists will complete an online questionnaire to document each session of the VR intervention. The questionnaire consists of questions about the fidelity of treatment delivery based on the fidelity protocol of Toomey et al [57] (e.g., did the therapist adhere to the treatment protocol or which components of the treatment were delivered) and whether there were any adverse events during that session. The therapists will use the VR intervention in their practices for six months. Prior to participation in the study, written informed consent will be obtained from participants. The collected process evaluation data will be analyzed descriptively using SPSS (28.0.1.0, IBM Corp.).

Phase 4

The final phase will be an evaluation of the overall implementation process and an analysis of the health-related outcomes of the patients.

The evaluation of the implementation process will be done through semistructured interviews with three patients, three therapists and three practice owners. Patients must have received the full treatment duration to be eligible for the interviews, therapists are included if they have treated at least 5 patients with Reducept, and three participants are selected from the practice owners of the participating practices. Prior to the interviews, all participants will complete the AIM, IAM and FIM questionnaires. The data from the questionnaires, noticeable aspects from the process evaluation in phase 3 and the implementation outcomes adoption, acceptability, appropriateness, feasibility, fidelity and implementation costs [43] will be used to develop an interview guide. The interviews will determine the perceived effectiveness of the implementation strategy was, how the VR intervention was used in the practices, how patients perceived the use of the VR intervention and give indications how the implementation strategy can be adapted for future projects. Prior to use, the interview guide is pilot-tested with people from the same background who are not part of the study to ensure comprehensibility.

The interviews will be conducted online via Zoom (Zoom Video Communications, Inc.) and are expected to last approximately 60 minutes. Written informed consent will be obtained from participants prior to participation in the study. Interviews will be audio-recorded and transcribed verbatim. Data collection and storage will be pseudonymized. Data will be analyzed using Kuckartz's qualitative content analysis [40].

This data will be used to adapt the implementation strategy and to create recommendations for the implementation of VR interventions for people with chronic pain in outpatient physiotherapy practices.

Ethical Considerations

Ethical approval for the study has been obtained from the ethics committee of the University of Applied Science and Art in Hildesheim/Holzminden/Göttingen (Germany) (April 3, 2023). The principles of the Declaration of Helsinki [58] will be strictly followed in this research project. Eligible participants will be informed of the objectives and procedures of the study. Prior to inclusion, written informed consent will be obtained from all patients. Participation will be voluntary, and participants will be free to withdraw from the study at any time.

Results

The recruitment process and phase 1 with the adaption of the treatment protocol are already conducted. Five physiotherapy practices were identified in which the VR intervention is to be implemented. A focus group with four practice owners was held in November 2023. Due to personal appointments, one owner had to cancel the focus group at short notice and was subsequently interviewed via a semistructured interview about the treatment protocol. The data was then analyzed via qualitative content analysis and used to adapt the treatment protocol.

Discussion

The described pilot implementation study will provide insight into the implementation of VR interventions for people with chronic pain managed in outpatient physiotherapy practices. The developed implementation interventions and implementation strategy can be foundation for future implementation projects. Especially the insights into the perspective of healthcare professionals will play an important role in the further implementation of VR interventions for people with chronic pain, as they play an important role in the implementation of digital interventions [59]. The implementation of VR interventions can lead to better outpatient care for people with chronic pain, as VR can help reduce pain, positively influence disability and reduce fear of movement [60–62].

Previous research suggests that technology adoption in healthcare is still lacking due to technically challenged staff, resistance to change, high costs and low acceptance [34,63,64]. In the implementation of VR the organizational structures and VR technology itself have been barriers to the implementation of VR interventions in various health care settings [35,65,66]. Regarding the use of VR in physiotherapy, VR itself seems to be the main barrier due to technical issues, lack of guidelines for VR interventions, and patient-related factors [32]. In contrast, staff and health care professionals can act as facilitators by reducing anxiety about new technologies and changing attitudes toward VR [32,35,66]. There is also a general interest in the use of VR in rehabilitation among health care professionals [35]. The development and application of systematic implementation strategies can help to promote the use of new technologies and VR. By identifying the barriers and facilitators in each setting, it will be possible to target implementation interventions to change the behavior of health care professionals, patients, and practice owners. The implementation study described here can develop an initial implementation strategy for the implementation of VR interventions for the outpatient physiotherapy treatment of people with chronic pain. This strategy can be a first step to increase the acceptance and use of VR interventions in the field of chronic pain, leading to better patient care. The next step in implementing VR interventions in physiotherapy practices should be to evaluate the effectiveness of the implementation strategy in a controlled trial.

Limitations

This study has some limitations that should be noted. First, the lack of a control condition (e.g., cluster randomization with other physiotherapy practices) makes it difficult to accurately assess the effectiveness of the implementation strategy. Second, the small sample size of only five practices limits the generalizability of the implementation strategy. In addition, involving all stakeholders in each phase of the study may allow for more comprehensive input into the development of implementation interventions.

Conclusions

The findings of this pilot implementation study will contribute to the body of knowledge regarding the development process and effectiveness of an implementation strategy for VR interventions for the treatment of people with chronic pain in outpatient physiotherapy practice. The objective is to develop an initial implementation strategy that can be used in future implementations of VR, with adaptation if necessary. The successful implementation of VR interventions in the outpatient treatment of people with chronic pain will lead to increased guideline adherence among physiotherapists and therefore to better care.

Acknowledgements

Data Availability

The data sets generated during and analyzed during this study are available from the corresponding author on reasonable request.

Authors' Contributions

AE, CK, and AS were responsible for the conception of the research project and the drafting of the manuscript. All authors contributed to the preparation of this manuscript and read and approved the final version for publication.

Conflicts of Interest

None declared.

References

1. Treede R-D, Rief W, Barke A, Aziz Q, Bennett MI, Benoliel R, Cohen M, Evers S, Finnerup NB, First MB, Giamberardino MA, Kaasa S, Kosek E, Lavand'homme P, Nicholas M, Perrot S, Scholz J, Schug S, Smith BH, Svensson P, Vlaeyen JWS, Wang S-J. A classification of chronic pain for ICD-11. Pain 2015 Jun;156(6):1003–1007. doi: 10.1097/j.pain.0000000000000160

2. Murray CJL, Atkinson C, Bhalla K, Birbeck G, Burstein R, Chou D, Dellavalle R, Danaei G, Ezzati M, Fahimi A, Flaxman D, Foreman, Gabriel S, Gakidou E, Kassebaum N, Khatibzadeh S, Lim S, Lipshultz SE, London S, Lopez, MacIntyre MF, Mokdad AH, Moran A, Moran AE, Mozaffarian D, Murphy T, Naghavi M, Pope C, Roberts T, Salomon J, Schwebel DC, Shahraz S, Sleet DA, Murray, Abraham J, Ali MK, Bartels DH, Chen H, Criqui MH, Dahodwala, Jarlais, Ding EL, Dorsey ER, Ebel BE, Fahami, Flaxman S, Flaxman AD, Gonzalez-Medina D, Grant B, Hagan H, Hoffman H, Leasher JL, Lin J, Lozano R, Lu Y, Mallinger L, McDermott MM, Micha R, Miller TR, Mokdad AA, Naghavi M, Narayan KMV, Omer SB, Pelizzari PM, Phillips D, Ranganathan D, Rivara FP, Sampson U, Sanman E, Sapkota A, Sharaz S, Shivakoti R, Singh GM, Singh D, Tavakkoli M, Towbin JA, Wilkinson JD, Zabetian A, Ali MK, Alvardo M, Baddour LM, Benjamin EJ, Bolliger I, Carnahan E, Chugh SS, Cohen A, Colson KE, Cooper LT, Couser W, Dabhadkar KC, Dellavalle RP, Dicker D, Duber H, Engell RE, Felson DT, Finucane MM, Flaxman S, Fleming T, Forouzanfar MH, Freedman G, Freeman MK, Gillum RF, Gosselin R, Gutierrez HR, Havmoeller R, Jacobsen KH, James SL, Jasrasaria R, Jayarman S, Johns N, Lan Q, Meltzer M, Mensah GA, Michaud C, Mock C, Moffitt TE, Nelson RG, Olives C, Ortblad K, Ostro B, Raju M, Razavi H, Ritz B, Sacco RL, Shibuya K, Silberberg D, Singh JA, Steenland K, Taylor JA, Thurston GD, Vavilala MS, Vos T, Wagner GR, Weinstock MA, Weisskopf MG, Wulf S. The state of US health, 1990-2010: burden of diseases, injuries, and risk factors. JAMA 2013 Jan 1;310(6):591–608. PMID:23842577

3. Vos T, Abajobir AA, Abate KH, Abbafati C, Abbas KM, Abd-Allah F, Abdulkader RS, Abdulle

AM, Abebo TA, Abera SF, Aboyans V, Abu-Raddad LJ, Ackerman IN, Adamu AA, Adetokunboh O, Afarideh M, Afshin A, Agarwal SK, Aggarwal R, Agrawal A, Agrawal S, Ahmadieh H, Ahmed MB, Aichour MTE, Aichour AN, Aichour I, Aiyar S, Akinyemi RO, Akseer N, Al Lami FH, Alahdab F, Al-Aly Z, Alam K, Alam N, Alam T, Alasfoor D, Alene KA, Ali R, Alizadeh-Navaei R, Alkerwi A, Alla F, Allebeck P, Allen C, Al-Maskari F, Al-Raddadi R, Alsharif U, Alsowaidi S, Altirkawi KA, Amare AT, Amini E, Ammar W, Amoako YA, Andersen HH, Antonio CAT, Anwari P, Ärnlöv J, Artaman A, Aryal KK, Asayesh H, Asgedom SW, Assadi R, Atey TM, Atnafu NT, Atre SR, Avila-Burgos L, Avokphako EFGA, Awasthi A, Bacha U, Badawi A, Balakrishnan K, Banerjee A, Bannick MS, Barac A, Barber RM, Barker-Collo SL, Bärnighausen T, Barquera S, Barregard L, Barrero LH, Basu S, Battista B, Battle KE, Baune BT, Bazargan-Hejazi S, Beardsley J, Bedi N, Beghi E, Béjot Y, Bekele BB, Bell ML, Bennett DA, Bensenor IM, Benson J, Berhane A, Berhe DF, Bernabé E, Betsu BD, Beuran M, Beyene AS, Bhala N, Bhansali A, Bhatt S, Bhutta ZA, Biadgilign S, Bicer BK, Bienhoff K, Bikbov B, Birungi C, Biryukov S, Bisanzio D, Bizuayehu HM, Boneya DJ, Boufous S, Bourne RRA, Brazinova A, Brugha TS, Buchbinder R, Bulto LNB, Bumgarner BR, Butt ZA, Cahuana-Hurtado L, Cameron E, Car M, Carabin H, Carapetis JR, Cárdenas R, Carpenter DO, Carrero JJ, Carter A, Carvalho F, Casey DC, Caso V, Castañeda-Orjuela CA, Castle CD, Catalá-López F, Chang H-Y, Chang J-C, Charlson FJ, Chen H, Chibalabala M, Chibueze CE, Chisumpa VH, Chitheer AA, Christopher DJ, Ciobanu LG, Cirillo M, Colombara D, Cooper C, Cortesi PA, Criqui MH, Crump JA, Dadi AF, Dalal K, Dandona L, Dandona R, das Neves J, Davitoiu DV, Courten B, Leo D, Defo BK, Degenhardt L, Deiparine S, Dellavalle RP, Deribe K, Des Jarlais DC, Dey S, Dharmaratne SD, Dhillon PK, Dicker D, Ding EL, Djalalinia S, Do HP, Dorsey ER, dos Santos KPB, Douwes-Schultz D, Doyle KE, Driscoll TR, Dubey M, Duncan BB, El-Khatib ZZ, Ellerstrand J, Enayati A, Endries AY, Ermakov SP, Erskine HE, Eshrati B, Eskandarieh S, Esteghamati A, Estep K, Fanuel FBB, Farinha CSES, Faro A, Farzadfar F, Fazeli MS, Feigin VL, Fereshtehnejad S-M, Fernandes JC, Ferrari AJ, Feyissa TR, Filip I, Fischer F, Fitzmaurice C, Flaxman AD, Flor LS, Foigt N, Foreman KJ, Franklin RC, Fullman N, Fürst T, Furtado JM, Futran ND, Gakidou E, Ganji M, Garcia-Basteiro AL, Gebre T, Gebrehiwot TT, Geleto A, Gemechu BL, Gesesew HA, Gething PW, Ghajar A, Gibney KB, Gill PS, Gillum RF, Ginawi IAM, Giref AZ, Gishu MD, Giussani G, Godwin WW, Gold AL, Goldberg EM, Gona PN, Goodridge A, Gopalani SV, Goto A, Goulart AC, Griswold M, Gugnani HC, Gupta R, Gupta R, Gupta T, Gupta V, Hafezi-Nejad N, Hailu GB, Hailu AD, Hamadeh RR, Hamidi S, Handal AJ, Hankey GJ, Hanson SW, Hao Y, Harb HL, Hareri HA, Haro JM, Harvey J, Hassanvand MS, Havmoeller R, Hawley C, Hay SI, Hay RJ, Henry NJ, Heredia-Pi IB, Hernandez JM, Heydarpour P, Hoek HW, Hoffman HJ, Horita N, Hosgood HD, Hostiuc S, Hotez PJ, Hoy DG, Htet AS, Hu G, Huang H, Huynh C, Iburg KM, Igumbor EU, Ikeda C, Irvine CMS, Jacobsen KH, Jahanmehr N, Jakovljevic MB, Jassal SK, Javanbakht M, Jayaraman SP, Jeemon P, Jensen PN, Jha V, Jiang G, John D, Johnson SC, Johnson CO, Jonas JB, Jürisson M, Kabir Z, Kadel R, Kahsay A, Kamal R, Kan H, Karam NE, Karch A, Karema CK, Kasaeian A, Kassa GM, Kassaw NA, Kassebaum NJ, Kastor A, Katikireddi SV, Kaul A, Kawakami N, Keiyoro PN, Kengne AP, Keren A, Khader YS, Khalil IA, Khan EA, Khang Y-H, Khosravi A, Khubchandani J, Kiadaliri AA, Kieling C, Kim YJ, Kim D, Kim P, Kimokoti RW, Kinfu Y, Kisa A, Kissimova-Skarbek KA, Kivimaki M, Knudsen AK, Kokubo Y, Kolte D, Kopec JA, Kosen S, Koul PA, Koyanagi A, Kravchenko M, Krishnaswami S, Krohn KJ, Kumar GA, Kumar P, Kumar S, Kyu HH, Lal DK, Lalloo R, Lambert N, Lan Q, Larsson A, Lavados PM, Leasher JL, Lee PH, Lee J-T, Leigh J, Leshargie CT, Leung J, Leung R, Levi M, Li Y, Li Y, Li Kappe D, Liang X, Liben ML, Lim SS, Linn S, Liu PY, Liu A, Liu S, Liu Y, Lodha R, Logroscino G, London SJ, Looker KJ, Lopez AD, Lorkowski S, Lotufo PA, Low N, Lozano R, Lucas TCD, Macarayan ERK, Magdy Abd El Razek H, Magdy Abd El Razek M, Mahdavi M, Majdan M, Majdzadeh R, Majeed A, Malekzadeh R, Malhotra R, Malta DC, Mamun AA, Manguerra H, Manhertz T,

Mantilla A, Mantovani LG, Mapoma CC, Marczak LB, Martinez-Raga J, Martins-Melo FR, Martopullo I, März W, Mathur MR, Mazidi M, McAlinden C, McGaughey M, McGrath JJ, McKee M, McNellan C, Mehata S, Mehndiratta MM, Mekonnen TC, Memiah P, Memish ZA, Mendoza W, Mengistie MA, Mengistu DT, Mensah GA, Meretoja TJ, Meretoja A, Mezgebe HB, Micha R, Millear A, Miller TR, Mills EJ, Mirarefin M, Mirrakhimov EM, Misganaw A, Mishra SR, Mitchell PB, Mohammad KA, Mohammadi A, Mohammed KE, Mohammed S, Mohanty SK, Mokdad AH, Mollenkopf SK, Monasta L, Montico M, Moradi-Lakeh M, Moraga P, Mori R, Morozoff C, Morrison SD, Moses M, Mountjoy-Venning C, Mruts KB, Mueller UO, Muller K, Murdoch ME, Murthy GVS, Musa KI, Nachega JB, Nagel G, Naghavi M, Naheed A, Naidoo KS, Naldi L, Nangia V, Natarajan G, Negasa DE, Negoi RI, Negoi I, Newton CR, Ngunjiri JW, Nguyen TH, Le Nguyen Q, Nguyen CT, Nguyen G, Nguyen M, Nichols E, Ningrum DNA, Nolte S, Nong VM, Norrving B, Noubiap JJN, O'Donnell MJ, Ogbo FA, Oh I-H, Okoro A, Oladimeji O, Olagunju TO, Olagunju AT, Olsen HE, Olusanya BO, Olusanya JO, Ong K, Opio JN, Oren E, Ortiz A, Osgood-Zimmerman A, Osman M, Owolabi MO, PA M, Pacella RE, Pana A, Panda BK, Papachristou C, Park E-K, Parry CD, Parsaeian M, Patten SB, Patton GC, Paulson K, Pearce N, Pereira DM, Perico N, Pesudovs K, Peterson CB, Petzold M, Phillips MR, Pigott DM, Pillay JD, Pinho C, Plass D, Pletcher MA, Popova S, Poulton RG, Pourmalek F, Prabhakaran D, Prasad NM, Prasad N, Purcell C, Qorbani M, Quansah R, Quintanilla BPA, Rabiee RHS, Radfar A, Rafay A, Rahimi K, Rahimi-Movaghar A, Rahimi-Movaghar V, Rahman MHU, Rahman M, Rai RK, Rajsic S, Ram U, Ranabhat CL, Rankin Z, Rao PC, Rao PV, Rawaf S, Ray SE, Reiner RC, Reinig N, Reitsma MB, Remuzzi G, Renzaho AMN, Resnikoff S, Rezaei S, Ribeiro AL, Ronfani L, Roshandel G, Roth GA, Roy A, Rubagotti E, Ruhago GM, Saadat S, Sadat N, Safdarian M, Safi S, Safiri S, Sagar R, Sahathevan R, Salama J, Saleem HOB, Salomon JA, Salvi SS, Samy AM, Sanabria JR, Santomauro D, Santos IS, Santos JV, Santric Milicevic MM, Sartorius B, Satpathy M, Sawhney M, Saxena S, Schmidt MI, Schneider IJC, Schöttker B, Schwebel DC, Schwendicke F, Seedat S, Sepanlou SG, Servan-Mori EE, Setegn T, Shackelford KA, Shaheen A, Shaikh MA, Shamsipour M, Shariful Islam SM, Sharma J, Sharma R, She J, Shi P, Shields C, Shifa GT, Shigematsu M, Shinohara Y, Shiri R, Shirkoohi R, Shirude S, Shishani K, Shrime MG, Sibai AM, Sigfusdottir ID, Silva DAS, Silva JP, Silveira DGA, Singh JA, Singh NP, Sinha DN, Skiadaresi E, Skirbekk V, Slepak EL, Sligar A, Smith DL, Smith M, Sobaih BHA, Sobngwi E, Sorensen RJD, Sousa TCM, Sposato LA, Sreeramareddy CT, Srinivasan V, Stanaway JD, Stathopoulou V, Steel N, Stein MB, Stein DJ, Steiner TJ, Steiner C, Steinke S, Stokes MA, Stovner LJ, Strub B, Subart M, Sufiyan MB, Sunguya BF, Sur PJ, Swaminathan S, Sykes BL, Sylte DO, Tabarés-Seisdedos R, Taffere GR, Takala JS, Tandon N, Tavakkoli M, Taveira N, Taylor HR, Tehrani-Banihashemi A, Tekelab T, Terkawi AS, Tesfaye DJ, Tesssema B, Thamsuwan O, Thomas KE, Thrift AG, Tiruye TY, Tobe-Gai R, Tollanes MC, Tonelli M, Topor-Madry R, Tortajada M, Touvier M, Tran BX, Tripathi S, Troeger C, Truelsen T, Tsoi D, Tuem KB, Tuzcu EM, Tyrovolas S, Ukwaja KN, Undurraga EA, Uneke CJ, Updike R, Uthman OA, Uzochukwu BSC, van Boven JFM, Varughese S, Vasankari T, Venkatesh S, Venketasubramanian N, Vidavalur R, Violante FS, Vladimirov SK, Vlassov VV, Vollset SE, Wadilo F, Wakayo T, Wang Y-P, Weaver M, Weichenthal S, Weiderpass E, Weintraub RG, Werdecker A, Westerman R, Whiteford HA, Wijeratne T, Wiysonge CS, Wolfe CDA, Woodbrook R, Woolf AD, Workicho A, Xavier D, Xu G, Yadgir S, Yaghoubi M, Yakob B, Yan LL, Yano Y, Ye P, Yimam HH, Yip P, Yonemoto N, Yoon S-J, Yotebieng M, Younis MZ, Zaidi Z, Zaki MES, Zegeye EA, Zenebe ZM, Zhang X, Zhou M, Zipkin B, Zodpey S, Zuhlke LJ, Murray CJL. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. The Lancet 2017 Jan 1;390(10100):1211–1259. doi: 10.1016/S0140-6736(17)32154-2

4. Yong RJ, Mullins PM, Bhattacharyya N. Prevalence of chronic pain among adults in the United States. Pain 2022 Jan 1;163(2):328–332. PMID:33990113

5. Häuser W, Schmutzer G, Hilbert A, Brähler E, Henningsen P. Prevalence of Chronic Disabling Noncancer Pain and Associated Demographic and Medical Variables: A Cross-Sectional Survey in the General German Population. The Clinical Journal of Pain 2015 Oct;31(10):886. doi: 10.1097/AJP.0000000000000173

6. Fayaz A, Croft P, Langford RM, Donaldson LJ, Jones GT. Prevalence of chronic pain in the UK: a systematic review and meta-analysis of population studies. BMJ Open BMJ Publishing Group; 2016 Jan 1;6(6):010364. PMID:27324708

7. Durán J, Tejos-Bravo M, Cid V, Ferreccio C, Calvo M. Chronic pain in Chile: first prevalence report of noncancer chronic pain, fibromyalgia, and neuropathic pain and its associated factors. Pain 2023 Jan 1; PMID:36893316

8. Jackson T, Thomas S, Stabile V, Shotwell M, Han X, McQueen K. A Systematic Review and Meta-Analysis of the Global Burden of Chronic Pain Without Clear Etiology in Low- and Middle-Income Countries: Trends in Heterogeneous Data and a Proposal for New Assessment Methods. Anesth Analg 2016 Jan 1;123(3):739–48. PMID:27537761

9. Du S, Hu Y, Bai Y, Hu L, Dong J, Jin S, Zhang H. Emotional Distress Correlates Among Patients With Chronic Nonspecific Low Back Pain: A Hierarchical Linear Regression Analysis. Pain Pract 2019 Jan 1;19(5):510–521. PMID:30739397

10. Suso-Ribera C, Yakobov E, Carriere JS, García-Palacios A. The impact of chronic pain on patients and spouses: Consequences on occupational status, distribution of household chores and care-giving burden. Eur J Pain 2020 Jan 1;24(9):1730–1740. PMID:32533892

11. Tang NKY, Crane C. Suicidality in chronic pain: a review of the prevalence, risk factors and psychological links. Psychol Med 2006 Jan 1;36(5):575–86. PMID:16420727

12. Institute of Medicine (U.S.), editor. Relieving pain in America: a blueprint for transforming prevention, care, education, and research. Washington, D.C: National Academies Press; 2011. ISBN:978-0-309-21484-1

13. Wolff R, Clar C, Lerch C, Kleijnen J. Epidemiologie von nicht tumorbedingten chronischen Schmerzen in Deutschland. Schmerz 2011 Jan 1;25(1):26–44. PMID:21336883

14. George SZ, Fritz JM, Silfies SP, Schneider MJ, Beneciuk JM, Lentz TA, Gilliam JR, Hendren S, Norman KS. Interventions for the Management of Acute and Chronic Low Back Pain: Revision 2021: Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Academy of Orthopaedic Physical Therapy of the American Physical Therapy Association. J Orthop Sports Phys Ther 2021 Nov;51(11):CPG1–CPG60. doi: 10.2519/jospt.2021.0304

15. Scottish Intercollegiate Guidelines Network. Management of chronic pain: A national clinical guideline. Edinburgh: Scottish Intercollegiate Guidelines Network; 2013. ISBN:978-1-909103-16-0

16. National Institute of Health and Care. Chronic pain (primary and secondary) in over 16s:

assessment of all chronic pain and management of chronic primary pain. 2021. Available from: https://www.nice.org.uk/guidance/ng193 [accessed Jan 10, 2024]

17. Zadro J, O'Keeffe M, Maher C. Do physical therapists follow evidence-based guidelines when managing musculoskeletal conditions? Systematic review. BMJ Open British Medical Journal Publishing Group; 2019 Oct 1;9(10):e032329. PMID:31591090

18. Husted M, Rossen CB, Jensen TS, Mikkelsen LR, Rolving N. Adherence to key domains in low back pain guidelines: A cross-sectional study of Danish physiotherapists. Physiotherapy Research International 2020;25(4):e1858. doi: 10.1002/pri.1858

19. Bahns C, Happe L, Thiel C, Kopkow C. Physical therapy for patients with low back pain in Germany: a survey of current practice. BMC Musculoskelet Disord 2021 Jan 1;22(1):563. PMID:34147077

20. Bernhardsson S, Johansson K, Nilsen P, Öberg B, Larsson MEH. Determinants of guideline use in primary care physical therapy: a cross-sectional survey of attitudes, knowledge, and behavior. Phys Ther 2014 Mar;94(3):343–354. PMID:24179140

21. Bauer MS, Kirchner J. Implementation science: What is it and why should I care? Psychiatry Res 2020 Jan 1;283:112376. PMID:31036287

22. Damschroder LJ. Clarity out of chaos: Use of theory in implementation research. Psychiatry Res 2020 Jan 1;283:112461. PMID:31257020

23. Graham ID, Logan J, Harrison MB, Straus SE, Tetroe J, Caswell W, Robinson N. Lost in knowledge translation: time for a map? J Contin Educ Health Prof 2006 Jan 1;26(1):13–24. PMID:16557505

24. Romney W, Bellows DM, Tavernite JP, Salbach N, Deutsch JE. Knowledge Translation Research to Promote Behavior Changes in Rehabilitation: Use of Theoretical Frameworks and Tailored Interventions: A Scoping Review. Arch Phys Med Rehabil 2022 Jan 1;103(7S):276–296. PMID:33561438

25. Moore JL, Mbalilaki JA, Graham ID. Knowledge Translation in Physical Medicine and Rehabilitation: A Citation Analysis of the Knowledge-to-Action Literature. Arch Phys Med Rehabil 2022 Jan 1;103(7S):256–275. PMID:33556348

26. Field B, Booth A, Ilott I, Gerrish K. Using the Knowledge to Action Framework in practice: a citation analysis and systematic review. Implement Sci 2014 Jan 1;9:172. PMID:25417046

27. Skolarus TA, Lehmann T, Tabak RG, Harris J, Lecy J, Sales AE. Assessing citation networks for dissemination and implementation research frameworks. Implement Sci 2017 Jan 1;12(1):97. PMID:28754140

28. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. Implement Sci 2012 Jan 1;7:37. PMID:22530986

29. Michie S, Johnston M, Abraham C, Lawton R, Parker D, Walker A. Making psychological theory useful for implementing evidence based practice: a consensus approach. Qual Saf Health

Care 2005 Jan 1;14(1):26–33. PMID:15692000

30. Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. Implement Sci 2011 Jan 1;6:42. PMID:21513547

31. Trost Z, France C, Anam M, Shum C. Virtual reality approaches to pain: toward a state of the science. Pain 2021 Jan 1;162(2):325–331. PMID:32868750

32. Brepohl PCA, Leite H. Virtual reality applied to physiotherapy: a review of current knowledge. Virtual Reality 2022 Jan 1; doi: 10.1007/s10055-022-00654-2

33. Goudman L, Jansen J, Billot M, Vets N, Smedt A, Roulaud M, Rigoard P, Moens M. Virtual Reality Applications in Chronic Pain Management: Systematic Review and Meta-analysis. JMIR Serious Games 2022 Jan 1;10(2):34402. PMID:35536641

34. Elser A, Lange M, Kopkow C, Schäfer AG. Barriers and Facilitators to the Implementation of Virtual Reality Interventions for People With Chronic Pain: Scoping Review. JMIR XR and Spatial Computing (JMXR) 2024 May 15;1(1):e53129. doi: 10.2196/53129

35. Kouijzer MMTE, Kip H, Bouman YHA, Kelders SM. Implementation of virtual reality in healthcare: a scoping review on the implementation process of virtual reality in various healthcare settings. Implement Sci Commun 2023 Jun 16;4:67. PMID:37328858

36. Stetler CB. Updating the Stetler Model of research utilization to facilitate evidence-based practice. Nurs Outlook 2001 Jan 1;49(6):272–279. PMID:11753294

37. Eldridge SM, Chan CL, Campbell MJ, Bond CM, Hopewell S, Thabane L, Lancaster GA. CONSORT 2010 statement: extension to randomised pilot and feasibility trials. BMJ British Medical Journal Publishing Group; 2016 Oct 24;355:i5239. PMID:27777223

38. Moseley GL, Butler DS. Fifteen Years of Explaining Pain: The Past, Present, and Future. J Pain 2015 Jan 1;16(9):807–13. PMID:26051220

39. Fennema M, Zantema L. Reducept guidelines for the treatment of Chronic Pain (Version 1.0). Medical Centre Leeuwarden 2019;

40. Kuckartz U, Rädiker S. Qualitative Inhaltsanalyse: Methoden, Praxis, Computerunterstützung: Grundlagentexte Methoden. 5. Auflage. Weinheim Basel: Beltz Juventa; 2022. ISBN:978-3-7799-6231-1

41. Morgan D. Focus Groups as Qualitative Research. 2455 Teller Road, Thousand Oaks California 91320 United States of America: SAGE Publications, Inc; 1997. doi: 10.4135/9781412984287ISBN:978-0-7619-0343-7

42. Schulz M, Mack B, Renn O, editors. Fokusgruppen in der empirischen Sozialwissenschaft: Von der Konzeption bis zur Auswertung. Wiesbaden: Springer VS; 2012. doi: 10.1007/978-3-531-19397-7ISBN:978-3-531-19397-7

43. Proctor E, Silmere H, Raghavan R, Hovmand P, Aarons G, Bunger A, Griffey R, Hensley M. Outcomes for implementation research: conceptual distinctions, measurement challenges, and research agenda. Adm Policy Ment Health 2011 Jan 1;38(2):65–76. PMID:20957426

44. Weiner BJ, Lewis CC, Stanick C, Powell BJ, Dorsey CN, Clary AS, Boynton MH, Halko H. Psychometric assessment of three newly developed implementation outcome measures. Implement Sci 2017 Jan 1;12(1):108. PMID:28851459

45. Kien C, Griebler U, Schultes M-T, Thaler KJ, Stamm T. Psychometric Testing of the German Versions of Three Implementation Outcome Measures. Glob Implement Res Appl 2021 Jan 1;1(3):183–194. doi: 10.1007/s43477-021-00019-y

46. Atkins L, Francis J, Islam R, O'Connor D, Patey A, Ivers N, Foy R, Duncan EM, Colquhoun H, Grimshaw JM, Lawton R, Michie S. A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. Implement Sci 2017 Jan 1;12(1):77. PMID:28637486

47. Elser A, Lange M, Kopkow C, Schäfer A. Barriers and facilitators to the implementation of virtual reality interventions for people with chronic pain: a scoping review (Preprint). Journal of Medical Internet Research; 2023 Sep. doi: 10.2196/preprints.53129

48. Michie S, Atkins L, West R. The behaviour change wheel: a guide to designing interventions. Sutton: Silverback; 2014. ISBN:978-1-912141-08-1

49. Proctor EK, Powell BJ, McMillen JC. Implementation strategies: recommendations for specifying and reporting. Implement Sci 2013 Jan 1;8:139. PMID:24289295

50. Dworkin RH, Turk DC, Farrar JT, Haythornthwaite JA, Jensen MP, Katz NP, Kerns RD, Stucki G, Allen RR, Bellamy N, Carr DB, Chandler J, Cowan P, Dionne R, Galer BS, Hertz S, Jadad AR, Kramer LD, Manning DC, Martin S, McCormick CG, McDermott MP, McGrath P, Quessy S, Rappaport BA, Robbins W, Robinson JP, Rothman M, Royal MA, Simon L, Stauffer JW, Stein W, Tollett J, Wernicke J, Witter J. Core outcome measures for chronic pain clinical trials: IMMPACT recommendations. Pain 2005 Jan 1;113(1–2):9–19. PMID:15621359

51. Farrar JT, Young JP, LaMoreaux L, Werth JL, Poole MR. Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. Pain 2001 Jan 1;94(2):149–158. PMID:11690728

52. Dillmann U, Nilges P, Saile H, Gerbershagen HU. PDI - Pain Disability Index - deutsche Fassung. ZPID (Leibniz Institute for Psychology) – Open Test Archive; 2011; doi: 10.23668/PSYCHARCHIVES.4505

53. Rusu AC, Kreddig N, Hallner D, Hülsebusch J, Hasenbring MI. Fear of movement/(Re)injury in low back pain: confirmatory validation of a German version of the Tampa Scale for Kinesiophobia. BMC Musculoskelet Disord 2014 Jan 1;15:280. PMID:25138111

54. Meyer K, Sprott H, Mannion AF. Cross-cultural adaptation, reliability, and validity of the German version of the Pain Catastrophizing Scale. J Psychosom Res 2008 Jan 1;64(5):469–78. PMID:18440399

55. Feng Y-S, Kohlmann T, Janssen MF, Buchholz I. Psychometric properties of the EQ-5D-5L: a systematic review of the literature. Qual Life Res Springer; Springer International Publishing; 2021 Jan 1;30(3):647–673. PMID:33284428

56. Mangels M, Schwarz S, Sohr G, Holme M, Rief W. Der Fragebogen zur Erfassung der

schmerzspezifischen Selbstwirksamkeit (FESS). Diagnostica 2009 Jan 1;55(2):84–93. doi: 10.1026/0012-1924.55.2.84

57. Toomey E, Matthews J, Guerin S, Hurley DA. Development of a Feasible Implementation Fidelity Protocol Within a Complex Physical Therapy-Led Self-Management Intervention. Phys Ther 2016 Jan 1;96(8):1287–98. PMID:26939605

58. World Medical Association. World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. JAMA 2013 Nov 27;310(20):2191–2194. doi: 10.1001/jama.2013.281053

59. Konttila J, Siira H, Kyngäs H, Lahtinen M, Elo S, Kääriäinen M, Kaakinen P, Oikarinen A, Yamakawa M, Fukui S, Utsumi M, Higami Y, Higuchi A, Mikkonen K. Healthcare professionals' competence in digitalisation: A systematic review. J Clin Nurs 2019 Jan 1;28(5–6):745–761. PMID:30376199

60. Li R, Li Y, Kong Y, Li H, Hu D, Fu C, Wei Q. Virtual Reality–Based Training in Chronic Low Back Pain: Systematic Review and Meta-Analysis of Randomized Controlled Trials. Journal of Medical Internet Research 2024 Feb 26;26(1):e45406. doi: 10.2196/45406

61. Moreau S, Thérond A, Cerda IH, Studer K, Pan A, Tharpe J, Crowther JE, Abd-Elsayed A, Gilligan C, Tolba R, Ashina S, Schatman ME, Kaye AD, Yong RJ, Robinson CL. Virtual Reality in Acute and Chronic Pain Medicine: An Updated Review. Curr Pain Headache Rep 2024 Apr 8; doi: 10.1007/s11916-024-01246-2

62. Zhang T, Li X, Zhou X, Zhan L, Wu F, Huang Z, Sun Y, Feng Y, Du Q. Virtual Reality Therapy for the Management of Chronic Spinal Pain: Systematic Review and Meta-Analysis. JMIR Serious Games 2024 Feb 12;12:e50089. PMID:38345832

63. Scott Kruse C, Karem P, Shifflett K, Vegi L, Ravi K, Brooks M. Evaluating barriers to adopting telemedicine worldwide: A systematic review. J Telemed Telecare 2018 Jan;24(1):4–12. PMID:29320966

64. Ahmed MI, Spooner B, Isherwood J, Lane M, Orrock E, Dennison A. A Systematic Review of the Barriers to the Implementation of Artificial Intelligence in Healthcare. Cureus 15(10):e46454. PMID:37927664

65. Glegg SMN, Levac DE. Barriers, Facilitators and Interventions to Support Virtual Reality Implementation in Rehabilitation: A Scoping Review. PM R 2018 Jan 1;10(11):1237–12511. PMID:30503231

66. Hung L, Mann J, Wallsworth C, Upreti M, Kan W, Temirova A, Wong KLY, Ren H, To-Miles F, Wong J, Lee C, Kar Lai So D, Hardern S. Facilitators and Barriers to Using Virtual Reality and its Impact on Social Engagement in Aged Care Settings: A Scoping Review. Gerontology and Geriatric Medicine 2023 Jan;9:233372142311663. doi: 10.1177/23337214231166355
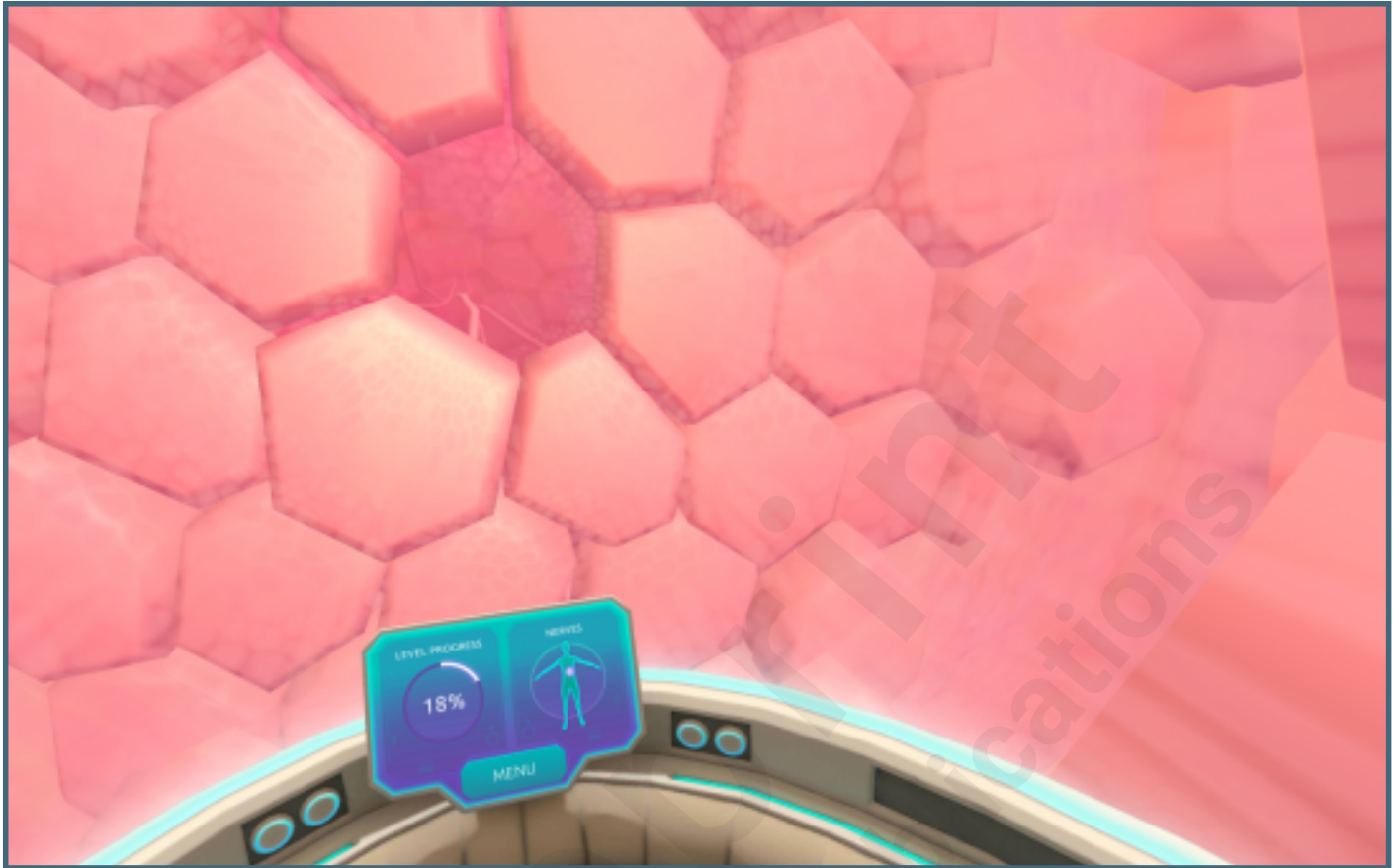
Supplementary Files

Figures

The four phases of the pilot implementation study for the development and evaluation of an implementation strategy. VR: Virtual Reality.

Phase 1

Adapt knowledge to local context

Adapting the treatment protocol through a focus group with practice managers and owners

Phase 2

Assess barriers to knowledge use

Collect barriers and facilitators from physical therapists and practice managers through interviews

Phase 3

Select, tailor, implement Interventions and monitor knowledge use

Selection, development and rollout of implementation interventions. Process evaluation during VR intervention phase

Phase 4

Evaluate Outcomes

Evaluation of the entire implementation process through three interviews, each with patients, physical therapists and practice managers

Screenshot from the nerve level of Reducept.

CONSORT (or other) checklists

CONSORT EHEALTH.
URL: http://asset.jmir.pub/assets/c14da2704d00e64e9ff0db1f1a72c094.pdf